School connectedness as a moderator for associations between parent-child relationship quality and adolescent use of alcohol, tobacco and cannabis

RHIANNON YAPP

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CANDIDATE ID NUMBER	0842726
CANIDIDATE SURNAME	YAPP
CANDIDATE FULL FORENAMES	RHIANNON

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ABSTRACT

Adolescent alcohol, tobacco and cannabis use is associated with costs to health services, the economy and wider society. Adolescents in the United Kingdom report some of the highest levels of alcohol use in Europe. Tobacco and cannabis use are less prevalent but associated with significant harms to health. Both parent child relationship quality (PCRQ) and school connectedness have been associated with alcohol, tobacco and cannabis use in adolescence. However, little is known on the role that school connectedness plays in the development of adolescent's use of alcohol, tobacco and cannabis.

This thesis presents findings from six systematic reviews which summarised the results of longitudinal studies reporting on a) the associations between PCRQ and alcohol, tobacco and cannabis use; b) the associations between school connectedness and adolescent alcohol, tobacco and cannabis use; and c) school connectedness as a moderator of associations between PCRQ and adolescent alcohol, tobacco and cannabis use. This thesis further presents findings from longitudinal analysis of a population-based birth cohort, the Avon Longitudinal Study of Parents and Children (ALSPAC) whereby, multivariate logistic models were used to examine associations between PCRQ (age 9 years), school connectedness (age 11 years) and alcohol, tobacco and cannabis use (age 17 years), and whether school connectedness (age 11 years) moderated associations between PCRQ (age 9 years) and alcohol, tobacco and cannabis use (age 17 years).

Systematic reviews found inconclusive evidence for an association between PCRQ and adolescent alcohol use, moderate evidence for an association with adolescent tobacco use, and weak evidence for an association with adolescent cannabis use. They further found moderate evidence for an association between school connectedness and adolescent alcohol use, strong evidence for an association with adolescent tobacco use, and moderate evidence for an association with adolescent cannabis use. No studies were found to examine the moderating effect of school connectedness.

Multivariate logistic regression models showed that PCRQ at nine years of age was not significantly associated with experimental or hazardous alcohol use, smoking or nicotine dependence, cannabis use nor cannabis dependence at 17 years of age. School connectedness at 11 years of age was associated with alcohol use, but no other outcome measures at 17 years of age. School connectedness at 11 years of age did not moderate any associations between PCRQ at 9 years of age and outcomes at 17 years of age.

Overall, there was little evidence to support the hypothesis that PCRQ is associated with use of alcohol, tobacco and cannabis in adolescence. There

was some support for a beneficial association between school connectedness in reducing the risk of substance misuse in adolescence in the published peer reviewed literature. There was no support for school connectedness moderating the effect of PCRQ on use of alcohol, tobacco and cannabis in adolescence.

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Chapter 1: Introduction, literature review and study aims

1.1 Chapter overview

This thesis aims to examine the evidence for an association of parent child relationship quality (PCRQ) and school connectedness with adolescent use of alcohol, tobacco and cannabis. It seeks to examine these associations for both experimental and hazardous levels of use. It further aims to examine whether school connectedness moderates associations between PCRQ and use of these substances in adolescence. This chapter outlines existing evidence on PCRQ, school connectedness and adolescent use of alcohol, tobacco and cannabis. For each substance, the key areas are described including: the impact of use upon public health; use and prevalence in adolescence; and current UK policy which seeks to prevent such use. This chapter ends with an overview of the research questions and an outline of the chapters within this thesis.

1.2 Introduction

Adolescent use of alcohol, tobacco and cannabis is a major public health problem. In the UK, over the past two decades, adolescent use of alcohol, tobacco and cannabis has reduced substantially (NHS 2016). Whilst lower than historic levels, use of these substances is still associated with harm, and there is a socioeconomic patterning of use in adolescence (NHS 2016).

1.3 Alcohol use

1.3.1 Alcohol use and public health

Alcohol use is one of the top five risk factors for disease, disability and death (Lim et al. 2013; WHO 2014). Use of alcohol has chronic and acute health impacts (WHO 2014). It is associated with more than 60 health conditions (WHO 2014) including neuropsychiatric conditions

(Samokhvalov et al. 2010), gastrointestinal disease (Rehm et al. 2010b), cancer (Nelson et al. 2013), fetal alcohol syndrome (Foltran et al. 2011), infectious disease (Lönnroth et al. 2008) and injury (Taylor et al. 2010; Cherpitel 2014). Alcohol use can lead to both intoxication and dependence, impacting negatively on family and friends, and has been associated with the neglect and physical abuse of others (Casswell et al. 2011; WHO, 2014). Thus, adverse health outcomes can occur to both the individual and to others (Cherpitel et al. 2003; Gmel and Rehm 2003).

In 2017, 173,000 prescriptions for drugs to treat alcohol misuse were prescribed, costing around £4.42 million (NHS Digital 2018). This is 41% higher than the number prescribed in 2007. Recent estimates from the Crime Survey for England and Wales reveal that there were 464,000 violent incidents in which the victim perceived the offender to be under the influence of alcohol (ONS 2018). This places burdens upon society, the NHS and the economy (Navarro et al. 2011; WHO, 2014), with an estimated cost of alcohol related crime of approximately £10.5bn per year (HM Government 2018).

1.3.2 Adolescent alcohol use

Typically, alcohol experimentation is initiated in adolescence (Hellandsjø Bu et al. 2002), but onset of such use before 14 years of age is linked to an increased risk of alcohol dependence and alcohol abuse in young adulthood (Toumbourou et al. 2004; Pitkänen et al. 2005; McCambridge et al. 2011; Marshall 2014). Use of alcohol in adolescence has been linked to an increased risk of alcohol-related car accidents and injury (Hingson et al. 2009), physical injury (Bonomo et al. 2001), violence and crime (Fergusson and Horwood 2002), risky sexual behaviour (Valois et al. 1999) and premature death (Marshall 2014). Part of the excess alcohol-related risk in adolescence is typically due to adolescents consuming a large of amount of alcohol in infrequent episodes (Surgeon General 2007). Further,

adolescents are more vulnerable to alcohol-related harm from a given volume of alcohol than any other age group (Mustonen 2000).

1.3.3 Prevalence of adolescent alcohol use

Most recent estimates suggest that 44% of 11 to 15 year olds have ever had an alcoholic drink (NHS 2017). Specifically:

- Girls (11%) were more likely than boys (7%) to report having been drunk in the past four weeks.
- Those who had consumed alcohol in the last week, consumed on average 9.6 units.
- Beer, lager and cider accounted for more than half of the units of alcohol consumed by 11 to 15 year olds in the last week (57%). These drinks accounted for approximately two thirds of boys' alcohol consumption (66%), in comparison to less than half for girls (47%).

Overall, UK adolescents report particularly high rates of alcohol use, compared to other European countries. According to the 2011 *European School Survey project on Alcohol and Other Drugs* (ESPAD), 90% of 15 to 16 year olds in the UK had drunk alcohol in the past 12 months, higher than the European average of 79%. In addition, 65% of UK adolescents had drunk alcohol in the past 30 days, compared to 57% across Europe, whilst 55% of UK adolescents reported ever having been drunk, compared to 47% across Europe (Atkinson and Bellis 2012). Even though UK adolescents report a persistently higher prevalence of alcohol use than their European counterparts, interpretation of these estimates requires some caution. Firstly, due to 2015 ESPAD estimates not being available for the UK and estimates presented use 2011 data. As alcohol use initiation has declined amongst younger age groups in the UK over the past 10 years, estimates may be inflated (Fuller et al. 2012; WHO 2014). Secondly, due to the 2011 ESPAD survey having only a 6% response rate from UK schools and

although ESPAD maintains that this sample is sufficient to make valid comparisons, it does highlight that comparability may be “limited” (Hibell et al. 2012).

Within the UK, there are variations in the prevalence of adolescent alcohol use by region and gender. Table 1 presents estimates taken from the Health Behaviour in School Aged Children 2013/14 survey for England, Scotland and Wales (HSBC; HSBC 2014). Specifically, the prevalence of drinking at least once a week at 15 years of age varied slightly across England, Scotland and Wales, more so for girls than boys. The highest prevalence was seen in Scotland where 16% of girls report drinking weekly, in comparison to the lowest prevalence in England (12% of girls). However, rates are equivalent to the HBSC average. For boys, the highest prevalence of drinking at least once a week at 15 years of age was highest in Wales where 12% of boys reported weekly drinking in comparison to 10% in England. These rates were slightly higher than the HBSC average. Even so, within the UK countries, girls reported weekly drinking more often than boys, with the gender difference being greatest in Scotland (11% of boys and 16% of girls respectively).

The prevalence of 15 year olds who reported being drunk on two or more occasions was relatively high in England, Scotland and Wales, with approximately a third of young people reporting being drunk 2 or more times (Table 1). All three nations had a similar prevalence of boys who had been drunk on two or more occasions (31%, 33% and 34% for England, Scotland and Wales respectively), with Wales having a slightly higher prevalence. For girls, there were wider variations in prevalence of being drunk on two or more occasions across the three UK countries (25%, 32% and 28% for England, Scotland and Wales respectively). As such, gender differences in drunkenness across these countries were relatively inconsistent, but the prevalence of use for each country was consistently higher than the HBSC average.

The prevalence of 15 year olds who reported first drunkenness at 13 years of age or younger was much lower than the other estimates presented with negligible variation across gender. Specifically, in England, 10% of boys and 9% of girls reported first drunkenness at age 13 or under. In Scotland, 12% of boys and girls reported such use and this reduced to 10% of boys and girls in Wales. These estimates are slightly higher than the HBSC average for boys, but not girls.

Table 1: Percentage of alcohol use at 15 years of age by country as reported in the HSBC Survey 2013/14

	15 year olds who drink at least once a week		**15 year olds who have been drunk on two or more occasions**		**15 year olds who report first drunkenness at 13 years of age or younger**	
	Boys %	Girls %	Boys %	Girls %	Boys %	Girls %
England	10	12	31	25	10	9
Scotland	11	16	33	32	12	12
Wales	12	14	34	28	10	10
HSBC average	9	16	20	24	7	10

1.3.4. Policies which tackle adolescent alcohol use

In the UK, it is illegal for those under 18 years of age to purchase or attempt to buy alcohol, to drink alcohol in public places, or to be sold alcohol (Healy et al. 2014). Those aged 16 or 17 years can legally drink beer, wine or cider with a meal if it is purchased by an adult and they are accompanied by an adult, but it is still illegal to drink spirits (Inside Government Ministry of Justice 2013).

The UK Government's Alcohol Strategy (2012) sought to reduce alcohol-related harm amongst 11 to 15 year olds, through seeking sustained

reductions in both the numbers drinking alcohol and the amount consumed (Home Office 2012). This strategy built upon the *Youth Alcohol Action Plan,* set out by the Department for Children, School and Families in 2008 (DCSF 2008), which aimed to tackle underage drinking by 2018. Initiatives included: a prohibition on the purchase of alcohol for under 18s, alongside tough enforcement against retailers selling to under 18s; collaboration with police and courts to stop underage drinking in public places; and school-based alcohol education. Voluntary and mandatory guidance for the advertising and marketing of alcohol was also proposed to reduce the appeal of alcohol to those under 18. These initiatives may have been part of recent declines in adolescent weekly drinking (WHO 2016), alongside the implementation of stricter prevention policies (Anderson et al. 2012). Changing social norms, such as a stronger disapproval of adolescent drinking, may have also played a role (De Looze et al. 2015). Despite such declines, there has been a change in alcohol drinking patterns whereby those aged 13 to 15 years are consuming more units in a single session, than compared to previous years (NHS 2017).

1.4. Tobacco use

1.4.1 Tobacco use and public health

Tobacco is used worldwide, with cigarette smoking being the principal form of consumption (Saleheen et al. 2014). Tobacco smoking has many adverse health effects. Short term, these include exposure to toxins, increased risk of a hospital inpatient stay (Lando et al. 1999), increased breathing problems such as shortness of breath, phlegm and a course cough and a predisposition to nicotine dependence (NHS 2017). Long term, these include an increased risk of chronic obstructive pulmonary disease (COPD) (Kenfield et al. 2008; HHS 2014), heart disease, lung disease and cancer (Prizment et al. 2014). Tobacco smoking is a top five risk factor for disease, disability and death amongst people of older ages (Sheild and Rehm 2015).

The treatment of smoking related diseases places an increased burden upon the health services, economy and society. It also has been related to reduced productivity and environmental costs (ASH 2017). Such costs have a lasting effect upon both the individual and society as a whole, with tobacco use being the most common preventable cause of premature loss of health worldwide, accounting for almost 6 million deaths annually (WHO 2017).

1.4.2 Adolescent tobacco use

Tobacco smoking is typically initiated in adolescence, between 13 and 18 years of age (Currie et al. 2012). Tobacco use in adolescence has a larger detrimental effect than tobacco use in adulthood as tissues and organ systems are still growing and maturing. Evidence suggests that those who start smoking in adolescence are 13 times more likely to develop a respiratory disease (Kenfield et al. 2008) and 10 times more likely to develop cancer in later life than those who initiate tobacco use in later years, due to developing a greater overall exposure to tobacco (Prizment et al. 2014). Those who initiate tobacco use in adolescence are more likely to be nicotine dependent (Hu et al. 2006; Buchmann et al. 2013), smoke more frequently (Hu et al. 2006; Buchmann et al. 2013; Reidpath et al. 2014; Nelson et al. 2015), and remain smoking for longer periods of time (Eisner et al. 2000) than those who start smoking after 18 years of age.

Adolescent tobacco use, particularly cigarette smoking, is one of the largest causes of health inequalities with smoking initiation appearing to be higher amongst those from lower socioeconomic backgrounds (Hiscock et al. 2012). However, as measures usually focus on adolescents still engaged with school and tobacco use is strongly related to school drop-out (Stiby et al. 2015), then the true association is unknown. Despite such limitations, research suggests that adolescence is a crucial age for the initiation and

development of tobacco use, so exact epidemiological data is needed to support evidence-based preventive interventions (Surgeon General 2012).

1.4.3 Prevalence of adolescent tobacco use

There has been a large decrease in the number of UK adolescents smoking tobacco over the past 20 years (ESPAD 2015). In 1996, 49% of 11 to 15 year olds in England reported having ever smoked tobacco in comparison to only 19% in 2016 (NHS 2017). Notably, these statistics are for experimental smokers, not for regular smokers, who are defined as those who smoke at least one cigarette per week (NHS 2016).

HSBC 2013/2014 survey data presents estimates, for both boys and girls in England, Scotland and Wales who report regular smoking at age 15 years, i.e. smoking at least once a week. As seen in Table 2, the percentage of regular smokers at 15 years of age in England, Scotland and Wales, is substantially lower than the average for both genders, across all HSBC countries. Specifically, England had the lowest prevalence of boys who were regular smokers across all three UK countries (11% and 10% for boys and girls respectively). Scotland had the highest prevalence for both boy and girl regular smokers (15% and 18% for boys and girls respectively), whilst Wales had similar levels of girl regular smokers to that in England (13% and 10% for boys and girls respectively).

The HSBC 2013/2014 survey data further presents estimates for boys and girls in England, Scotland and Wales who are 15 years of age and report first smoking at 13 years of age or under (HSBC 2014). Table 2 shows the percentage of those who are 15 year of age and who report first smoking at 13 years of age or under, is lower than the HSBC average for both genders, across in England, Scotland and Wales. Specifically, in England, 8% of boys and 6% of girls reported first smoking at 13 years of age or under. In

Scotland, a higher proportion of both boys and girls reported smoking at 13 years or under in comparison to both England and Wales (10% and 11% for boys and girls respectively). In Wales, 9% of boys reported first smoking at 13 years or under and 7% of girls. Both boys and girls in England, Scotland and Wales were less likely to smoke regularly or start at a younger age than boys and girls in HSBC associative countries.

Table 2: Percentage of tobacco use at 15 years of age by country as reported in the HSBC Survey 2013/14

	Ever smoked at 15 years of age		**15 year olds who report first smoking at 13 years of age or younger**	
	Boys %	Girls %	Boys %	Girls %
England	11	10	8	6
Scotland	15	18	10	11
Wales	13	10	9	7
HSBC average	13	22	11	12

Even though the prevalence of adolescent smoking in the UK is lower than in other countries, experimental smoking in adolescence presents an increased future risk for nicotine dependence and daily smoking, as nicotine dependence can typically appear within days/weeks of occasional use (DiFranza et al. 2000).

1.4.4. Policies which tackle adolescent tobacco use

In the UK, it is illegal for anyone under 18 to buy or attempt to buy any tobacco products. Over recent years, there have been many changes in UK legislation to limit young people's access to cigarettes. In 2007, a ban on smoking in public places was introduced, followed by a change in the legal age to purchase tobacco products from 16 years to 18 years. In 2011, there was a ban on tobacco vending machines and in 2014, under the Children's

and Families Act 2014, it became illegal for an adult to purchase tobacco products for anyone under 18 years of age (Barber 2017). Around the same time, there was a ban on displaying tobacco in large stores and in 2015, this was extended to all retail outlets. These changes in legislation may have contributed to the overall decline in adolescent tobacco consumption, in accordance with the aim of Public Health England (PHE) which seeks to see a tobacco-free generation by 2025 (PHE 2015). Despite the continuing decline in smoking rates, nearly 90,000 young people smoke regularly, aged between 11 and 15 years (PHE 2015).

1.5 Cannabis use

1.5.1 Cannabis use and public health

Regular cannabis use has been linked to the development of psychosis, especially amongst the young (van Ours and Williams 2010; Volkow et al. 2014). Early onset and heavy, accelerating cannabis use has also been linked to low height and weight (van Ours and Williams 2010), short-term memory loss and cognitive disorders (van Ours and Williams 2010), depression and anxiety (Chen et al. 2002; van Ours and Williams 2010) and aggression (White and Hansell 1998). Approximately, 10% of regular cannabis users go on to become dependent upon it, with adolescents more likely to be dependent than adults at a given level of cannabis use (Chen et al. 1997; Nelson et al. 2015).

1.5.2 Adolescent cannabis use

Cannabis is the most commonly used drug in the UK (Currie et al. 2012). In 2014, 14.6 million young people reported using cannabis, and it was a primary reason for admission into drug treatment facilities across Europe (27% cannabis) (EMCDDA 2014).

Young people who start using cannabis before 18 years of age are at increased risk for the development of mental health problems including suicide, depression, psychotic symptoms and disruptive behaviour disorders than those who start using cannabis in early adulthood (Arseneault et al. 2002; Patton et al. 2002). Cannabis use in adolescence has also been linked to accidental injury, self-harm, suicide, deteriorating school performance and dropout and other "problem" behaviours, including alcohol misuse, unprotected sex, and antisocial behaviour (Macleod et al. 2004; Bonell et al. 2007; Bachman et al. 2008).

Over the past 15 years, there has been growing interest in identifying distinct cannabis using developmental trajectories (Crano et al. 2008; Tucker et al. 2005; Nelson et al. 2015). Swift et al. (2008) examined data from a ten year representative prospective study with data across two time-points in adolescence (mean age 14.9 and 17.4 years) and young adulthood (mean age 20.7 and 24.1 years). Participants reported frequency of past 6 month cannabis use at varying time-points in adolescence. Cannabis exposure was defined through: maximum frequency of use (occasional, weekly, daily); number of waves of used; and wave of first use. Young adult (24 years) outcomes were: weekly+ cannabis use and DSM-IV cannabis dependence (i.e. problematic use). At age 24, 34% reported cannabis use in adolescence (waves 1-6), 12% at being weekly or more frequent use; 37% of these adolescent cannabis users were using at least weekly at wave 8, with 20% exhibiting dependence. Hence, heavy, persistent and early-onset cannabis use were each strongly predictive of later cannabis problems. Occasional use was also found to be predictive of later cannabis abuse problems when there was co-occurring tobacco use or persistent mental health problems.

Tucker et al. (2005) examined patterns of cannabis use from early adolescence (age 13) to emerging adulthood (age 23), using data from the RAND Adolescent/ Young Adult Panel Study (N = 6,527). They found two periods of vulnerability for cannabis use: early adolescence and the transition to emerging adulthood. Early adolescent users were at high risk for poor outcomes at age 23 compared to consistent low-level users and abstainers, even if they reduced their use during adolescence. Youths who were not early users, but instead steadily increased their use over time, were also at relatively high risk for poor outcomes at age 23. Thus, adolescent cannabis use was linked to an increased risk of poor outcomes in emerging adulthood, compared to those who had never tried cannabis.

More recently, Taylor et al. (2017) examined patterns of cannabis use amongst UK adolescents aged 13 to 18 years and their influence on problematic substance use at age 21 years. Using longitudinal latent class analysis to derive trajectories of cannabis use from self-report measures in a UK birth cohort (n=5,315), they investigated (1) factors associated with latent class membership and (2) whether latent class membership predicted subsequent nicotine dependence, harmful alcohol use and recent use of other illicit drugs at age 21 years. They found cannabis use patterns were captured as four latent classes. This was 'non-users' (80.1%), 'late-onset occasional' (14.2%), 'early-onset occasional' (2.3%) and 'regular' users (3.4%). Sex, mother's substance use, and child's tobacco use, alcohol consumption and conduct problems were associated with cannabis use. At age 21 years, compared with the non-user class, late-onset occasional, early-onset occasional and regular cannabis user classes had higher odds of nicotine dependence. One-fifth of adolescents followed a pattern of occasional or regular cannabis use, and these young people were more likely to progress to harmful substance use behaviours in early adulthood.

1.5.3 Prevalence of adolescent cannabis use

In 2013/2014, 15% of 15 year olds in HSBC countries reported ever trying cannabis (Currie et al. 2014). Table 3 presents the percentage of 15 years olds in the UK countries of England, Scotland and Wales who reported ever trying cannabis, using cannabis in the past 30 days and first using cannabis at 13 years of age or younger. For those who had ever used cannabis at 15 years of age, England had the highest prevalence for boys across the three UK countries (19% and 19% for boys and girls respectively). Scotland had the highest prevalence for girls (14% and 20% for boys and girls respectively), whilst Wales had similar levels of use for both genders (17% and 16% for boys and girls respectively). These percentages were equal to or higher than the HSBC average for 2013/14.

For those 15 year olds who had used cannabis, 8% of boys and 9% of girls in England reported use of cannabis in the last 30 days. In Scotland, a slightly lower proportion of boys reported using cannabis in the last 30 days in comparison to England, but a much higher proportion of girls (7% and 13% for boys and girls respectively). In Wales, 8% of boys reported using cannabis in the last 30 days, but only 7% of girls which is slightly lower than the 9% of girls across all HSBC countries. All other estimates were again equal to or above the 2013/14 HSBC average for all countries.

The proportion of 15 year olds in England, Scotland and Wales who reported first using cannabis at 13 years of age or younger, was highest amongst girls in England and Scotland when compared to the 2013/14 HSBC average. Specifically, 5% of girls in England and 7% of girls in Scotland reported using cannabis at 13 years or younger in comparison to the 4% of girls across all HSBC countries. Generally, girls were more likely to report cannabis use than boys across all levels of use.

Table 3: Percentage of cannabis use at 15 years of age by country, as reported in the HSBC Survey 2013/14

	Ever used cannabis at 15 years of age		**15 year olds who have used cannabis in the past 30 days**		**15 year olds who report first cannabis use at 13 years of age or younger**	
	Boys %	Girls %	Boys %	Girls %	Boys %	Girls %
England	19	19	8	9	3	5
Scotland	14	20	7	13	3	7
Wales	16	17	8	7	2	4
HSBC average	13	17	6	9	3	4

1.5.4. Policies which tackle adolescent cannabis use

In the UK, cannabis use is illegal under The Misuse of Drugs Act 1971. Under this act, cannabis offences include: unlawful supply; intent to supply, import or export, unlawful production and unlawful possession. Enforcement of the law enables police to stop, detain and search people under 'reasonable suspicion' of possessing cannabis. Cannabis is currently classified as a Class B drug with adolescents using cannabis potentially facing criminal prosecution. In January 2004, following much public and policy debate on the risks and benefits of cannabis classification, it was reclassified to a Class C drug under the Criminal Justice Act 2003 with less stricter penalties for use. However, in January 2009, this decision was reversed, with cannabis being reclassified from a Class C to a Class B drug. Despite the penalties associated with cannabis use, UK adolescents still use cannabis with 19% of 15 year olds in England reporting such use (see Table 3).

1.6 Summary of adolescent use of alcohol, tobacco and cannabis

Preventing and reducing harmful adolescent alcohol, tobacco and cannabis use is an international public health priority (WHO 2014). Use of alcohol,

tobacco and cannabis use in adolescence has long-lasting negative effects later in life and changing trajectories in the early years can have life changing beneficial effects. Despite the adverse long-lasting negative effects associated with use of alcohol, tobacco and cannabis in adolescence, young people under 18 years of age still continue to use these substances. Interventions designed to reduce levels of use have been found to only have small to medium effects which are not always enduring over time (Griffin and Botvin 2010). Traditionally, they centre upon school-based programs which challenge peer influences and develop resistance, but these have had limited success (Mahabee Gittens et al. 2011). There is a need to further understand the factors associated with adolescent use of alcohol, tobacco and cannabis and such knowledge would be valuable for informing the design and implementation of effective prevention programs. In particular, there is need to examine these risk factors in terms of different levels of alcohol, tobacco and cannabis use as much research has focused on experimental use of alcohol, tobacco and cannabis (Avenevoli and Merikangas 2003), but it is more frequent use which presents the most risk of harm.

1.7 Literature review

1.7.1 Parent child relationship quality and adolescent use of alcohol, tobacco and cannabis

Parent child relationship quality (PCRQ) is defined as the *"parent or child appraisals of the quality of the relationship between them, characterized by parental behaviours which give evidence of a warm and supporting relationship (e.g. giving emotional affection or praising, active listening, encouraging or showing respect)"* (Visser et al. 2012). Sometimes relationship quality is assessed as negative construct, expressed by rejection, criticism, frequent rows or lack of affection (Maccoby 1992; Wood et al. 2003).

PCRQ is an important part of child development (Ransen and Urichuk 2008). It has been linked to both externalizing and internalising problems in adolescence including aggression (Allen et al. 2007), delinquency (Buist et al. 2004), depressive symptoms (Brumariu and Kerns 2010), anxiety (Sheeber et al. 2007) and suicidal behaviour (Martin and Waite 1994).

PCRQ as a risk factor for adolescent alcohol use has been well documented over the past 10 years. Specifically, negative PCRQ has been linked to alcohol use in adolescence, including experimental drinking (Shelton and van den Bree 2010; Rusby et al. 2018), binge drinking (Shelton and van den Bree 2010; Rusby et al. 2018), problematic drinking (Johnson 2013) and an overall steeper drinking trajectory between 13 and 19 years of age (Gerrard et al. 1999; Gutman et al 2011). Evidence on the association between PCRQ and adolescent alcohol use has been synthesised in a number of systematic reviews. Some of these reviews suggest that PCRQ has a negative linear relationship with adolescent drinking (Foxcroft and Lowe 1991; Vakalahi 2001; Ryan et al. 2010), whereby increases in PCRQ reduces the risk of adolescent alcohol use. However, others have argued that the evidence is weak and the direction is far from clear (Visser et al. 2012). Arguably, differences in findings may stem from variations in the assessment of PCRQ, failings to specify whether prior substance use was adjusted for in study analysis, the methodological quality of included studies, or the inclusion of both cross sectional and longitudinal studies in reviews (Visser et al. 2012; Wellman et al. 2016).

PCRQ as a risk factor for adolescent smoking has also been well documented. For smoking initiation, Fleming et al. (2002) found that weakened PCRQ between 7 and 9 years of age predicted greater risk of smoking initiation 4 years later. For increased levels of smoking, Flay et al. (1998) found that weakened PCRQ at 12 to 13 years of age distinguished between experimental and regular smokers at 17 to 18 years of age. Tucker

et al. (2003) found that poor parental support between 13 and 16 years of age was related to regular smoking amongst adolescents who had already initiated smoking, at 13 to 16 years of age, 15 to 18 years of age and 18 to 23 years of age. Hill et al. (2005) found that low levels of PCRQ at 10 to 11 years of age increased the risk of daily smoking initiation from age 10 to 21 years. These studies examine associations between PCRQ and different frequencies of adolescent smoking. The majority focus on onset, experimentation and occasional tobacco use rather than predicting more frequent tobacco use or nicotine dependence (Avenevoli and Merikangas 2003). Further, systematic reviews summarising longitudinal evidence surrounding PCRQ and adolescent smoking are limited, with many focusing upon parental and sibling smoking as a risk factor for smoking initiation and escalation in adolescence (Avenevoli and Merikangas 2003; Hill et al. 2005).

PCRQ as a risk factor for adolescent cannabis use is documented to a lesser extent than that with alcohol and tobacco use in adolescence. Of the few longitudinal studies available, Rusby et al. (2018) found that that weakened PCRQ between 13 and 14 years of age was linked to an increased risk of cannabis use onset at 14 and 15 years of age. von Sydow (2002) found that weakened PCRQ at ages 14 to 24 years was linked to increased risk of cannabis abuse 4 years later.

Although there is longitudinal evidence to support associations between PCRQ and adolescent alcohol, tobacco and cannabis use, more evidence is needed, especially specific to UK youth. Further, support across studies for the association of PCRQ with adolescent alcohol, tobacco and cannabis use is inconsistent, so the literature as a whole needs to be reviewed to estimate the extent of support. The few studies which have examined the association in terms of hazardous levels of adolescent alcohol, tobacco and

cannabis use and if assessed, primarily failed to draw upon existing, validated and comparable measures. An assessment of experimental and hazardous alcohol, tobacco and cannabis use in adolescence would provide a more accurate assessment of the potential benefits of positive PCRQ.

This thesis presents up to date systematic reviews of evidence examining PCRQ and adolescent use of alcohol, tobacco and cannabis. To address the gap in UK based studies and lack of validated measures, it also presents a longitudinal analysis of the association between PCRQ and experimental and hazardous alcohol, tobacco and cannabis use using existing data from a population-based birth cohort study in England, UK (the Avon Longitudinal Study of Parents and Children; ALSPAC).

1.7.2 School connectedness and adolescent use of alcohol, tobacco and cannabis

School connectedness has many definitions. The Centre for Disease Control Prevention defines school connectedness as "*the belief by students that adults in the school care about their learning as well as about them as individuals*" (CDC 2009). Whilst, Libbey (2004) defines it as the study of a student's relationship to school, drawing across nine salient constructs: 1) academic engagement; 2) belonging; 3) discipline/fairness; 4) extracurricular activities; 5) liking of school; 6) student voice/opportunities to participate in decision making; 7) peer relations; 8) safety; and, 9) teacher support. As such, school connectedness is used as an umbrella term for concepts of school engagement, school bonding, school attachment, orientation to school, school climate, school context, school involvement, teacher support or student satisfaction (Libbey 2004).

School connectedness is important for young people of all ages and can improve health, educational and long term outcomes (Osterman 2000).

Young people who feel more connected to school are: more likely to attend school regularly; more likely to stay in school longer and achieve higher grades; less likely to have emotional problems, eating disorders or suicidal tendencies; less likely to become involved in violence, become a gang member or carry weapons; less likely to partake in sexual activity; and less likely to use alcohol, tobacco and cannabis (Bryant and Zimmerman 2002; Croll et al. 2002; Shochet et al. 2006; Bond et al. 2007; Bonell et al. 2007; CDC 2009). Thus, feeling isolated or alienated from others at school can present risk for a variety of behaviors (CDC 2009), including adolescent use of alcohol, tobacco and cannabis (Bond et al. 2007; Bonell et al. 2007).

Theoretically, school connectedness is thought to be a risk factor in the development of alcohol, tobacco and cannabis use in adolescence, as outlined by the Social Development Model (SDM: Hawkins and Weiss 1985; Catalano and Hawkins 1996). The SDM posits that school connectedness has the propensity to change associations between PCRQ and adolescent use of alcohol, tobacco and cannabis. Even though there is evidence in support of this theory, whereby school connectedness has been linked to adolescent use of alcohol, tobacco and cannabis (see Chapter 4), the evidence is somewhat limited in terms of the number of studies examining this area alongside the generalisability of findings to UK adolescents.

Further, there is little to no evidence available which examines how school connectedness operates to influence associations between PCRQ and use of alcohol, tobacco and cannabis in adolescence. Although both PCRQ and school connectedness have been linked to adolescent use of alcohol, tobacco and cannabis, they have tended to be seen as two distinct concepts. Relatively few studies have examined them as a series of inter-connected influences, even though theoretically, it is possible that there is

a dynamic process between the two factors which includes both indirect and direct effects. Drawing upon the SDM, school connectedness has the propensity to moderate associations between PCRQ and adolescent use of alcohol, tobacco and cannabis whereby school connectedness alters the strength of the causal relationship between PCRQ and each adolescent substance using outcome (Aikin and West 1991). Mediation analyses could be an alternative approach, examining whether school connectedness mediates the effect of PCRQ on adolescent alcohol, tobacco and cannabis use (Aikin and West 1991), or PCRQ as a moderator or mediator for associations between school connectedness and adolescent substance use. However, these analytical approaches are theoretically unfeasible and there is unclear support across the literature for such associations. Given that high levels of school connectedness have been found to be protective against adolescent substance use (Das et al. 2016; Carver et al. 2017), and the SDM highlights moderation effects, school connectedness was examined as a moderator for associations between PCRQ and school connectedness.

Systematic reviews of this area are limited and have primarily examined school connectedness as an intervention for adolescent use of alcohol, tobacco and cannabis (Das et al. 2016; Carver et al. 2017) instead of a risk factor for use. As such, the knowledge base for prospective associations between school connectedness in earlier developmental years and the development of alcohol, tobacco and cannabis use in late adolescence is less clear. This thesis presents an up to date systematic review of evidence specifically examining school connectedness and adolescent use of alcohol, tobacco and cannabis. It also presents a longitudinal analysis of the association between school connectedness and experimental and hazardous use of alcohol, tobacco and cannabis, using data from the ALSPAC population-based birth cohort study in England, UK, as

aforementioned. It further explores the moderating influence of school connectedness upon associations between PCRQ and use of alcohol, tobacco and cannabis in adolescence.

1.8 Thesis aims, research questions and overview

1.8.1 Thesis aims

This thesis aims to:

- Present three distinct systematic reviews examining the association between PCRQ and adolescent use of alcohol, tobacco and cannabis.
- Present three distinct systematic reviews examining the association between school connectedness and adolescent use of alcohol, tobacco and cannabis, and whether school connectedness moderates associations between PCRQ and each substance type.
- Examine whether PCRQ and school connectedness directly influences experimental and hazardous use of alcohol, tobacco and cannabis in adolescence within a population-based birth cohort study in England, UK (the Avon Longitudinal Study of Parents and Children; ALSPAC).
- Examine the moderating effect of school connectedness upon associations between parent child relationships and experimental and hazardous use of alcohol, tobacco and cannabis in adolescence within a population-based birth cohort study in England, UK (the Avon Longitudinal Study of Parents and Children; ALSPAC).

1.8.2 Research questions and hypotheses

Six research questions guided this thesis. Three questions were specific to the systematic reviews:

1. Is the quality of parent child relationships associated with experimental and hazardous levels of alcohol, tobacco and cannabis consumption in adolescence?
2. Is school connectedness associated with experimental and hazardous levels of alcohol, tobacco and cannabis consumption in adolescence?
3. Does school connectedness moderate existing associations between PCRQ and adolescent alcohol, tobacco and cannabis use?

Three additional research questions were specific to the analysis of ALSPAC data:

1. Is PCRQ at 9 years of age associated with experimental and hazardous use of alcohol, tobacco and cannabis use at 17 years of age?
2. Is school connectedness at 11 years of age associated with experimental and hazardous use of alcohol, tobacco and cannabis use at 17 years of age?
3. To what extent does school connectedness at 11 years moderate associations between PCRQ at 9 years of age and experiemental and hazardous use of alcohol, tobacco and cannabis at 17 years of age?

The ALSPAC analysis specifically hypothesised that:

a. Adolescents with lower levels of PCRQ at 9 years of age would have higher levels of use of alcohol, tobacco and/or cannabis at 17 years of age.
b. Adolescents with lower levels of connectedness to school at 11 years of age would have higher levels of use of alcohol, tobacco and/or cannabis at 17 years of age.
c. Higher levels of school connectedness at 11 years of age would reduce the strength of the association between PCRQ

at 9 years of age and alcohol, tobacco and cannabis use at 17 years of age.

1.8.3 Thesis synopsis

- Chapter 1 is this introductory chaper and presents the context of the thesis, alongside specifying the research aims and questions of study.
- Chpater 2 outlines the theoretical underpinnings of the thesis.
- Chapter 3 presents the methodology of the thesis.
- Chapter 4 presents three systematic reviews, each examining associations between PCRQ and adolescent use of alcohol, tobacco and cannabis, respectively.
- Chapter 5 presents three systematic reviews, each examining associations between school connectedness and adolescent use of alcohol, tobacco and cannabis, respectively.
- Chapter 6 presents the results from the ALSPAC analysis which examined associations between PCRQ, school connectedness and adolescent alcohol use.
- Chapter 7 presents the results from the ALSPAC analysis which examined associations between PCRQ, school connectedness and adolescent tobacco use.
- Chapter 8 presents the results from the ALSPAC analysis which examined associations between PCRQ, school connectedness and adolescent cannabis use.
- Chapter 9 provides a summary of the main findings, strengths and limitations, implications and suggestions for future research. This chapter closes with a conclusion which summarises the main findings of this thesis.

Chapter 2: Theories of alcohol, tobacco and cannabis use in adolescence

2.1 Chapter overview

This chapter examines the assertions, applications and boundaries of theories which attempt to explain the use of alcohol, tobacco and cannabis in adolescence. This chapter firstly examines competing theories which are used to explain use of alcohol, tobacco and cannabis in adolescence, focusing exclusively upon psychosocial theories, ecological theories and socio-ecological theories. It then presents competing arguments between the theories and by way of closing, justifies the theoretical framework selected to underpin this study.

2.2 Theories of alcohol, tobacco and cannabis use in adolescence

There are many theories which attempt to explain adolescent use of alcohol, tobacco and cannabis. Those most frequently applied are psychosocial theories, ecological systems theories and social-ecological theories, and so these were examined.

2.2.1 Psychosocial theories of adolescent alcohol, tobacco and cannabis use

Following an extensive review, Petraitis et al. (1995) synthesised psychosocial theories of adolescent alcohol and cannabis use across four competing paradigms. These were: cognitive-affective theories; social learning theories; conventional commitment and social attachment theories; and intra personal theories.

Cognitive-affective theories of adolescent substance use focus upon the decision-making processes of using substances in terms of the perceived 'costs' and 'benefits' (Ajzen and Fishbein, 1980; Ajzen 1985, 1988). They focus on how the perceptions surrounding the costs and benefits of experimentally using substances contribute to an adolescents' decision to

use (Petraitis et al. 1995). Cognitive-affective theories primarily draw on upon two assumptions: (1) the primary causes of decisions to use substances arise from the substance-specific expectations and perceptions adolescents hold and, (2) the effects of other factors (e.g. personality traits or substance using peers) are mediated through their effects on substance-specific cognitions, evaluations, and decisions (Petraitis et al. 1995). Notably, these theories leave ambiguity surrounding the formation of beliefs specific to adolescent use of alcohol, tobacco and cannabis as some adolescents hold positive perceptions surrounding use whilst others hold negative perceptions. It is possible that these perceptions could be a cause of future use, or a consequence from previous use (Petraitis et al. 1995) or alternatively stem from wider social factors not accounted for.

Social learning theories of experimental substance use instead focus upon the learning of substance-specific attitudes and behaviours from close family and friends (Bandura 1977, 1979; Akers 1985; Akers and Cochran 1985). They suggest that adolescent use of substances begins with the specific attitudes and behaviours of role models towards such use. There is much empirical support for social learning theories of experimental substance use whereby alcohol, tobacco and cannabis being more prevalent amongst young people who have peers which talk about use, and hold positive attitudes towards use (Brook et al. 2006, Kokkevi et al. 2007). However, questions remain as to whether role models who use substances are a cause of future use or a consequence of previous use.

Conventional commitment and social attachment theories of adolescent substance use are primarily those of the social control theory (SCT; Elliott et al. 1979, 1985) and the social development model (SDM; Hawkins and Weiss 1985; Catalano and Hawkins 1996). Both assume that emotional attachments to substance using peers is a primary cause of experimental substance use, but unlike social learning theories, they focus on the causes

of attachments, specifically targeting weak conventional bonds to society and institutions, and individuals who encourage deviant behaviours, including experimental substance use in adolescence (Petraitis et al. 1995). Whilst, the SCT emphasises weak conventional bonds to social systems including the family, school, peers and neighbourhood as risk factors for adolescent substance use, the SDM emphasises the individual, their social development and immediate social interactions (Petraitis et al. 1995). The SDM posits that social behaviours are learned through social interactions, which gives rise to the formation of attachments which can have a lasting effect upon behaviours (Catalano and Hawkins 1996; Catalano et al. 2005). Specifically, attachment to others who offer opportunities for and reward prosocial behaviour protects against antisocial behaviour, while attachments to those who support and reward anti-social behaviours may increase risk behaviour (Catalano and Hawkins 1996; Catalano et al. 2005). These relationships form much of the basis for adolescent use of alcohol tobacco and cannabis. For example, close parent child relationships are discussed as protective against use of alcohol, tobacco and cannabis in adolescence, whilst peer relationships are considered simultaneously as being potential risk and protective factors.

The SDM further asserts that adolescents form attachments to peers using alcohol, tobacco and cannabis when they are unattached to parents and other conventional role models or not committed to conventional society (Catalano and Hawkins 1996). It posits that the relative influence of families, schools and peers shifts developmentally whereby parents dominate preschool years, teachers dominate preadolescent years and peers dominate adolescent years. Applied to using alcohol, tobacco and cannabis in adolescence the SDM suggest that use is more likely if during earlier developmental stages, they experience:

a. Few opportunities for rewarding interaction at home and school;

b. Have poor interpersonal and academic skills which enable rewarding interactions at home and school;
c. Infrequent positive reinforcement during interactions with parents and teachers.

Here adolescent use of alcohol, tobacco and cannabis arises from a sequence of cascading events, stemming from within the family and school (Masten et al. 2005). It has been argued that the SDM deemphasizes the role of substance using cognitions, focusing instead upon attachments to peers as the main cause of subsequent use of alcohol, tobacco and cannabis (Petraitis et al. 1995). However, the Seattle Social Development Project (SSDP; Hawkins et al. 1999, 2000) presents empirical support specific to the SDM in terms of associations between PCRQ, schools and adolescent use of alcohol, tobacco and cannabis (Guo et al. 2001; Guo et al. 2002; Hill et al. 2005; Mason et al, 2010; Bailey et al. 2011; Herrenkohl et al. 2012).

Intra-personal theories of substance use in adolescence build upon previous theories and suggest that adolescents are at risk for experimental substance use if: (a) they have close relationships with substance using peers or adults and they encourage such use; and (b) their communities and families leave them little reason to commit to conventional values or bond to parents. These theories focus equal attention on the characteristics of adolescents' social environment (e.g. peers, communities, and families) and the adolescent's personal characteristics (e.g. self-esteem and coping skills) (Petraitis et al. 1995). Such theories encompass the Social Ecology Model (Kumpfer and Turner 1991), the self-derogation theory (Kaplan 1976; Kaplan et al. 1984), the multistage social learning model (Simons et al. 1988) and family interaction theory (Brook et al. 1990). However, these theories assume that personality traits and affective states directly influence experimental substance use in adolescence, but

longitudinal evidence suggests that they are not related (Shedler and Block 1990; McBride et al. 1991).

2.2.2 Ecological theories of alcohol, tobacco and cannabis use in adolescence.

Many epidemiological researchers draw upon social-ecological frameworks for understanding adolescent alcohol, tobacco and cannabis use, both systemically and contextually. The most prominent of these theories are those of the ecological systems theory (Bronfenbrenner 1992), the social model of health (Dahlgren and Whitehead 1991) and the theory of triadic influence (Flay and Petraitis 1994; Flay et al. 2009).

According to the ecological systems theory (Bronfenbrenner 1992), adolescent behaviours and wellbeing are only partly influenced by biology and individual pre-dispositions, as additional influences arise through the interaction of multiple layers of environmental influence (Moore et al. 2014). As such, environmental contexts (e.g. home, school, society) interact with the individual to either promote healthy behaviours or create risk for maladaptive ones, including the use of alcohol, tobacco and cannabis (Conn and Marks 2017). The theory holds that different environments are encountered throughout the lifespan which may influence behaviour in varying degrees. These systems include the micro system, the mesosystem, the exosystem, the macro system, and the chronosystem.

Specific to the model, microsystems are the environments most proximal to the adolescent. They are seen to exert direct influence on (e.g. schools, families and peer networks). In contrast, mesosystems represent the interrelationships amongst microsystem agents (i.e. family-to-school). The exosystem (e.g. broader social contexts like neighbourhoods) and the macrosystem (i.e. societal and cultural norms) are those in which the

microsystem and mesosystem are contained (Moore et al. 2014). Figure 1 depicts these four major contextual levels. The chronosystem accounts for changes over time in adolescent's interactions with, and responses to, their environments as they transition through childhood and teenage years.

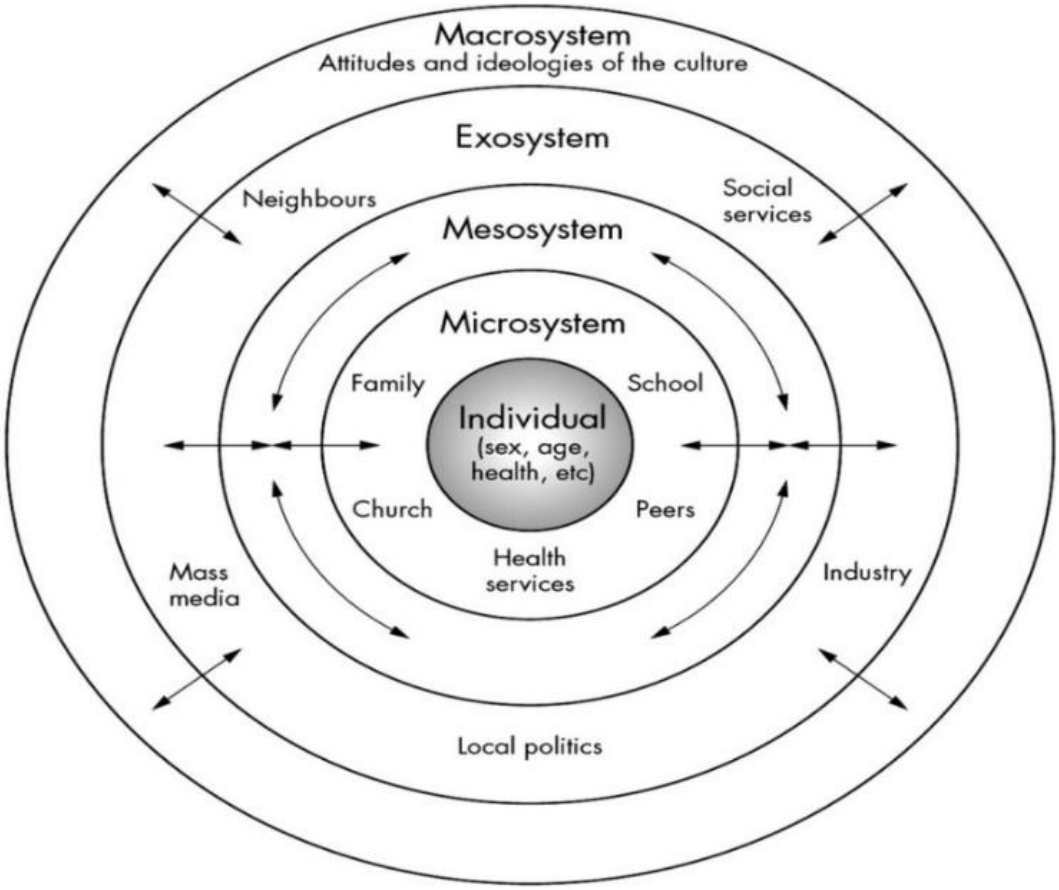

Figure 1: Brofenbrenner's (1992) ecological theory of development

The influence of micro-systems (schools, families and peer networks) upon adolescent use of alcohol, tobacco and cannabis have commonly been investigated using the SDM (Catalano and Hawkins 1996), as aforementioned. However, ecological systems theory differs to the SDM as it explores how higher level contextual factors interact (e.g. neighbourhoods, cultural norms) to shape the adolescents' attitudes, beliefs, and practices surrounding use of alcohol, tobacco and cannabis

(Conn and Marks 2017). There is empirical support for ecological systems theory. Specific to microsystems, researchers have found that PCRQ and school connectedness are both directly related to adolescent use of alcohol, tobacco and cannabis (Resnick et al. 1997; Dishion et al. 2004; DeVore and Ginsburg, 2005; Ackard et al. 2006; Kokkevi et al. 2007; Skinner et al. 2009). They have also found evidence in terms of other familial and peer factors, including parental monitoring, deviant peers and peer substance use as risk factors for adolescent alcohol, tobacco and cannabis use (Brook et al. 2001; Fleming et al. 2002; Simons-Morton et al. 2004; Van Ryzin et al. 2012). Specific to mesosystems, exosystems and mesosystems, researchers have found neighbourhood factors to be associated to adolescent use of alcohol, tobacco and cannabis both directly, and indirectly through parental and peer processes (Chuang et al. 2005).

Even though evidence favours the ecological systems theory, Bronfenbrenner fails to provide specificity about the particular attributes of social contexts which enable direct measurement (Ennett et al. 2008). The evidence provided is primarily for the microsystem and mesosystem as separate entities, not as a full systems approach. Even though each system is theoretically salient with evidence provided in isolation, ambiguity still remains as to whether there is direct influence between each system as a whole.

The social model of health (Dahlgren and Whitehead 1991) is a competing social ecological theory readily applied to understanding health inequalities. The model describes layers of influence on individual health outcomes, being termed the 'Policy Rainbow'. As illustrated in Figure 2, it draws upon a multifactoral approach which differentiates between individual and social factors. Such factors are those which are fixed (e.g. sex, age and genetic) and those which are modifiable, arising from a series of layers of influence (e.g. personal lifestyle, the physical and social environment and wider socio-economic, cultural and environment

conditions). There is also potential for layer-to-layer interaction within the model. For example, benefit cutbacks might adversely affect the pocket money adolescents receive and subsequently influence their health through being unable to buy alcohol, tobacco and cannabis.

The Dahlgren and Whitehead model is useful for providing a framework which examines the contribution of each of the layers to health outcomes. The model has been used to assist researchers in constructing hypotheses about the determinants of health, to explore the relative influence of these determinants on different health outcomes and the interactions between the various determinants. For example, in the UK alcohol-related deaths increase with decreasing socioeconomic status, producing a social gradient with the gradient steeper for males, especially in Scotland (Siegler et al. 2011). Such evidence is used in policy interventions at different levels and has been drawn upon to target adolescent use of alcohol, tobacco and cannabis. Even so, the specificity of the model in explaining how PCRQ and school connectedness influence adolescent use of alcohol, tobacco and cannabis is less clear cut, with the model instead examining each factor in isolation rather than the influence of interactions between levels.

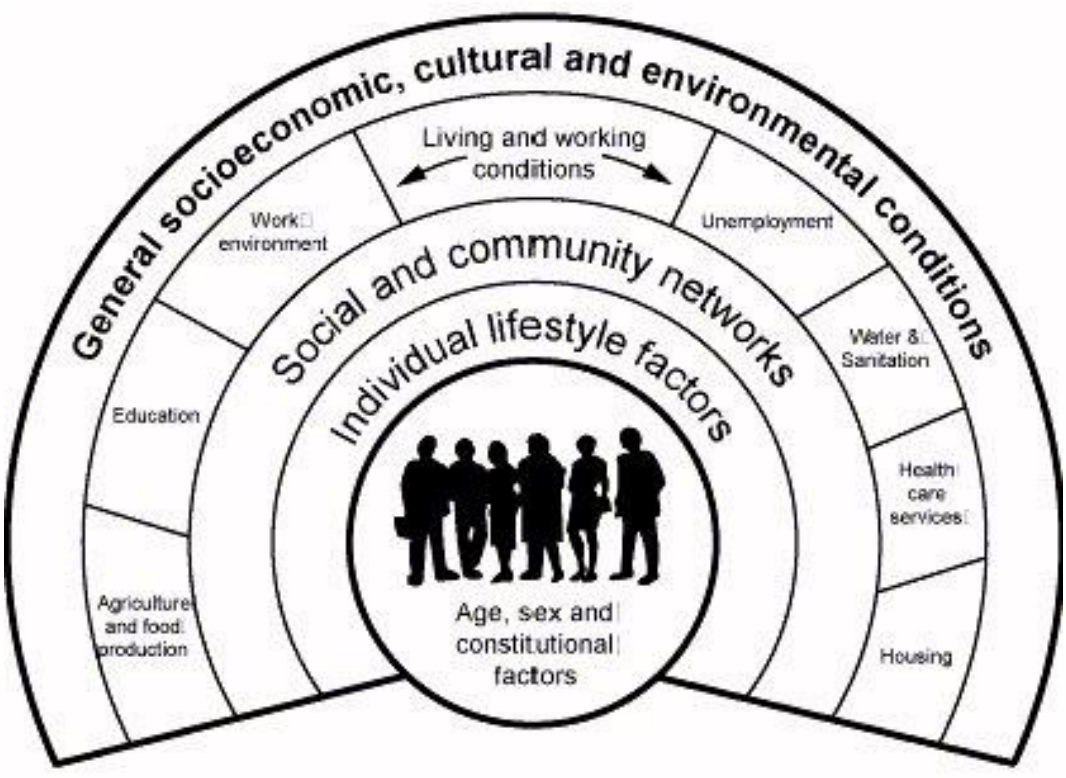

Figure 2: Dahlgren and Whitehead's (1991) Social Model of Health

The Theory of Triadic Influence (Flay and Petraitis 1994; Flay et al. 2009) is based upon an extensive review of numerous theories of adolescent substance use (i.e. cognitive-affective, social-learning, conventional commitment/social attachment, intrapersonal, and integrative). It examines individual characteristics alongside those of the family, peer, and community which influence the likelihood of using alcohol, tobacco and cannabis in adolescence. The theory organises influences by type (social, attitudinal, and intrapersonal) in addition to the level of influence (ultimate/contextual, distal/indirect, and proximal/direct). The theory also suggests that causal processes can occur through: mediation (i.e. one variable mediating another's effects); moderation (e.g. one variable modifying another's effects); or feedback (e.g. reciprocal causation) (Flay et al. 2009).

There is research support for the TTI as explaining adolescent use of alcohol, tobacco and cannabis (Hawkins et al. 1992; Petraitis et al. 1995; Scheier 2001; Connell et al. 2010). Specifically, the TTI posits that there are direct and interactive influences of social and psychological factors on adolescent use of alcohol, tobacco and cannabis. The TTI suggests that social environmental influences, such as parents' and friends' substance use, are arguably the most studied and well-supported type of psychosocial influence on adolescent smoking (Connell et al. 2010). The authors of TTI recommend that research should examine how these theory-based psychosocial factors predict substance using transitions (e.g. from never to trying smoking; Flay et al. 1999).

2.3. Summary and implications for this thesis

This thesis sought to examine whether PCRQ and school connectedness are directly related to use of alcohol, tobacco and cannabis in adolescence; whether the factors are linked to hazardous levels of alcohol, tobacco and cannabis use; and whether school connectedness moderates associations between PCRQ and experimental and hazardous levels of alcohol, tobacco and cannabis use in adolescence.

Drawing upon the research questions of this thesis, this study does not seek to examine the influence of wider social domains. Nor, examine a whole systems approach. Instead, it seeks to focus upon immediate social interactions within the family and school and how these shape subsequent use of alcohol, tobacco and cannabis in adolescence. The Social Development Model (SDM: Hawkins and Weiss 1985; Catalano and Hawkins 1996) provides theoretical explanation for the relative influence of both PCRQ and school connectedness upon of adolescent use of alcohol, tobacco and cannabis. Unlike other theories, the SDM perceives both PCRQ

and school connectedness to be integral components of why adolescents use alcohol, tobacco and cannabis. The theory goes beyond conventional explanations, outlining the importance of these factors in the early years upon the development of alcohol, tobacco and cannabis using behaviours in late adolescence. It is a dynamic model, outlining the relative influence of specific risk factors across different developmental periods, an important feature of this study. On this basis, the SDM is the most appropriate theoretical framework for situating this study.

Although there is much empirical support for the SDM as explaining the use of alcohol, tobacco and cannabis in adolescence, the evidence base specific to PCRQ and school connectedness and adolescence substance misuse is not clear. In accordance with this need, Chapters 4 and 5 present systematic reviews of the evidence. Chapter 4 presents the systematic reviews which examined PCRQ with adolescent use of a) alcohol, b) tobacco and, c) cannabis. Chapter 5 presents the systematic reviews which examined school connectedness and adolescent use of a) alcohol, b) tobacco and, c) cannabis.

Chapter 3: Methodological overview

3.1 Chapter overview

This chapter provides a rationale and detailed overview of the methodological approaches used in this thesis. The chapter firstly revisits the thesis' research questions, secondly progresses to ontological and epistemological considerations and thirdly specifies the research design and methods used. It presents detailed overviews of the approaches used for the systematic reviews and the study of the Avon Longitudinal Study of Parents and Children (ALSPAC) birth cohort. It includes study procedures, sample representation and measures used for analyses. The strengths and weaknesses of the data are discussed, alongside the statistical procedures and ethical considerations of the study.

3.2 Revisit of research questions

Three research questions were specific to the systematic reviews:

1. Is the quality of parent child relationships associated with experimental and hazardous levels of alcohol, tobacco and cannabis consumption in adolescence?
2. Is school connectedness associated with experimental and hazardous levels of alcohol, tobacco and cannabis consumption in adolescence?
3. Does school connectedness moderate existing associations between PCRQ and adolescent alcohol, tobacco and cannabis use?

Three additional research questions were specific to the study of ALSPAC data:

1. Is PCRQ at 9 years of age associated with experimental and hazardous levels of adolescent alcohol, tobacco and cannabis use at 17 years of age?

2. Is school connectedness at 11 years of age associated with experimental and hazardous levels of adolescent alcohol, tobacco and cannabis use at 17 years of age?
3. To what extent does school connectedness at 11 years moderate associations between PCRQ at 9 years and adolescent use of alcohol, tobacco and cannabis at 17 years?

As per detailed in the introduction, it was hypothesised that:

a. Adolescents with lower levels of PCRQ at 9 years of age would have higher levels of use of alcohol, tobacco and/or cannabis at 17 years of age.
b. Adolescents with lower levels of school connectedness at 11 years of age would have higher levels of use of alcohol, tobacco and/or cannabis at 17 years of age.
c. Higher levels of school connectedness at 11 years of age would reduce the strength of the association between PCRQ at 9 years of age and alcohol, tobacco and cannabis use at 17 years of age.

3.3 Research strategy: ontological and epistemological considerations

3.3.1 Research strategy

In *Approaches to Social Enquiry*, Blaikie (2007) outlines four social research strategies: retroductive; abductive; inductive; and deductive. Each is argued to connect with different philosophical traditions and vary in ontological assumptions. In short, retroductive research focuses on the building of hypothetical models of structures and mechanisms which produce empirical phenomena (Bhasker et al. 1979), abductive research focuses on constructing theories derived from the language, meanings, interpretations, motives and intentions people use in everyday lives (Blaikie 2007), inductive research focuses on developing explanations from data whilst deductive research seeks to test theory and identify causality.

This research does not seek to build models or theories, neither does it seek to develop explanations from the data. Instead it seeks to test the Social Development Model (SDM: Hawkins and Weiss 1985; Catalano and Hawkins 1996) as presented in Chapter 2 and identify regularities between social relations at 9 and 11 years of age and the subsequent use of alcohol, tobacco and cannabis at 17 years of age. Therefore drawing upon a deductive approach to enquiry.

3.3.2 Ontological and epistemological considerations

Ontological considerations question 'what is the nature of reality' whilst epistemological considerations question the 'what is the nature of the relationship between the knower (the inquirer) and the known (or knowledge)' (Allison and Hobbs 2006; Blaikie 2007). Considerations of both perspectives were needed in the design of this study as within social sciences, they can create an array of 'paradigmatic disputes' (Blaikie 1993).

Ontological considerations seek to uncover the nature of reality, with proponents being either realist or anti-realist. Thus, either accepting facts are objective in which they are real and independent of the "human mind" (realist), or that reality is subjective (anti-realist). This study accepts that facts are objective and real, aligning with a realist approach.

Alternatively, epistemological considerations seek to uncover the nature of the relationship between the knower (the inquirer) and the known (or knowledge), with four major positions: positivism, empiricism, interpretivism and realism (Guba and Lincoln 1994; May 2011). As summarised by May (2011), positivism argues that 'truths' can be validly established within both the natural *and* social worlds through cause and

effect and can be generalised to make statements about the population as a whole. Empiricism argues that 'objectivity' is possible and that 'validity' can't be independently established, and instead, facts 'speak for themselves' (Bulmer 1982, p.31). Interpretivism argues that in order to understand human action we need to achieve 'Verstehen', or empathetic understanding – we need to see the world through the eyes of the actors doing the acting. Whilst realism shares with positivism the aim of explanation, but differs in that there is a commitment "to the existence of some disputed kind of being" (Bhasker 1993, p.308), with objectivity and validity sometimes differing because of divergences in subject matter (Bhaskar, 1979).

Critical realism is a competing epistemological perspective which attempts to steer between naive realism and idealism (Archer et al. 1998; 2016). It is now one of the major strands of scientific and social scientific methodology rivalling positivism, empiricism, interpretivism and realism as it emphasises the importance of ontology for understanding beings, separately from human thought and language. Bhaskar's theory of critical realism establishes that things exist apart from our experience and knowledge of those things, and even though scientific observation and measurement are important in the knowledge of reality, they are not the core of social observation as social 'truth' cannot always be studied precisely in the same way as 'natural' objects (Bhaskar 1975, 1979). Hence, scientific and social observation are qualitatively different, with science being a product of a social world which has no objective reality, instead being moulded by social, ideological and political conditions (Bhaskar 1975; 1979). In short, critical realism argues for a structured and separate account of reality in which difference, stratification and change plays a central role and where "ontological theory presupposes an[y] epistemological theory" (Scott 2005, p. 634). It explores, tests and explains observed phenomena with reference to underlying structures and mechanisms, whilst acknowledging

differences between 'social worlds': the *empirical*, the *actual* and the *real* (Bhaskar 1975).

Drawing upon the competing ontological and epistemological perspectives presented, this thesis aligns with a critical realist approach for examining adolescent use of alcohol, tobacco and cannabis. In adopting a critical realist approach to knowledge, this thesis accepts that there are events which can be observed in the empirical world and that there are *structures and mechanisms* in the real world which produce these events. In seeking this knowledge, critical realism does not insist on an 'identity of methods'. Instead, it claims compatibility, whereby researchers are not restricted to using quantitative or qualitative procedures, but use the most appropriate method for answering the *research questions*.

Specifically, the research questions of this thesis sought to explain the underlying mechanisms surrounding the development of adolescent use of alcohol, tobacco and cannabis through delineating temporal differences in social processes (e.g. PCRQ and school connectedness), as aforementioned. Estimates were derived for the relationships between concepts and attempts were made to control a range of variables to make internally valid findings (Baum 1995). Even though this approach to research has been criticised for being too reductionist and less powerful in understanding more complex issues (Baum 1995), this study accepted these limitations and a quantitative approach was selected.

3.4 Quantitative approaches to research

Quantitative research seeks to create meaning through the assessment of data. Designs can be experimental, cross sectional or longitudinal (Bryman 2012). Experimental research seeks to evaluate an intervention or

manipulate a hypothesized causal factor. In studies examining the development of adolescent alcohol, tobacco and cannabis use experimental designs are rarely used, with only cross sectional and longitudinal designs considered.

Cross sectional and longitudinal research designs are both widely used for the study of adolescent alcohol, tobacco and cannabis use (Melotti et al. 2011). Cross sectional designs are advantageous in that they examine patterns of association but are limited as they have an inability to determine the direction of influence between two variables (Donovan et al. 2004). Longitudinal research designs are advantageous in that they can provide temporal priority and examine the sequential ordering of associations but are limited as they are more vulnerable to missing data and high levels of participant attrition (de Vaus 2002). This thesis accepts the strengths and weaknesses of each approach but given the identified need for research which examines prospective associations between PCRQ, school connectedness and adolescent use of alcohol, tobacco and cannabis across differing developmental time-points, a longitudinal research design was selected.

3.5 Systematic Reviews

This section describes the research design and methodology used in the six systematic reviews.

3.*5.1 Systematic review research design*

A systematic review seeks to collate all relevant evidence which meets a pre-specified eligibility criterion to answer a specific research question (Higgins and Green 2011). It uses specific, systematic methods to minimise bias in the identification, selection, synthesis, and summary of studies.

Systematic reviews are the preferred approach to synthesizing health care evidence due to holding methodological rigor (Moher et al. 2015). They have been used to support the development of clinical practice guidelines and inform clinical decision-making.

Moher et al (2015) outlines the key characteristics of a systematic review as being: (a) a clearly stated set of objectives with a clear, reproducible methodology; (b) a systematic search which identifies all studies meeting the eligibility criteria; (c) an assessment of the validity of the findings of all included studies (e.g. assessment of risk of bias and confidence in cumulative estimates); and (d) systematic presentation and synthesis of findings from all included studies.

Meta-analysis uses statistical techniques to synthesise and summarise the results of included studies (Moher et al. 2009; 2015). This approach may or may not be used within a systematic review. It is advantageous in that by combining data from several included studies, it can provide precise estimates of the effects of health care than those derived from individual studies (Moher et al.2009; 2015).

The QUOROM Statement (Moher et al. 2000), was the reporting guidance for a meta-analysis of randomized trials (Moher et al. 2009). Since its application, the conduct and reporting of systematic reviews has changed considerably. Further, there have been many conceptual changes, including assessments of the risk of bias within systematic reviews (Guyatt et al. 2008), and the increasing use of systematic reviews to summarize evidence other than that provided by randomized trials (Moher et al. 2009). In an update and expansion of the statement, it was changed to the Preferred

Reporting Items for Systematic reviews and Meta-Analyses (PRISMA: Moher et al. 2009).

The PRISMA Statement is an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses, first published in 2009 (Moher et al. 2009). It entails a 27-item checklist (see Appendix 1) and a four-phase flow diagram. The PRISMA Statement aims to improve the reporting of systematic reviews and meta-analyses and even though primarily used for reporting reviews which evaluate randomized trials, it can be used for reporting systematic reviews of other research types (Moher et al. 2009).

There are alternative approaches to reporting a systematic review including those as suggested by Cochrane (Higgins and Green 2011), Campbell Collaborations and the Joanna Briggs Institute (Moher et al. 2015). The Institute of Medicine (IOM) also provides 'Standards for Systematic Reviews', but for reporting the review, "*standards draw extensively from the PRISMA checklist"* (Institute of Medicine 2011). Thus, the PRISMA Statement was the favoured approach for the reporting of the systematic reviews contained within this thesis.

3.5.2 Systematic review methodology

This study sought to identify peer-reviewed journal articles reporting longitudinal associations between PCRQ, school connectedness and adolescent use of alcohol, tobacco and cannabis. Six systematic reviews were undertaken, all reported in accordance with the PRISMA statement (Moher et al. 2009). This was to ensure literature was reviewed systematically in addition to providing a robust evaluation of the evidence (Moher et al. 2009). The standardised methodology across all six

systematic reviews is detailed as follows, where methods needed tailoring for each individual review, it has been documented in the corresponding review:

Review design: Each review was designed and reported systematically, according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (see Appendix 1).

Electronic search: For each review, six electronic databases were searched: Ovid Medline, PsycINFO (PI), ASSIA, ERIC, Web of Science and SCOPUS. The dates of the searches and the search terms used (see Appendix 2), were specific to each review.

Citation search: Additional papers were identified from citations of the electronic search of included studies.

Exclusion criteria: All exclusion criteria were postulated prior to the search. Within each review, papers were excluded if titles and/or abstracts indicated that studies focused on study populations older than 18 years of age, multiple risk behaviours including teenage sexuality/pregnancy, or clinical or vulnerable (e.g. young offenders, attention deficit hyperactivity disorder and/or learning difficulties) populations. As were those not printed in English or cross sectional in design.

Exclusion criteria specific to each review were also formulated. This focused upon the population of interest, exposure and outcome for each review. This approach was based on the Cochrane 'PICO' statement (Higgins and Green 2011), which examines population of interest,

intervention, comparator and outcome, whereby the “I” for intervention is replaced with an “E” for exposure (PECO).

In addition to the exclusion criteria aforementioned, due to the longitudinal research design of this thesis, an important criterion of all reviews was that PCRQ or school connectedness preceded assessment of adolescent alcohol, tobacco or cannabis use. Studies not meeting this criterion were also excluded.

A*bstract screening:* Titles and abstracts were screened by one reviewer. Studies which raised uncertainty were discussed with two independent reviewers.

Screening of full papers: Full papers were read in detail and excluded according to the criteria aforementioned. This process was individualised to each review. Results for each review were synthesised in EndNote.

Summary measures: Principal summary measures for all included studies were odd’s ratios. Where this had not been reported, alternative summary measures were presented.

Quality assessment: For each review, all included studies were assessed for methodological quality in accordance with a checklist derived from the Newcastle Ottawa Quality Assessment Scale (NOS: Wells et al. 2013) (see Appendix 3). The NOS is a convenient tool which has face/content validity (Wells et al. 2013). The NOS uses a 'star system' to assess the quality of cohort studies whereby each study is assessed against 8 specific criteria, across three domains: selection; comparability; and outcome. Criteria are rated as “yes” (*) or “no” (.).

All included studies were independently assessed against the NOS 'star system' by the main author. Scores were awarded, with a maximum possible score of 9. If >50% of the maximum score was obtained, the study was seen to be of high quality; if ≤50% of the maximum score was obtained, then the study was seen to be poor quality and present considerable risk for bias. This threshold was selected following a search on literature whereby a NOS score of less than 5 was considered "poor quality" and likely to have biased or invalidated results (McPheeters et al. 2012). The quality assessment and associated NOS scores of all included studies has been presented within the results section of each of the six reviews.

3.6 ALSPAC study

This section describes the research design and methodology used in the ALSPAC study.

3.6.1 ALSPAC research design

3.6.1.2 Selection of a birth cohort study

Longitudinal research requires data at two or more time points, with the same individuals analysed from one period to the next (Menard 2007). There are primarily two types of longitudinal designs, cohort studies and panel studies. A cohort study is that which is formed from a sample on the basis of a shared characteristic, e.g. birth year, whilst a panel study is that which in which the sample do not always have a shared characteristic (Mason and Wolfinger 2001). Panel surveys are distinct from cohort studies, as they typically sample from the entire age range and collect repeated measures throughout the life course, whilst cohort surveys often sample an age cohort born in a particular year and follow that cohort at infrequent intervals, often with a focus on early childhood development (Menard 2007). To enable a sequence of events to be established in early

childhood, whilst also enabling change at the individual level to be assessed, birth cohorts were the favoured approach. This enabled the examination of how multiple risk factors of PCRQ and school connectedness 'interacted in concert' in early years to predict the development of alcohol, tobacco and cannabis use at 17 years (Glaser et al. 2010).

3.6.2.2 Consideration of potential data sources

There are many high-quality UK cohort studies which contained data on adolescent use of alcohol, tobacco and cannabis. These included the Millennium Cohort Study (MCS), the British Household Panel Survey (BHPS; British Young Peoples Survey/Understanding Society), the Cambridge Study in Delinquent Development (CSSD), the Edinburgh Study of Youth Transitions and Crime (ESYTC), the Belfast Youth Development Study (BYDS), the Longitudinal Study of Young People in England (LSYPE) and the Avon Longitudinal Study of Parents and Children (ALSPAC). To select the most appropriate data source for this study, a screening criterion was developed (see Appendix 4). The criteria were having assessments of alcohol, tobacco and cannabis use in late adolescence, alongside prior measures of PCRQ and school connectedness. Each cohort study is described as follows.

The Millennium Cohort Study (MCS) is a longitudinal birth cohort study following approximately 19,000 children born in 2000/01 in the UK (England, Wales, Scotland and Northern Ireland). It is one of the UK's most recent birth cohort studies, tracking Millennium children from early childhood to present day. The study is advantageous in that it includes participants from all of the UK and collects data for: parenting; childcare; school choice; child behavior and cognitive development; child and parental health; parents' employment and education; income and poverty;

housing, neighborhood and residential mobility; and social capital and ethnicity (UCL 2018). However, at present, the MCS only has six waves of participant data: 9 months; 3 years; 5 years; 7 years; 11 years; and 14 years (UCL 2018). Due to this study examining use of alcohol, tobacco and cannabis in late adolescence and the MCS not collecting data for those aged 17 years until 2018 (UCL 2018), this was not a suitable source of data for the study.

The British Household Panel Survey (BHPS: British Young Peoples Survey/Understanding Society) is an annual household panel survey of approximately 5,500 nationally representative households, recruited in 1991. It is advantageous in that contains approximately 10,000 participants who are re-interviewed each successive year and still followed if they split from the original household. Similarly, new members joining households in the sample become eligible, with children interviewed when reaching 16 years of age. Since 1994, children aged 11-15 also complete a short interview. In 2009, the BHPS sample was merged with Understanding Society (the UK household Longitudinal Study (UKHLS)). Understanding Society currently contains eight waves of completed data (USOC 2018) and is unique in that it contains an ethnic minority boost (Berthoud et al. 2009). It contains measures on alcohol, tobacco and cannabis use under 18 years of age, alongside parental and school measures in earlier years. However, the school measures are limited in that they do not specifically measure school connectedness, instead focusing upon truancy, homework, parental involvement in education, misbehaviour in school and bullying (USOC 2018b). Therefore, not suitable for this study.

The Cambridge Study in Delinquent Development (CSDD) and the Edinburgh Study of Youth Transitions and Crime (ESYTC) were also dismissed as potential data sources. Although containing childhood

measures, the Cambridge study was dismissed as measures were not available to effectively assess PCRQ and school connectedness. Further, the sample was drawn in 1961 from an inner area of London and comprised of only males (Muncie 2004) which presents problems in terms of generalisability and bias. Although ESTYC is a more recent study, being established in 1998, it was also dismissed for not containing measures of PCRQ and school connectedness, alongside the study only following participants initially over a 5 year period (Aston 2015; ESTYC 2018).

Limited measures of PCRQ and school connectedness were also seen in the Belfast Youth Development Study (BYDS) and Next Steps, the more recent version of the Longitudinal Study of Young People in England (LSYPE). Even though the BYDS is unique in that it is a UK study of adolescent drug use, the study did not start until 2001 and comprised of yearly data collection from approximately 4,000 young people between the ages of 11-12 years of age. As children were aged 11-12 at baseline, no earlier measures of parent child relationships were available. As this is important feature of this study, the BYDS was not a potential data source. Next Steps is also a large study started in 2004 with the yearly data collection from about 16,000 children living in England (UCL 2018b). However, no childhood measures of parent child relationships or school connectedness were available.

The Avon Study of Parents and Children (ALSPAC) was given consideration as it is one of the largest ongoing UK population-based birth cohort studies, established to understand how both genetic and environmental characteristics can influence health and development in children (Fraser et al. 2012). ALSPAC initially enrolled a cohort of 14,541 pregnancies, with 13,973 eligible participants at 1 year. ALSPAC is advantageous in that its scale and richness is unprecedented in epidemiological studies (Fraser et al.

2012), currently containing a total of 33 child completed questionnaires across ages of 65 months to 23 years. Area's covered within the questionnaires, at multiple time points, include parenting, school connectedness and use and hazardous use or a screener for dependency on alcohol, tobacco and cannabis. It collects in depth data on PCRQ and school connectedness in childhood, alongside detailed data on adolescent alcohol, tobacco and cannabis use in addition to dependency. It was selected as the data source for this study.

3.6.2 ALSPAC study methodology

3.6.2.1 History of ALSPAC

ALSPAC contains a core-sample of 14,541 pregnant women who were expected to deliver their infants between April 1 1991 and December 31 1992 from Avon, UK. All were invited to participate in the study, which was set up to collect comprehensive socioeconomic and health related data on a large population sample of new-born children and their parents throughout early pregnancy and childhood. A total of 13,973 singletons and twins who were alive at 1 year and their mothers were eligible for the study, with children now 23 years of age. Since 1991/92 the children's development and health has been followed by collecting genetic and environmental information through questionnaires, clinics and lab-based assessments. At 17 years, a total of 105 postal questionnaires had been administered (19 carer-based, 23 child-based answered by the carer, 24 child-completed, 16 partner-based, nine puberty and 14 school-based). Additionally, since age 7 years, ALSPAC children were annually invited to nine walk-in clinics comprising of computer tasks, individual interviews and focus group interviews (Fraser et al. 2012).

3.6.2.2 ALSPAC attrition

Despite efforts to maintain levels of participation, the number of ALSPAC participants has reduced over time, from 13,973 at baseline to 3,372 at child age 18 years 7 months. Attrition rates throughout the study were greatest when children participants were less than 33 months old and again when they were over 13 years of age (Boyd et al. 2013). Over 9,467 participants have completed at least 10 questionnaires (Fraser et al. 2012). However, at 13 years of age, only 48.2% of 12776 eligible participants had complete data for all 12 waves (Boyd et al. 2013).

3.6.2.3 ALSPAC representativeness

ALSPAC representativeness has been described retrospectively at various time points, using several information sources. In 1991, at child age of under 1 year, comparisons were made between ALSPAC mothers, mother's resident in the Avon area also with a child under 1 year and 1991 UK census data (ALSPAC 2018). Table 4 shows that ALSPAC mothers were more likely than both Avon and UK mothers to live in owner occupied accommodation, have a car, be married and be of white ethnicity. This is similar to all studies where a representative sample has been attempted (ALSPAC 2018).

Table 4: Comparison of UK, Avon and ALSPAC mothers with children less than 1 year old in 1991

Socio-economic characteristic	**UK**	**Avon**	**ALSPAC**
Owner occupier	63.4%	68.7%	79.1%
1+ person/room	30.8%	26.0%	33.5%
Car in household	75.6%	83.7%	90.8%
Married couple	71.8%	71.7%	79.4%
Non-white mother	7.6%	4.1%	2.2%

At child age of 16 years, the sample contained an overrepresentation of young adolescent girls, who performed better in school and had families with a higher socioeconomic status than the UK average (Boyd et al. 2012). Such biases could have had implications for missing data and associated results. This needs to be kept in mind when interpreting study findings.

3.6.2.4 ALSPAC data

ALSPAC has frequent and detailed waves of data, collected regularly from birth to child age 24 years through questionnaires, clinical measures and biological samples (Fraser et al. 2012; Boyd et al. 2013). Data were collected from the child, parent(s)/primary carer and staff at schools attended by ALSPAC children, with data available for ALSPAC children, ALSPAC mothers/main carer and ALSPAC fathers. This study only focused on child, mother/main carer and father completed questionnaires, alongside child attended clinic data. Table 5 presents the details and number of participants at each wave of child completed questionnaires.

Table 6 presents the details and number of participants at each wave of mother/main carer completed questionnaires.

Table 7 presents the detail and number of participants at each wave of partner completed questionnaires, primarily representing the father of the child.

Table 8 presents the details, number of participants and dates of each Focus clinic attended by ALSPAC children.

Table 5: Summary of ALSPAC data collected from child completed questionnaires

Child Completed Questionnaires	File	Time points	N
Your Own Questionnaire	CCA1	65 months	7554
My Second Questionnaire	CCA2	69 months	7521
Your Next Questionnaire	CCA3	73 months	7348
Growing Up	CCA4	77 months	7751
My Questionnaire	CCA5	81 months	6277
Things to do	CCA6	85 months	7426
My Teeth	CCB	91 months	7086
Me and My School	CCC	97 months	7688
Some more about me	CCD	103 months	8223
My World	CCE	110 months	8580
My Hands, My Feet & Me	CCF	115 months	8084
Rings & Things	CCG	122 months	8343
Teeth and Things	CCH	128 months	7827
School Life and Me	CCJ	134 months	7940
Watches and Funny Feelings	CCK	140 months	7544
All Around Me	CCL	145 months	7523
Food and Things	CCM	157 months	7115
Reading and Singing	CCN	157 months	7109
Travelling, Leisure and School	CCP	166 months	6877
Boys'/Girls' Experiences, Thoughts and Behaviour	CCQ	167 months	6160
Life of a Teenager	CCR	169 months	6005
Life of a 16+ Teenager	CCS	198 months	5131
Your Changing Life	CCT	18 years	3372
It's all about you	CCU	20 years	4342
Your Life Now	YPA	21 years	TBC
Life at 22+	YPB	22 years	4026
Me at 23+	YPC	23 years	4233
Year 11 questionnaire for young people	CCXA*	192 months	5439
You and Your Friends	CCXB*	192 months	3132
Internet Use	CCXC*	17.5 years	1584
Plans and aspirations (DCSF)	CCXD*	17.6 years	4500
Gambling	CCXE*	17.5 years	3833
You and Your Body	CCXF*	19.6 years	1944

**Note – collected in a clinic setting, sent to a subgroup or covered in a single research topic.*

Table 6: Summary of ALSPAC data collected from mother/main carer completed questionnaires

Questionnaire[1]	**File**	**Time points (child age)**	**N**
Your Environment	A	Gestation	13548
About Yourself	D	Gestation	12452
Having a Baby	B	Gestation	13194
Your Pregnancy	C	Gestation	12423
Me and My Baby	E	8 weeks	11712
Looking After The Baby	F	8 Months	11213
Caring for a Toddler	G	21 months	10313
Your Health Events and Feelings	H	33 months	9641
Mother's New Questionnaire	J	47 months	9504
Study Mother's Questionnaire	K	61 months	9021
Mother's Lifestyle	L	73 months	8531
Mother and Home	M	85 months	8365
Mother and Family	N	97 months	8011
Mother of a 9 year old	P	110 months	7983
You and your surroundings	Q	122 months	8155
Lifestyle and Health of Mother	R	134 months	7679
Twelve Years On	S	145 months	7099
You & Your Life	T	18 years	4175
You & Your Study Young Person	U	20 years	4471
Your Life in 2013	V	22 years	4669
Adult learning	XA	Not specified	5378
About Eating	XB	Not specified	5661

[1] These are identified as carer questionnaires, but usually completed by the Mother.

Table 7: Summary of ALSPAC data collected from partner completed questionnaires

Questionnaire[2]	File	Time points (child age)	Number
You and Your Environment	PA	Gestation	8624
Partners Questionnaire	PB	Gestation	9960
Being a Father	PC	8 weeks	8353
The Baby and Me	PD	8 months	7101
A Toddler in the House	PE	21 months	6155
Partner's Health Events and Feelings	PF	33 months	5462
Partner's New Questionnaire	PG	47 months	5102
Study Partner's Questionnaire	PH	61 months	4750
Partners' Lifestyle	PJ	73 months	4688
Partner and Home	PK	85 months	4230
Father and Family	PL	97 months	3784
Father of a 9 year old	PM	110 months	3837
Father and Surroundings	PN	122 months	4313
Lifestyle and Health of Partner	PP	134 months	3840
About me	PQ	145 months	3486
Adult learning – partner	PXA		2700

Table 8: Summary of ALSPAC data collected from children attending focus clinics

Clinic	N	Clinic dates	Mean age (years)
Focus @ 7	8290	Sep 1998 – Sep 2000	7.5
Focus @ 8	7488	Oct 1999 – Dec 2001	8.7
Focus @ 9	7722	Jan 2001 – Jan 2003	9.9
Focus 10+	7557	Feb 2002 – Oct 2003	10.7
Focus 11+	7153	Jan 2003 – Jan 2005	11.7
TF1	2095	Feb 2004 – Oct 2004	12.8
TF1 FastTrack	4737	Oct 2004 – Nov 2005	12.8
TF2	6147	Jan 2005 – Sep 2006	13.8
TF3	5515	Oct 2006 – Nov 2008	15.5
TF4	5081	Dec 2008 – June 2011	17.8
Focus 24+	4026	June 2015 – Oct 2017	24

[2] These are identified as partner questionnaires, but usually completed by the Father.

The tables presented illustrate the sample attrition, with additional missing data being present for some variables in each case. This informed the decision to impute missing data, as discussed below in Section 3.6.5. Ethical approval for use of this data was obtained from the ALSPAC Law and Ethics Committee and Cardiff University in June 2013. The ALSPAC project approval and Cardiff University ethical approval are presented in Appendix 5. The proposed specific variable request is presented in Appendix 6.

3.6.3 ALSPAC measures

The measures used for analysis were parent child relationship quality (PCRQ) at 9 years, school connectedness at 11 years, and use of alcohol, tobacco and cannabis at 17 years. A timeline of the predictors, moderators and alcohol, tobacco and cannabis using outcomes are presented in Figure 3. A summary of each measure is presented below.

3.6.3.1 Outcome measures

Six adolescent outcome measures were used in this study:

- Experimental alcohol use;
- Hazardous alcohol use via the Alcohol Use Disorders Identification Test (AUDIT: Babor et al. 2001);
- Experimental smoking;
- Nicotine dependence using the Fagerström test of nicotine dependence (FTND: Heatherton et al. 1991);
- Experimental cannabis use;
- Cannabis dependence using the Cannabis Abuse Screening Test (CAST: Legleye et al. 2007).

All outcome measures were assessed by self-report in the TF4 Focus Clinic (mean age = 17.8 years). This time point was selected as it marks the

transition between adolescence and adulthood, enabling overall measurement of those who passed through substance use initiation in younger years (MacArthur et al. 2012). The total sample at this time point was 5,081, but the sample size for each outcome vary due to missing data. Other illicit drug types were considered, but the number of participant's reporting use were too small to generate precise estimates, as shown in Table 9.

Table 9: Illicit drugs used at 17 years of age

Drug Type	N	Yes	%	No	%
Cocaine	3317	292	8.8	3025	91.2
Crack	3312	32	1.0	3280	99.0
Amphetamines	3310	329	9.9	2981	90.1
Hallucinogens	3309	227	6.9	3082	93.1
Opioids	3306	55	1.7	3251	98.3
Other stimulants	3311	192	5.8	3119	94.2
Other	2624	92	3.5	2532	96.5

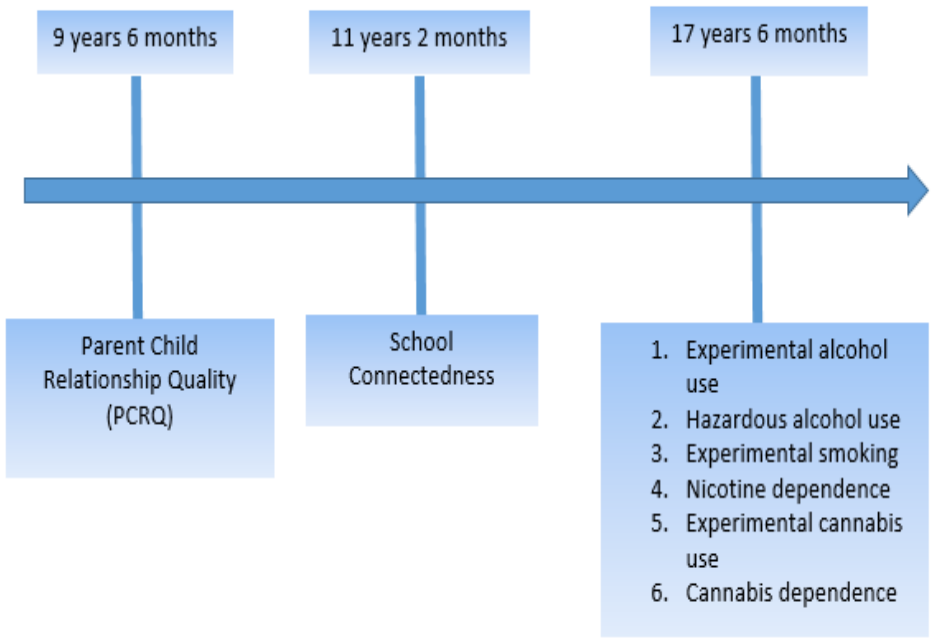

Figure 3: Timeline of main variables

Experimental alcohol use

Experimental alcohol use was assessed by asking participants 'Have you ever had a whole alcoholic drink?' A whole alcoholic drink was defined as a can of beer, a glass of wine, a bottle of alcopop or a shot of spirits (vodka, gin, etc). Responses were dichotomous, Yes = 1, No = 2. This was recoded so participants answering 'No' were assigned a score of zero and classified as non-users. Data were provided by 4,196 participants.

Hazardous alcohol use

For respondents answering 'Yes' to having ever had a whole alcoholic drink, hazardous alcohol use was assessed by self-report on all ten items of the Alcohol Use Disorders Identification Test (AUDIT: Babor et al. 2001). AUDIT is a validated screening tool, sensitive to early detection of hazardous and harmful drinking (Knight et al. 2003; Lima et al. 2005; Ronald et al. 2006; Reinert and Allen 2007). Table 10 presents the 10 AUDIT items, response categories and associated scores. AUDIT contains three questions on alcohol consumption (Q's 1 to 3), three questions on drinking behaviour and dependence (Q's 4 to 6) and four questions on the drinking related problems (Q's 7 to 10). Previous ALSPAC studies have used this measure to assess adolescent problem drinking (MacArthur et al. 2012; Heron et al. 2013; Kretschmer et al. 2014; Stapinski et al. 2016). A total of 3,852 respondents answered all 10 items of AUDIT questionnaire. Participants answering no to the stem question on alcohol use were excluded from this analysis.

Table 10: The ten individual items of the Alcohol Use Disorders Identification Test (AUDIT: Babor et al. 2001)

Item	Variable	Description	Scoring System
1	FJAL1000	How often do you have a drink containing alcohol?	0 = Never 1 = Monthly or less 2 = 2-4 times per month 3 = 2-3 times per week 4 = 4+ times per week
2	FJAL1050	How many standard drinks do you have on a typical day when you are drinking?	0 = 1-2 1 = 3-4 2 = 5-6 3 = 7-9 4 = 10+
3	FJAL1100	How often do you have six or more standard drinks on one occasion?	0 = Never 1 = Less than monthly 2 = Monthly 3 = Weekly 4 = Daily or mostly daily
4	FJAL1150	How often during the last year have you found that you were not able to stop drinking once you had started?	0 = Never 1 = Less than monthly 2 = Monthly 3 = Weekly 4 = Daily or mostly daily
5	FJAL1350	How often during the last year have you failed to do what was normally expected of you because of drinking?	0 = Never 1 = Less than monthly 2 = Monthly 3 = Weekly 4 = Daily or mostly daily
6	FJAL1400	How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	0 = Never 1 = Less than monthly 2 = Monthly 3 = Weekly 4 = Daily or mostly daily
7	FJAL1450	How often during the last year have you had a feeling of guilt or remorse after drinking?	0 = Never 1 = Less than monthly 2 = Monthly 3 = Weekly 4 = Daily or mostly daily
8	FJAL1550	How often during the last year have you been unable to remember what	0 = Never 1 = Less than monthly 2 = Monthly

		happened the night before because you had been drinking?	3 = Weekly 4 = Daily or mostly daily
9	FJAL1900	Have you or someone else been injured because of your drinking?	0 = No 2 = Yes, but not in the last year 4 = Yes, during the last year
10	FJAL1950	Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	0 = No 2 = Yes, but not in the last year 4 = Yes, during the last year

The internal consistency of the ten AUDIT items was acceptable ($\alpha = 0.78$). A total AUDIT score was calculated summing the responses to each individual test item. Scores typically ranged from 0 to 40, with a mean score of 7.92 (SD = 4.74). AUDIT guidance suggests that scores of 1-7 represent harmless drinking, 8-15 hazardous drinking and 16-40 harmful drinking. Harmless being that which poses no concern, harmful being that which results in physical or psychological harm, and hazardous being that which places the user person at risk of physical or psychological harm (Babor et al. 2001). However, due to the distribution of scores presenting an approximately normal distribution (see Figure 4) and the low number of participants presenting as harmful drinkers, this was treated as a continuous measure.

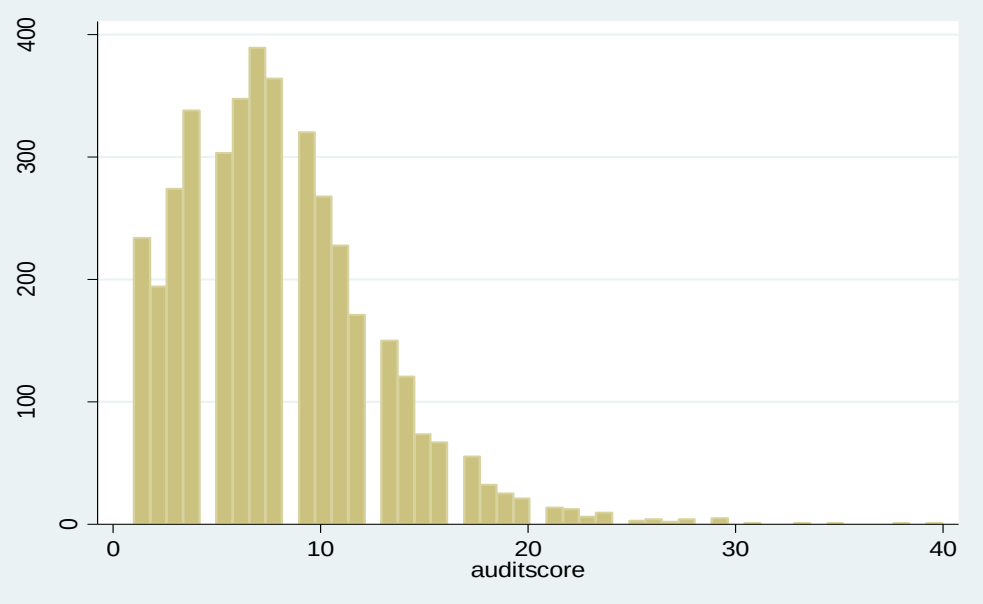

Figure 4: Participant responses to the AUDIT questionnaire (n=3,852)

Experimental smoking

Experimental smoking was assessed by asking participants '*Have you ever smoked a cigarette (or roll up)*?' Responses were binary: (1) Yes (0) No. For analyses, this was recoded so that No = 0 and Yes = 1. Participants answering 'No' were classified as the non-smokers. Data were provided by 4,200 participants.

Nicotine dependence

For young people answering 'Yes' to the stem question '*Have you ever smoked a cigarette/roll-up'*, nicotine dependence was measured using the Fagerstrom Test for Nicotine dependence (FTND: Heatherton et al. 1991). The FTND is a 6 item standard instrument used for assessing nicotine dependence and demonstrates acceptable levels of construct and discriminant validity (Japuntich et al. 2009). The FTND has been used to assess nicotine dependence amongst adolescents and young adults (Brook

et al. 2009; Pahl et al. 2010) and has been used with ALSPAC participants (Kennedy et al. 2017; Taylor et al. 2017).

Table 11 presents the six individual test items and the associated response scores of participants. Overall, the measure had good internal consistency ($\alpha = 0.755$). A total FTND score was calculated through summing the six individual item responses. FTND guidance suggests scores 1-2 indicate low nicotine dependence, 3-4 indicate low to moderate dependence, 5-7 indicate moderate dependence and 8-10 indicate high dependence.

The distribution of total FTND scores were seen to present a non-normal distribution, with a very low number of participants who were low-moderate, moderate or high nicotine dependent. To overcome this issue, nicotine dependence was measured as a dichotomous variable. Other studies have used a cut point of 5 to assess nicotine dependence in adolescence using the FTND (Brook et al. 2009; Cornelius et al. 2012). This cut point was used and participants scoring <5 were assigned a score of 0 (not nicotine dependent) and participants scoring >= 5 were assigned a score of 1 (nicotine dependent).

A total of 521 respondents answered all 6 items of the Fagerstrom Test for Nicotine Dependence (Heatherton et al. 1991). Participants answering no to the stem question on smoking were excluded from the analysis. Given the small sample size in comparison to those reporting having ever smoked, data was checked and the number of participants was restricted due to missing data in response to FJSM400: “How many cigarettes a day do you smoke?” This sample size was accepted.

Table 11: The six individual items of the Fagerstrom Test for Nicotine Dependence (FTND: Heatherton et al. 1991)

Item	Variable	Description	Scoring System
1	FJSM550	How soon after you wake up do you smoke your first cigarette?	1 = 31 – 60 minutes 2 = 5 – 30 minutes 3 = Within 5 minutes
2	FJSM600	Do you find it difficult to refrain from smoking in places where it is forbidden (e.g. in church, buses, trains, the library, cinemas)?	0 = No 1 = Yes
3	FJSM650	Which cigarette would you hate most to give up?	0 = Any other 1 = The first in the morning
4	FJSM400	How many cigarettes a day do you smoke?	0 = 10 or less 1 = 11 – 20 2 = 21 – 30 3 = 31 or more
5	FJSM700	Do you smoke more frequently during the first hours after waking than during the rest of the day?	0 = No 1 = Yes
6	FJSM750	Do you smoke if you are so ill that you are in bed most of the day?	0 = No 1 = Yes

Experimental cannabis use

Experimental cannabis use was assessed by asking participants '*have you ever tried cannabis (also called marijuana, hash, dope, pot, blow, skunk, puff, grass, draw, ganja, joints, smoke, weed)?*' Responses were dichotomous, Yes = 1, No = 2. This was recoded so participants answering 'No' were assigned a score of zero and classified the non-cannabis users. Data were provided by 4,158 participants.

Cannabis dependence

For respondents answering 'Yes' to having ever used cannabis, cannabis dependence was measured by self-report on all six items of the Cannabis Abuse Screening Test (CAST: Legleye et al. 2007). CAST is a screening tool used for clinical diagnosis (EMCDDA 2008) but also widely used in general population surveys (Legleye et al. 2007). It has further been used in prior ALSPAC studies to assess cannabis abuse in adolescence (Kennedy et al. 2017).

The internal consistency of the six CAST items was acceptable ($\alpha = 0.87$). Participants answering no to the stem question of ever used cannabis were excluded from this analysis. Only 1,165 participants provided data on all six CAST items. Given this small number of participants, data was checked in terms of the stem question. However, the number of participants was representative of the population of adolescents who had tried cannabis.

Table 12 presents the individual items and associated response scores for participants. A total CAST score was calculated by summing responses to each individual item. Scores ranged from 0 to 24. CAST guidance suggest scores of less than 3 indicate no addiction risk, 3-6 indicates low addiction risk and scores of 7+ indicate high addiction risk (Spilka et al. 2013). The distribution of total CAST scores presented a non-normal distribution, with a very low number of participants who were of addiction risk. Thus, cannabis abuse was measured as a dichotomous variable, with a cut-off score of 3: participants scoring <= 2 were assigned a score of 0, 'no addiction risk'; those scoring =>3 were assigned a score of 1, 'addiction risk'. This cut off score was selected in accordance with recommendations of optimal measurement by Legleye et al. (2011).

Table 12: The six individual items of the Cannabis Abuse Screening Test (CAST: Legleye et al. 2007)

Item	Variable	Description	Scoring system
1	FJDR1000	Have you ever smoked cannabis before midday?	0 = Never 1 = Rarely 2 = Sometimes 3 = Quite often 4 = Very often
2	FJDR1050	Have you smoked cannabis when you were alone?	0 = Never 1 = Rarely 2 = Sometimes 3 = Quite often 4 = Very often
3	FJDR1100	Have you had memory problems when you smoked cannabis?	0 = Never 1 = Rarely 2 = Sometimes 3 = Quite often 4 = Very often
4	FJDR1150	Have friends or family members told you that you ought to reduce your cannabis use?	0 = Never 1 = Rarely 2 = Sometimes 3 = Quite often 4 = Very often
5	FJDR1200	Have you tried to reduce or stop your cannabis use without succeeding?	0 = Never 1 = Rarely 2 = Sometimes 3 = Quite often 4 = Very often
6	FJDR1250	Have you ever had problems because of your cannabis use (argument/fight/accident/bad result at school etc)?	0 = Never 1 = Rarely 2 = Sometimes 3 = Quite often 4 = Very often

3.6.3.2 Exposure: Parent child relationship quality

Parent child relationship quality (PCRQ) was assessed with ten items from the child-completed CCF questionnaire, obtained by self-report at 9 years of age (115 months). Table 13 presents the ten individual items, response

options and scores. Notably, this is not a validated measure of PCRQ but items were selected *a priori* based upon other studies which have examined this concept (see Chapter 4). All items were ordinal, asking participants to indicate their level of agreement with each statement. Response options were 1= not true, 2=mostly untrue, 3= partly true, 4=mostly true and 5= true. Two items were reverse scored: “I can't do anything right” and “I have a parent who is usually unhappy or disappointed with what I do”. Response options for these two items were recoded (5=1, 4=2, 3=3, 2=4, 1=5). The internal consistency of the ten items was $\alpha = 0.63$.

A total score for all items was calculated, whereby higher scores were indicative of higher levels of PCRQ. There is no requirement for normality of an independent variable (Spicer 2005), with this item treated as a continuous measure for analyses.

3.6.3.3 School connectedness

Thirty-nine items about school related experiences were included in the CCJ child self-report questionnaire ‘School life and me’ at 11 years of age (134 months). The questions asked participants to indicate their level of agreement with statements on school experiences. Responses were ordinal, measured on a four-point likert scale (1 = agree, 2 = mostly agree, 3 = mostly disagree, 4 = disagree). The thirty-nine items were selected *a priori* in accordance with the measurement of self-reported school experience used by Kidger et al. (2015). This measure has previously been used to assess school experiences, including connectedness to school (Kidger et al. 2015).

Table 13: PCRQ questionnaire items

Item	Variable	Description	Scoring system
1	ccf104	I have a parent who understands me	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True
2	ccf111	I have a parent who is usually unhappy or disappointed with what I do	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True
3	ccf118	I have a parent I like	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True
4	ccf125	I have a parent who likes me	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True
5	ccf133	If I have children of my own, I want to bring them up like I have been brought up	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True
6	ccf141	I have a parent who I spend a lot of time with	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True
7	ccf149	I have a parent who is easy to talk to	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True
8	ccf157	I have a parent I get along well with	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True
9	ccf160	I can’t do anything right	1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true

10	ccf165	I have a parent who I have a lot of fun with	5= True 1= Not true 2= Mostly untrue 3= Partly true 4=Mostly true 5= True

To reduce the 39 items used to assess school experiences, including connectedness to school, Kidger et al. (2015) undertook a factor analysis to identify a smaller group of key exposure variables which were distinct for each other. A rotated solution with six factors was an adequate fit (comparative fit index [CFI]=0.962, Tucker– Lewis index [TLI]=0.949, root mean square error of approximation [RMSEA]=0.046), but three of these factors were discarded. One for having only two items assessing schoolwork appraisal. Another for examining school related feelings and possibly being confounded by emotional state. The other for only having items which were a subset of those loaded on to another factor. The three factors retained were 'connectedness to school/other students', 'enjoyment of school' and 'clear/fair boundaries'. For each factor, only the two items loading most heavily were used to aid identification of specific aspects of the school experience (Kidger et al. 2015).

For this study, school connectedness was measured using the factor 'connectedness to school/other students' as identified by Kidger et al. (2015). The two items loading most heavily onto this factor were used for analysis: (1) 'school is a place where I am popular with other pupils'; and (2) 'school is a place where other pupils accept me for who I am'. These were labelled: (1) popular in school; and (2) accepted in school. Table 14 shows the variable identifier and response options for each item.

For analyses, each school connectedness item was examined as both an exposure variable and a moderator variable. This was in accordance with the study aims.

Table 14: School connectedness questionnaire items

Variable	Description	Label	Scoring system
ccj133	Child's school is a place where they are popular with other pupils	Popular in school	1 = agree 2 = mostly agree 3 = mostly disagree 4 = disagree
ccj105	Child's school is a place where other pupils accept them for who they are	Accepted in school	1 = agree 2 = mostly agree 3 = mostly disagree 4 = disagree

As an exposure variable, each item was transformed into a dichotomous variable, using the median score as the cut-off point. Across all six data sets (e.g. experimental alcohol use, hazardous alcohol use, experimental smoking, nicotine dependence, experimental cannabis use and cannabis dependence), 'popular in school' had a median score of 2, encompassing participants who both agreed (1) and mostly agreed (2). Participants with a score of <=2, were assigned to the category 'agree' and given a score of 0. Participants answering >2 were assigned to the category 'disagree' and given a score of 1. 'Accepted in school' had a median score of 1, encompassing participants who agreed (1). Participants with a score <=1 were assigned to the category 'agree' and given a score of 0. Participants with a score of >1 were assigned to the category 'disagree' and given a score of 1.

To assess moderation, using the approach recommended by Aiken and West (1991), two interaction terms were created whereby each dichotomous school connectedness measure was multiplied with PCRQ:

PCRQ * popular at school

PCRQ * accepted at school

These interaction terms assessed whether the association between PCRQ varied (moderated) according to whether participants felt popular at school or whether they felt accepted in school.

Notably, the two measures of school connectedness, being popular in school and being accepted in school, could be argued to be a proxy of peer group influences. This could have strengthened observed effects for school connectedness at 11 years of age and subsequent use of alcohol, tobacco or cannabis in late adolescence. Despite this limitation, the two measures were accepted for the study design as aforementioned, they were the two items which loaded most heavily onto the 'connectedness to school/other students' as identified by Kidger et al. (2015). Further they enabled comparisons to be drawn to previous studies of school connectedness with ALSPAC data.

3.6.3.4 Confounders

Confounders are a major concern as they can produce spurious estimations of exposure effects (McNamee 2005). In the extreme, an association can be suggested, when none exists, or alternatively a true effect is concealed. To produce "adjusted" estimates of the effect of exposure within the analysis (McNamee 2005), confounders which had previously been linked with adolescent substance misuse were identified *a priori*. For all six analyses, confounders were: gender; ethnicity; social class; mother's highest educational qualification; and behavioural difficulties. Data on these variables were collected during pregnancy and birth, with the exception of behavioural difficulties, which was assessed at 8 years of age.

Parental substance use confounders were also included in this study. These were: maternal alcohol use at 1 year 9 months and 9 years; maternal cigarette use at 1 year 9 months; maternal cannabis use at 6 years; paternal alcohol use at 1 year 9 months and 9 years; paternal cigarette use at 1 year 9 months; and paternal cannabis use at 9 years. Notably, only the variables specific to the substance using outcome were used within statistical models, e.g. outcome of ever smoked and nicotine dependence only controlled for maternal cigarette use at 1 year 9 months and paternal cigarette use at 1 year 9 months. A number of the confounding variables needed recoding due to small number of participants responding in some categories for some items. Table 15 presents each individual confounder, the time of assessment, the original response categories and the recoded response categories.

3.6.4 Limitations of using ALSPAC DATA

Some issues surrounded the use of ALSPAC data. Firstly, issues presented through using the FTND to assess nicotine dependence and the CAST to assess cannabis abuse. The use of the FTND was limited due to the small sample size answering all six items of the scale (n=521) in comparison to those who reported ever smoking a whole cigarette (or roll up) (n=4,200). The CAST presented similar limitations with a smaller sample size answering all six items of the scale (n=1,165) in comparison to those who reported ever trying cannabis (n=4,158). Therefore, the reduced sample sizes had potential implications for reduced statistical power when analysing both nicotine dependence and cannabis abuse.

Secondly, although self-report has been criticised for recall and social desirability biases (Kelly et al. 2011a; 2011b; Visser et al. 2013; Trucco et al. 2014; Wang et al. 2015), adolescents have been found to be accurate reporters of their own alcohol, tobacco and cannabis using behaviours (Dekovic et al. 2006 cited in Ohannessian et al. 2016). Further, adolescent reports of alcohol and tobacco use have been found to have high test–retest validity (Winters et al. 1991) and are a valid method for measuring these behaviours (Del Boca and Darkes 2003 cited in Visser et al. 2013).

Thirdly, issues presented through participant attrition whereby the majority of participants did not participate in all waves of data collection, instead favouring to complete single measures (Boyd et al. 2013). Specifically, at the TF4 focus Clinic, 11,351 cohort members were invited to attend but only 6,147 participated. Those participants who participated in the TF4 focus clinic, additional missing data was present for some individual responses. So, approximately half of the data set was missing. Missing data is unavoidable in long-term longitudinal studies (Sterne et al. 2009; Boyd et al. 2012; Fraser et al. 2012) and this has implications for loss of statistical precision and power (Sterne et al. 2009). To deal with missing data, Sterne et al. (2009) suggests using multiple imputation as this can remove the loss of information and bias which occurs in analyses restricted to complete case data (Spratt et al. 2010). It involves estimates being provided for the missing values through ”*creating several different plausible imputed data sets and appropriately combining results obtained from each of them*” (Sterne et al. 2009).

Table 15: Full description of covariates used in analysis, including original response options and recoding structure

Variable[3]	**Description**	**Child Age** ***Years*** ***Months***	**Response options and recoding of variables**			
			Original response	Recoding	New response categories	New response scores
Kz021	Gender	Birth	1= Male 2 =Female			
c804	Child's ethnic group	Gestation	1=White 2=Non-white	1=1 2=0	White Non-white	1 0
c645a	Mum's highest educational qualification	Birth	1=CSE 2=Vocational 3=O level 4=A Level 5=Degree			
c755	Maternal Social Class	Gestation	1= I 2= II 3= III (manual) 4= III (non-manual) 5= IV 6= V 6s=Armed forces	1=0 2=0 3=1 4=1 5=2 6=2 6s=2	I & II III (manual & non-manual) IV, V & armed forces	0 1 2

[3] Variable names are case sensitive.

j556f	Total Behavioural Difficulties Score	8 years	N/A			
pe410	Maternal alcohol consumption	1yr 9m	1= Never drinks alcohol 2= Very occasionally drinks 3= Occasionally drinks 4= 1-2 glasses per day 5= 3-9 glasses per day 6= 10+ glasses per day			
pm3190	Maternal alcohol consumption	9 years	1= Never 2 = < Once a week 3 = >= Once a week 4 = 1-2 glasses, nearly everyday 5 = 3-9 glasses every day 6 = 10+ glasses a day 9 = Don't know	1=0 2=1 3=2 4=3 5=3 6=3 9=.	Never < Once a week >= Once a week Daily	0 1 2 3
g750	Paternal alcohol consumption	1yr 9m	1= Never drinks alcohol 2= Very occasionally drinks 3= Occasionally drinks 4= 1-2 glasses per day 5= 3-9 glasses per day 6= 10+ glasses per day			
p3190	Paternal alcohol consumption	9yr	1= Never 2 = < Once a week 3 = >= Once a week 4 = 1-2 glasses, nearly everyday	1=0 2=1 3=2 4=3	Never < Once a week >= Once a week Daily	0 1 2 3

			5 = 3-9 glasses every day 6 = 10+ glasses a day 9 = Don't know	5=3 6=3 9=.		
g820	No. of cigarettes mother smokes per day	1yr 9m	0= None 1= 1-4 5= 5-9 10=10-14 15=15-19 20=20-24 25= 25-29 30= >30			
g649	No. of cigarettes partner smokes per day	1yr 9m	0= None 1= <10 2= 10-19 3= 20+			
l3042	Frequency mother has taken cannabis since study child's 5th birthday	73m	1= Every day 2= Often 3 =Sometimes 4 =Not at all 5 = Once Only	1=1 2=1 3=1 4=0 5=1	No Yes	0 1
pm1052	Frequency father has taken cannabis in last 2 years	9yr	1= Every day 2= Often 3= Sometimes 4 =Not at all	1=1 2=1 3=1 4=0	No Yes	0 1

3.6.5 Statistical methods

3.6.5.1 Multiple imputation

Multiple imputation involves predicting missing values from participants' data (Sterne et al. 2009; Jackobson et al. 2017). This is to address the possibility that missingness is not generated at random, and to restrict analysis only to participants with complete data, may result in selection bias (Jackobson et al. 2017). Prior to undertaking multiple imputation, consideration has to be given to three mechanisms which cause missing data. This is whether data is: missing completely at random (MCAR); missing at random (MAR); and missing not at random (MNAR) (Rubin 1976; Little and Rubin 2000). For multiple imputation to ensue, missing data has to be either MCAR or MAR (Sterne et al. 2009).

In this study, missing data across the six ALSPAC samples may have been caused by the observed data, with sample demographics of those dropping out of each sample being no different to those retained. Thus, data was hypothesized to be missing at random (MAR). Within each sample, complete outcome data was available as follows:

- Ever drank a whole alcoholic drink, 4,196 individuals;
- Problematic alcohol use, 3,852 individuals;
- Ever smoked, 4,200 individuals;
- Nicotine dependence, 512 individuals;
- Ever used cannabis, 4,158 individuals; and
- Cannabis abuse, 1,165 individuals.

Data was imputed only amongst participants with complete outcome data due to suggestions that missing outcome data are more likely to be NMAR (Sterne et al. 2009). This took the form of three distinct phases, imputation, analysis and pooling, all within the STATA 13 ice package

(Royston 2007), for each of the six samples. The variables included in each multiple imputation prediction model included PCRQ, school connectedness, the outcome of interest and the confounders as aforementioned. For each sample, twenty datasets were imputed, analyses conducted and then pooled using Rubin's rules (Rubin 1976). This approach sought to increase the validity of study findings and to minimise the loss of precision and power caused by missing data (Sterne et al. 2009).

3.6.5.2 Moderation analyses

In this study, moderation was investigated by following the guidelines of Kenny (2018). This involved the creation of a new variable which was the product of an interaction between PCRQ (X) and the first school connectedness hypothesized moderator (e.g. popular in school (M)). The interaction term (PCRQ * popular in school (XM)) was then entered into the regression model after the main effects for each outcome (Y). This enabled the variability in Y above and beyond the two additive effects of each independent variable to be observed and provided insight as to how the two independent variables jointly (PCRQ * popular in school (XM)) predicted the six outcomes. If the effect of interaction was significant, then the effect of X on Y was either increased or reduced dependent upon the levels of M. All moderation analyses were re-run using the second school connectedness hypothesised moderator (e.g. accepted in school (W)). The interaction term entered into this regression model was PCRQ * accepted in school (XW).

3.6.5.3 Analytical models

There were six separate analytical models for this study, one for each outcome measure:

1. Experimental alcohol use
2. Hazardous alcohol use
3. Experimental smoking
4. Nicotine dependence
5. Experimental cannabis use
6. Cannabis dependence

Experimental and hazardous alcohol use

For the experimental alcohol use outcome, three separate logistic regression analyses were used to examine:

1. Whether PCRQ at 9 years predicted experimental alcohol use at 17 years.
2. Whether school connectedness at 11 years predicted experimental alcohol use at 17 years.
3. Whether high or low levels of school connectedness interacted with PCRQ to moderate associations between PCRQ and experimental alcohol use (see Figure 5).

Each analysis contained 8 separate models. The 8 models of analyses 1[4] were:

1. PCRQ (IV) and experimental alcohol use (DV).
2. PCRQ (IV), *covariates* and experimental alcohol use (DV).
3. Popular in school (IV) and experimental alcohol use (DV).
4. Popular in school (IV), *covariates* and experimental alcohol use (DV).
5. PCRQ (IV), popular in school (IV) and experimental alcohol use (DV).
6. PCRQ (IV), popular in school (IV), *covariates* and experimental alcohol use (DV).
7. PCRQ (IV), popular in school (IV), PCRQ * popular in school (M) and experimental alcohol use (DV).
8. PCRQ (IV), popular in school (IV), PCRQ * popular in school (M), *covariates* and experimental alcohol use (DV).

The second analyses run the 8 separate models, but the variable popular in school was replaced with the variable accepted in school. This was both as an independent variable and for the interaction term: PCRQ * accepted in school.

The third analyses run the 8 separate models again but included both school connectedness measures. These were modelled as two independent variables and two interaction terms: PCRQ * popular in school; and PCRQ * accepted in school. These models tested whether high and low levels of school connectedness interacted with PCRQ to moderate associations between PCRQ and experimental alcohol use, with and without the inclusion of covariates (see Figure 5). Covariates in all models were:

[4] IV = Independent Variable
DV = Dependent Variable
M = Moderator

gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years of age, paternal drinking at 1 year 9 months and paternal drinking at 9 years of age.

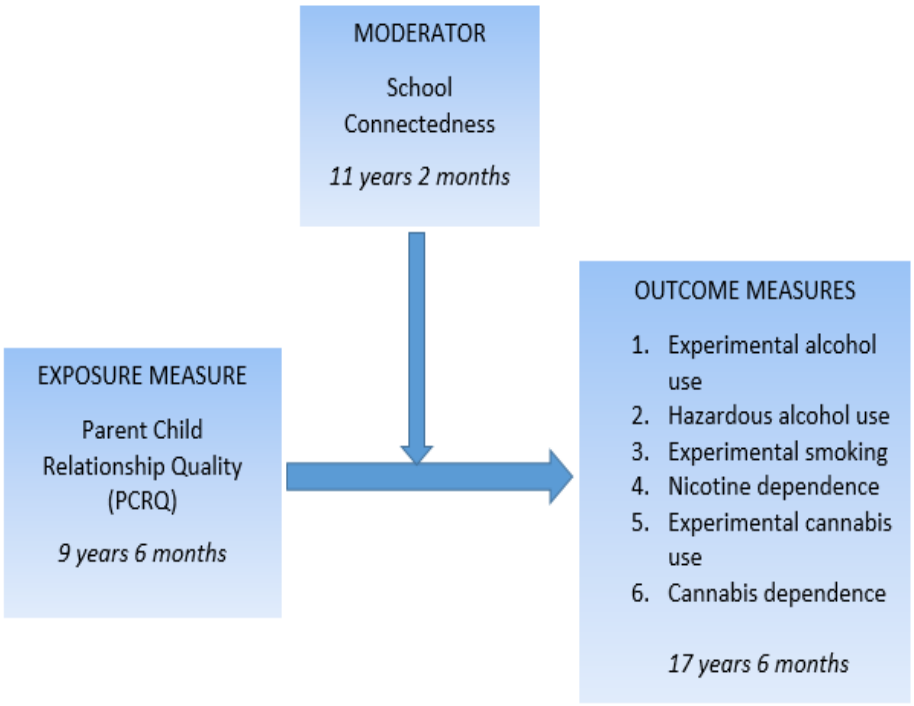

Figure 5: Moderation model of school connectedness upon associations between PCRQ and study outcomes

For the outcome hazardous alcohol use, three separate linear regression analyses were used. The questions framing the analysis and the analytical models remained the same, but the outcome experimental alcohol use was replaced with hazardous alcohol use as assessed by total AUDIT score. Covariates in all models were the same as those for experimental alcohol

use and included gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years. Prior to analyses, data were tested against linear regression test assumptions (see Appendix 7).

Experimental smoking and nicotine dependence

For the outcome experimental smoking, three separate logistic regression analyses were again used examine:

1. Whether PCRQ at 9 years predicted experimental smoking at 17 years.
2. Whether school connectedness at 11 years predicted experimental smoking at 17 years.
3. Whether high or low levels of school connectedness interacted with PCRQ to moderate associations between PCRQ and experimental smoking (see Figure 5).

Each analysis contained eight separate models, as detailed in section 3.9.3.1 but replaced experimental alcohol use with experimental smoking. For nicotine dependence, the same questions and models were used but replaced experimental smoking with nicotine dependence. Covariates in the models were: gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months and paternal smoking at 1 year 9 months.

Experimental cannabis use and cannabis dependence

For the outcome experimental cannabis use, three logistic regression analyses were used to examine:

1. Whether PCRQ at 9 years predicted experimental cannabis use at 17 years.

2. Whether school connectedness at 11 years predicted experimental cannabis use at 17 years.
3. Whether high or low levels of school connectedness interacted with PCRQ to moderate associations between PCRQ and experimental cannabis use (see Figure 5).

For consistency, each analysis contained the eight separate models described in section 3.9.3.1 but replaced the outcome experimental alcohol use with experimental cannabis use. To assess cannabis dependence, the same questions and models were again used but replaced the outcome experimental cannabis use with cannabis dependence. Covariates in all models were: gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal cannabis use at 5 years of age and paternal cannabis use at 9 years of age.

3.7 Ethical considerations

All ethical considerations associated to ALSPAC data are dealt with by the ALSPAC Ethics and Law Committee (IRB00003312) and the Research Ethics Committee of Cardiff University. As aforementioned, full consent to undertake this study was obtained and the associated documentation is presented in Appendix 5 and 6 respectively. Prior to obtaining consent, agreement was made to not disseminate any identifying or confidential individual information, not to use the data to obtain information on an identifiable individual, not attempting to identify an individual, storing data on secured hardware and password locked files, and gaining ALSAPC approval for any associated publications. All conditions have been adhered to and dealt with to the satisfaction of the ALSPAC ethical committee. No issues were arising in terms of informed consent, right to withdraw and researcher safety as this study analysed secondary data.

3.8 Summary and implications for this thesis

This chapter presented the methodologies used in this thesis: systematic reviews using the PRISMA checklist; and multivariate regression models. The next two chapters present the results of the systematic reviews.

Chapter 4: Systematic reviews examining the association of parent child relationship quality with adolescent alcohol, tobacco and cannabis use

4.1 Chapter overview

This chapter presents the results from three systematic reviews. The reviews examined the association between parent child relationship quality (PCRQ) with the development of adolescent alcohol, tobacco and cannabis use, respectively. This chapter presents each review in succession, detailing the review specific research question(s), background, methodology, results, discussion and conclusion. By way of closing, this chapter describes the implications of all three reviews for the remaining chapters of this thesis.

4.2 Systematic review 1: parent-child relationship quality and the development of adolescent alcohol use

4.2.1 Research question

The first review focused specifically on one research question:

1. Is the quality of parent child relationships associated with the experimental and hazardous levels of alcohol consumption in adolescence?

4.2.2 Background

Visser et al. (2012) reviewed longitudinal cohort studies examining associations between PCRQ and changes in adolescent alcohol use, published between 1985 and July 2011. Twenty-eight studies were included in the review, with methodological quality of each study assessed against six domains of potential bias: (1) study participation; (2) study attrition; (3) predictor measurement; (4) outcome measurement; (5) confounding measurement; and (6) analysis (Hayden et al. 2006). Only 9 of

the 28 studies were found to be of high quality (32%), with the remaining 19 (68%) presenting risk for one or more sources of bias. Overall, the majority of studies found no significant association between PCRQ and adolescent alcohol use (n=16). Only five studies reported negative PCRQ as associated to higher levels of alcohol use and seven studies reported an association but only for certain subgroups (i.e. boys, girls, or specific ages). Of the five studies reporting an association between PCRQ and alcohol use, none were of high methodological quality. Thus, there was only weak evidence available for a prospective association between PCRQ and adolescent alcohol use.

The review of Visser et al. (2012) was advantageous in that it evaluated the methodological quality of included studies. It also presented consistent research findings upon associations between PCRQ and alcohol use. This review did not seek to replicate the findings of Visser et al. (2012), but instead used the eligibility criteria and methods used by Visser et al. (2012) to update the review and include studies published between July 2011 and December 2016.

4.2.3 Methodology

The methods used for this systematic review are detailed in section 3.5.2. The electronic search strategy, exclusion criteria and screening of full papers were tailored as follows.

Electronic search: Six electronic databases (e.g. Ovid Medline, PsycINFO (PI), ASSIA, ERIC, Web of Science and SCOPUS) were searched from July 2011 up to December 2016, using the keywords presented in Table 16. These date limits were imposed on the search to avoid replication of the studies identified by Visser et al. (2012) and to extract more recent evidence. The specific search terms used are presented in Appendix 2.

Exclusion criteria: Papers were excluded if they focused upon: adult populations; multiple risk behaviours; clinical/vulnerable populations; had a cross sectional design; or were not printed in English. Papers were also excluded if they did not focus upon children and/or adolescents, PCRQ and alcohol use. Table 17 presents the full exclusion criteria.

Screening of full papers: Full papers were read in detail and excluded according to the criteria outlined above. This is illustrated in Figure 6.

Table 16: Specification of search parameters for PCRQ and adolescent alcohol use

Operator	**Definition**
# 1 Keywords	Parent* OR famil* OR child*
# 2 Keywords	longitudinal OR cohort OR prospective OR follow up
# 3 Keywords	TI ("alcohol*" OR "drink*" OR "binge")
# 4 Boolean operator	#1 AND #2 AND #3
#5 Limits language	English
#6 Limits subjects of studies	Humans AND (adolescen* OR child* OR teenager OR youth OR young OR student OR pupil)
#7 Limits kind of studies	Peer reviewed
#8 Limit years	July 2011 – present
#9 Boolean operator	#4 AND #5 AND #6 AND #7 AND #8
#10 Selection	Removal of duplicates and manual exclusion of articles not meeting inclusion criteria

Table 17: Exclusion criteria specific to the systematic review examining PCRQ and adolescent alcohol use

	Include	Exclude
Population	At first assessment aged<18 years Has to be of school age and/or attended school	Young people 18 and over Clinical/psychiatric samples Criminal samples Teenage sexuality and pregnancy Samples focusing on those with special educational needs
Exposure	PCRQ Elements of PCRQ including parental attachment, family bonds, parent-child conflict	Family mechanisms PCRQ which primarily focuses on the wider family and not parents Sibling relationships Parental supervision Parental monitoring Parental rules Parental attitudes to use Parental rules on alcohol use Parental responsibility Family meals
Outcome	Alcohol Drinking Binge drinking Experimental drinking Sip of alcoholic beverage	Attitudes towards alcohol use Perceptions towards alcohol use Alcohol related violence Drink driving (DUI) Risk behaviour(s) Intention to drink College/freshman drinking Drinking cultures

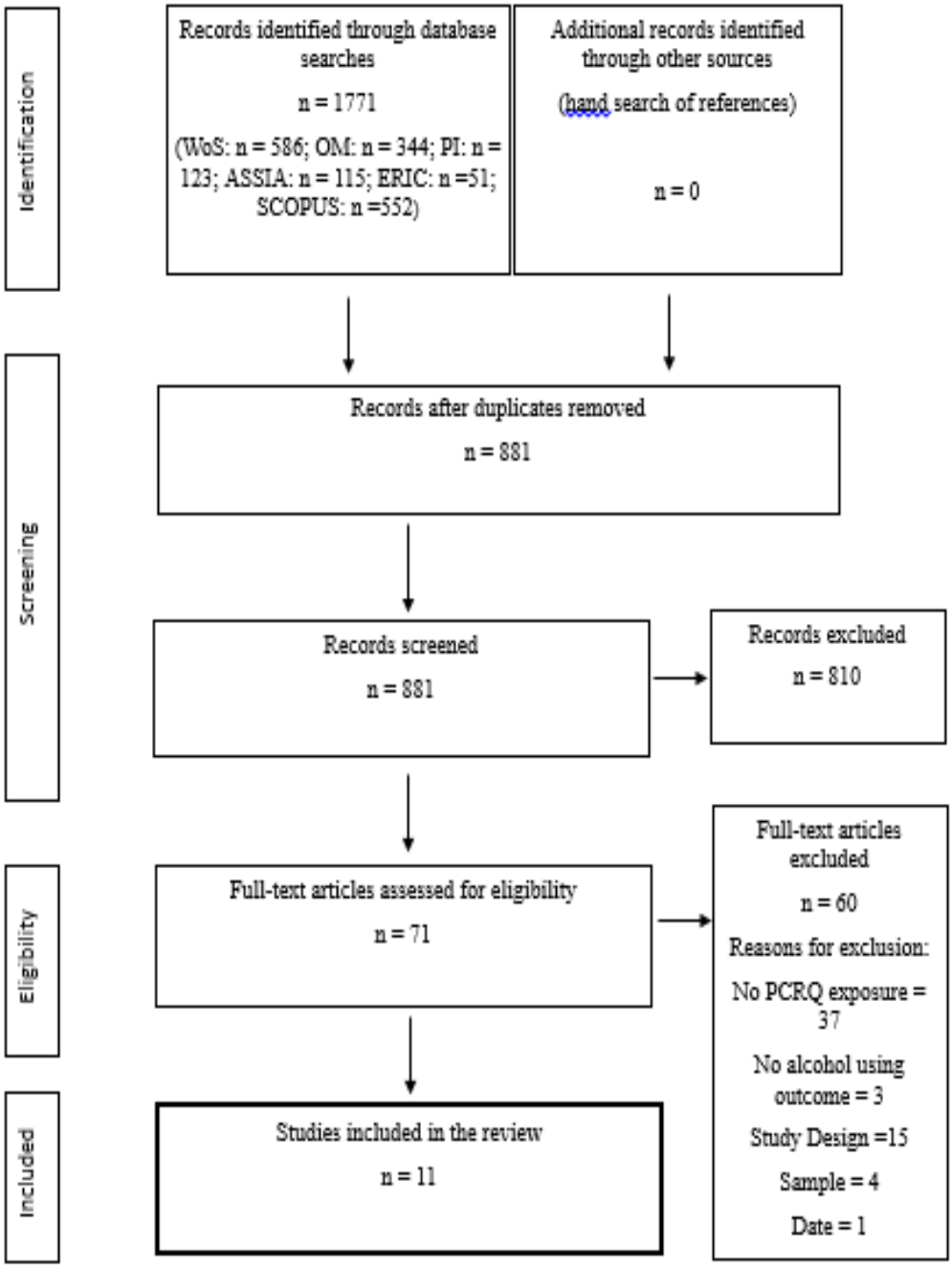

Figure 6: A schematic of the selection of research for inclusion: PCRQ and adolescent alcohol use[5]

[5] Key: WoS = Web of Science; PM = PubMed; PI = PsycINFO

4.2.4 Results

Eleven studies with data from 44,439 participants reported on prospective associations between PCRQ and adolescent alcohol use. These studies are presented in Table 18. Table 19 shows the NOS ratings for each individual study included in the review.

Of the eleven studies included in the review, six were undertaken in the USA, two in Australia, one in the Netherlands, one in the UK and one in Germany. The studies differed in baseline age, ranging from 9 years of age to 17 years of age. The number of participants in the studies varied from 387 to 14,333. The total follow up period ranged from 1 to 9 years and the total number of waves varied between 2 and 9.

Table 18 presents the terms and descriptions used for the assessment of PCRQ and in this review, all measures of PCRQ were self-reported.

There was some heterogeneity observed across the eleven studies for the measurement of adolescent alcohol use. Five studies examined the initiation of monthly or yearly use (Kelly et al. 2011a; White and Halliwell 2011; Cleveland et al. 2012; Weichold et al. 2014; Wang et al. 2015), one study examined having ever sipped/drank a full alcoholic drink (Abar et al. 2014) and another examined lifetime use (Minaie et al. 2015). The four remaining studies examined level of alcohol use through the frequency and/or amount of alcohol drank (Visser et al. 2013; Trucco et al. 2014; Ohannessian et al. 2016; Soloski et al. 2016). No studies used validated measures to assess adolescent alcohol use. All measures of alcohol use were derived by adolescent self- report.

Table 18: Studies included in the systematic review examining PCRQ and adolescent alcohol use

Author Country	Study design	Sample (n)	Method of survey	Objective	Age at Baseline Waves	Outcome	PCRQ	Statistical model	Covariates	Findings[6]
Abar et al. (2014) USA	Prospective study	Middle school students and their parents from six schools in Rhode Island, USA (n= 1,023)	Adolescents: Computer based survey at baseline and follow up Parents: Paper based survey at baseline No follow up	"To identify …parental predictors of adolescent tobacco and alcohol initiation behaviors."	11-14 years 2 waves in 1 year	1. Ever sipped an alcoholic drink 2. Ever drank a full alcoholic drink	Network of Relationships Inventory (Furman and Buhrmester 1985; 2009): social support (6 items); negative interchanges (9 items)	Logistic regression	Sex Grade Ethnicity Alcohol & cigarette availability	Social support & ever having sipped alcohol (OR = 0.84, 95% CI = 0.69, 1.03) Social support & drank a full alcohol drink (OR = 0.80, 95% CI = 0.52, 1.23) Negative interchanges & having ever sipped an alcoholic drink (OR = 1.14, 95% CI = 0.87, 1.50) Negative interchanges & drinking a full alcoholic drink (OR = 2.00, 95% CI = 1.26, 3.18)

[6] NS = Not significant

Cleveland et al. (2012) USA	Longitudinal	Two samples: 1. PROSPER (n= 8,744)	Questionnaires administered in school by trained university-based data Collectors	"To examine associations among RPFs …and subsequent-year alcohol use across early to late adolescence in two independent samples"	M=12.3 years 5 waves over 5 years	Self-reported alcohol use in the past month	Family protection: 1. family attachment (4 items) 2. family opportunities for prosocial involvement (6 items) 3. family supervision (5 items) 4. parents' use of inconsistent discipline (5 items)	Cross lagged models	None specified	PROSPER: 6->7 = -0.05 (p<0.001) 7->8 = -0.02 (NS) 8->9 = -0.05 (NS) 9->10 = 0.05 (NS)
		2. ASAPS (n= 8,051)	Self-administered surveys		M=12.5 years 7 waves over 5 years	ASAPS: self-reported alcohol use in the past 30 days	Family protection: 1. family opportunities for prosocial involvement (1 item)			ASAPS 7->8 = -0.10 (p<0.001) 8->9 = -0.10 (p<0.01) 9->10 = 0.04 (p<0.05) 10->11 = -0.02 (NS)

Kelly et al. (2011a) Australia	Longitudinal	Victoria, Australia Part of the International Youth Development Study (IYDS) (n=927)	Survey administered by school	"To examine gender differences in how family emotional climate influence growth in alcohol use from the pre- to mid-teens"	10 years 6 waves in 6 years	Self-reported frequency of alcohol use in past year.	Closeness to each parent (3 items) Family conflict (3 items)	Logistic regression	Sensation seeking Family structure Socio-economic status	Emotional closeness to mother (Girls: OR = 0.69, 95% CI = 0.50 , 0.96) (Boys: OR = 0.83, 95% CI = 0.60, 1.15) Emotional closeness to father (Girls: OR = 0.96, 95% CI = 0.72, 1.28) (Boys: OR = 0.92, 95% CI = 0.70, 1.22) Family conflict (Girls: OR = 1.18, 95% CI = 0.91, 1.53) (Boys: OR = 0.92, 95% CI = 0.72, 1.17)

Minaie et al. (2015) Australia	Cluster randomized controlled trial	Resilient Families Research Initiative (RFRI) (n=2081)	Questionnaire	"To explore the … development of adolescent alcohol use [and] parenting behaviours and… styles"	12 years of age 3 waves in 2 years	Self-reported lifetime alcohol use	Parental nurturance: Family Opportunities Attachment to Mother Attachment to Father Family Rewards (11 items)	Logistic regression	Prior alcohol use	Mother attachment (OR = 1.11, 95% CI = 0.84, 1.48) Father attachment (OR = 0.87, 95% CI = 0.67, 1.12) Family opportunities (OR = 1.00, 95% CI = 0.80, 1.26) Family rewards (OR = 1.04, 95% CI = 0.88, 1.23)
Ohannessian et al. (2016) USA	Longitudinal	(AAP) (n=1031)	In school surveys	"To examine the relationship between family functioning and adolescent alcohol use"	M = 16.15 years 3 waves in 2 years	Self-reported Quantity Frequency alcohol use (Sobell and Sobell 1995) Self-reported binge drinking in the past six months	The Parent-Adolescent Communication Scale (Barnes and Olson 2003) (20 items)	Multiple group comparison	Baseline alcohol use Age Ethnicity Parental education Family structure	Adolescent mother communication Girls: NS Boys: NS Adolescent father communication Girls: β = -.29, p<0.01 Boys: NS

Soloski et al. (2016) USA	Longitudinal	AddHealth (n=3342)	In school surveys /In home interviews	"To examine whether … family cohesion were linked with trajectories of binge drinking"	12–17 years 2 waves in 1 year	Self-reported binge drinking in the last year	Parent–child bond (maternal and paternal): (Crosnoe and Elder 2004) (5 items)	Latent growth curve analyses	Age Gender Ethnicity Number of parents	Mother-adolescent bond NS Father-adolescent bond NS
Trucco et al. (2014) USA	Longitudinal	US families (n=387)	Interviewer lead questionnaire	"To test [parental] factors in the development of early adolescent alcohol use and …bidirectional associations between parenting and alcohol use"	11-12 years 3 waves in 2 years	Self-reported quantity and frequency of alcohol use in the past year.	Parenting Style Inventory (PSI; Darling and Toyokawa 1997)	Cross-lagged mediation path model	Socio-economic status Marital status	Wave 1 positive parenting & Wave 3 alcohol use (β = -0.16, $p<0.05$)
Visser et al. (2013) Netherlands	Prospective cohort study	TRIALS Survey (n= 2230)	Wave 1: In home parental questionnaire	To examine: "the influence of parenting styles in early adolescence on regular alcohol	M= 11.09 years 3 waves in 5 years	Self-reported quantity and frequency of alcohol use	EMBU-C scales (Markus et al. 2003): Overprotection	Logistic regression	Age Socio-economic status Parental divorce	Overprotection (OR = 1.14, 95% CI = 1.00, 1.30). Emotional warmth

			In school child completed questionnaire administered by trained TRIAL interviewers All other waves: Child completed questionnaires administered in school by TRIAL assistant.	use in late adolescence".		in the past week.	(12 items) Emotional warmth (18 items) Rejection (12 items)		Parental alcohol use Educational level Baseline adolescent alcohol use	NS Rejection use NS
Wang et al. (2016) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=14,333)	Wave 1: In school survey Wave 2: In home survey	To explore parental support and alcohol use behaviour	12-17 years 2 waves in 1 year	Self-reported alcohol use in the last year	Parental support (6 items)	Stochastic Actor-Based modelling	Gender Grade Parental education Socio-economic status	NS

Weichold et al. (2014) Germany	Longitudinal	Younger Cohort of the Leipzig Schuler-Intervall (LSI) (n=1619)	All waves: In school survey administered by study personnel	To examine if problematic alcohol use trajectories for girls and boys between ages 14 and 18 "were related to … correlates of parent child relationships".	M=9.01 years 5 waves in 9 years	Self-reported alcohol use in the last 4 weeks.	Parent–adolescent relationship (4 items)	Latent growth mixture modelling (LGMM)	Age Gender Paternal education Community Family income	Negative parent-adolescent relationships & alcohol use trajectory Girls: NS Boys: NS
White and Halliwell (2011) UK	Longitudinal	School based (n=671)	In school survey supervised by researchers and staff	To examine: "the direction of associations between family meals, alcohol and tobacco consumption during early adolescence."	M = 14.05 years 2 waves in 1 year	Self-reported alcohol use in the last year	Family connectedness (2 items; Ackard et al. 2004)	Structural equation modelling	Age Socio-economic status	Family connectedness NS

A range of statistical approaches were used to analyse the association between PCRQ and adolescent alcohol use. The majority of studies used logistic regression models (Kelly et al. 2011a; Visser et al. 2013; Abar et al. 2014; Minaie et al. 2015), whilst others used alternative methods including structural equation modelling (SEM) (White and Halliwell 2011), multivariate cross lagged models (Cleveland et al. 2012; Trucco et al. 2014), multiple group comparison analyses (Ohannessian et al. 2016), latent growth mixture modelling (LGMM) (Weichold et al. 2014), latent growth curve analyses (LGCM) (Soloski et al. 2016) and stochastic actor based approach (SAB) (Wang et al. 2015). There was also a large variation in the covariates that were adjusted for across studies. Some studies adjusted for factors including gender, grade, parental education and socio-economic status. Whilst others adjusted for factors including baseline alcohol use, sensation seeking and alcohol/cigarette availability. Such adjustments had the potential to influence the strength of associations.

Results for the quality assessment of all included studies are presented in Table 19. The mean NOS methodological quality score was 5.91 (SD =0.83, range = 4, 7) out of a maximum score of 9. Ten of the eleven studies were of high methodological quality (Kelly et al. 2011a; White and Halliwell 2011; Visser et al. 2013; Abar et al. 2014; Trucco et al. 2014; Weichold et al. 2014; Minaie et al. 2015; Wang et al. 2015; Ohannessian et al. 2016; Soloski et al. 2016), with only one study deemed as low quality and presenting considerable risk for bias (Cleveland et al. 2012).

Despite ten of the eleven included studies being of high methodological quality, there were some concerns around attrition. Specifically, five studies (45%) reported inadequate response rates ranging from 7% to 68% and in some instances, not reported. This presents concerns as reported strength of associations may differ for participants who remained in the

study to those lost. However, the six remaining studies included in the review did have attrition rates of 80% and above. Hence, it was not deemed too problematic but did need consideration when interpreting the results of this systematic review.

Of the eleven included studies, two representing 1,410 participants found poor PCRQ to increase the risk of alcohol consumption in adolescence (Abar et al. 2014; Trucco et al. 2014). However, in one of these studies, findings were equivocal whereby an association was only found for one of four PCRQ dimensions (negative interchanges and drinking a full alcoholic drink: OR = 2.00, 95% CI = 1.26, 3.18) (Abar et al. 2014). The remaining three dimensions presented no association (social support and ever sipped an alcoholic drink: OR = 0.84, 95% CI = 0.69, 1.03) (social support and drank a full alcoholic drink: OR = 0.80, 95% CI = 0.52, 1.23) (negative interchanges and ever sipped an alcoholic drink: OR = 1.14, 95% CI = 0.87, 1.50).

Four additional studies, representing 20,372 participants, found poor PCRQ did not increase the risk of alcohol consumption in adolescence but associations however were found in sub-groups. One of the studies only found an effect for certain grades (Cleveland et al. 2012) whereby the protective effects of PCRQ against alcohol use in the early years waned during the years spanning middle and high school. Another study found an effect for a certain gender (Weichold et al. 2014) whereby in models controlling for age, gender, paternal education, community size and per capita family income, negative PCRQ at 14 years was linked to membership in the rare alcohol user group as compared to regular alcohol users for boys, between 14 and 18 years (β =-0.82, SE = 0.26, $p<0.01$). For girls, PCRQ was not related to any alcohol using trajectories. This was for regular alcohol users, rare alcohol users, early peakers and late escalators. The remaining two studies only found an effect for a certain gender across maternal and paternal PCRQ (Kelly et al. 2011a; Ohannessian et al. 2016).

Table 19: NOS scores for studies examining PCRQ and adolescent alcohol use

	Representativeness	Selection of non exposed cohort	Ascertainment of exposure	Outcomes not present at study start	Comparability of cohorts on design basis	Assessment of outcome	Follow up long enough for outcomes to occur	Adequacy of follow up cohort	TOTAL
Abar et al. (2014)	*	*	-	-	**	-	*	80%	6
Cleveland et al. (2012a)	-	*	*	-	*	-	*	-	4
Kelly et al. (2011a)	*	*	-	-	**	-	*	88%	6
Minaie et al. (2015)	*	*	-	*	**	-	*	88%	7
Ohannessian et al. (2016)	*	*	-	-	**	-	*	80%	6
Soloski et al. (2016)	*	*	*	-	**	-	*	51%	6
Trucco et al. (2014)	*	*	*	-	**	-	*	7%	6
Visser et al. (2013)	*	*	*	-	**	-	*	83%	7
Wang et al. (2015)	*	*	*	-	**	-	*	-	6
Weichold et al. (2014)	*	*	-	-	**	-	*	89%	6
White and Halliwell (2011)	*	*	-	-	**	-	*	68%	5

Kelly et al. (2011a) found a statistically significant negative association between *maternal* PCRQ at 10 years of age and alcohol use at 15 years of age for girls (emotional closeness to mother; OR = 0.69, 95% CI = 0.50, 0.96) but not boys (emotional closeness to mother; OR = 0.83, 95% CI = 0.60, 1.15). Whilst Ohanessian et al. (2016) found a statistically significant negative association between *paternal* PCRQ at 16 years and alcohol use at 18 years for girls ($\beta = -0.29$, $p<0.01$) but not for boys.

The remaining five studies, representing 22,657 participants, did not find an association between PCRQ and adolescent alcohol use (White and Halliwell 2011; Visser et al. 2013; Minaie et al. 2015; Soloski et al. 2016; Wang et al. 2016). Notably, one study did find that when adjusting for baseline alcohol use across three models of PCRQ, the strength of the effect of PCRQ decreased whereby initial associations became nonsignificant (overprotection and regular alcohol use; OR = 1.10, 95% CI = 0.98, 1.21) (emotional warmth and regular alcohol use; OR = 0.95, 95% CI = 0.85, 1.06) (rejection and regular alcohol use; OR = 1.04, 95% CI = 0.94, 1.16) (Visser et al. 2013).

4.2.5 Discussion

This review firstly sought to summarise the strength of the evidence on the effects of PCRQ on adolescent alcohol use. Eleven studies were included, ten of which were of high quality (Kelly et al. 2011a; White and Halliwell 2011; Visser et al. 2013; Abar et al. 2014; Trucco et al. 2014; Weichold et al. 2014; Minaie et al. 2015; Wang et al. 2015; Ohannessian et al. 2016; Soloski et al. 2016). Overall, inconclusive evidence was presented for a prospective association between PCRQ and adolescent alcohol use. Two studies reported a prospective association for the whole group (Abar et al. 2014; Trucco et al. 2014), four studies reported an association for specific sub groups (Kelly et al. 2011a; Cleveland et al. 2012; Weichold et al. 2014; Ohannessian et al. 2016) and five studies reported no association (White

and Halliwell 2011; Visser et al. 2013; Minaie et al. 2015; Soloski et al. 2016; Wang et al. 2016). In the two studies which found an association between PCRQ and the onset of alcohol use, the association was only present in the fully adjusted analysis of one study for one of four PCRQ dimensions (Abar et al. 2014). This was for negative interchanges at 11 to 14 years and ever having a full alcoholic drink one year later (OR = 2.00, 95% CI = 1.26, 3.18). No association was observed for the remaining three dimensions.

In contrast to the findings of Visser et al. (2012), who found weak evidence for a prospective association between PCRQ and adolescent alcohol use, this review found the level of evidence for an overall effect of PCRQ upon adolescent alcohol use was that there was a null to very weak association.

Limitations of the studies included in the review

The studies included in the review presented a number of limitations. Firstly, the measurement of PCRQ was heterogeneous across studies with some using validated questionnaires and others using ad hoc questions. Additionally, studies provided diverse reference periods (i.e. a period over which the respondent is asked to provide information, such as 30 days or 12 months) alongside diverse measurements of quantity and/or frequency. This may offer explanation for no evidence of a prospective association between PCRQ and alcohol use in adolescence being found. Secondly, bias due to self-reporting alcohol use may have attenuated the problems of no association (Weichold et al. 2013). However, questions still remain about the degree to which response accuracy is jointly influenced by social context factors, participant characteristics, and task attributes, and whether different drinking patterns are linked to different response biases (Weichold et al. 2013). Thirdly, measures of PCRQ were heterogeneous and were also assessed by adolescent report and not parent report, presenting potential bias. However, it has been shown that children are influenced by

parenting practices through their mental representations of it (Main et al. 1985 cited in Visser et al. 2013), with adolescent report being preferential to parent report (Parsons et al. 1999, cited in Wang 2015). Fourth, potential bias through attrition of adolescents with high levels of alcohol use. This was specifically noted within four of the eleven included studies (White and Halliwell 2011; Cleveland et al. 2012; Trucco et al. 2014; Ohannessian et al. 2016), with only three using imputation methods to reduce this effect (Visser et al. 2012; Weichold et al. 2014; Wang et al. 2015).

4.2.6 Conclusions

Following a summary of the evidence presented, which involved eleven studies reporting upon prospective associations between PCRQ and adolescent alcohol use and representative of 44,439 participants, it was concluded that the evidence base is inconclusive. Ten of the included studies were of high methodological quality. Most examined the onset of alcohol consumption with only four studies examining more frequent use or hazardous levels of use. Considering such gaps in the knowledge base, future research would be well positioned to examine associations between PCRQ and levels of alcohol use in adolescence using validated measures to address issues highlighted within this review.

4.3 Systematic review 2: parent-child relationship quality and the development of adolescent smoking

4.3.1 Research questions

The second review sought to answer one research question:

1. Is the quality of parent-child relationships associated with the experimental smoking and nicotine dependence in adolescence?

4.3.2 Background

Wellman et al. (2016) examined longitudinal population-based studies reporting on predictors of adolescent smoking. Studies were searched from 1984 to 2015 in PubMed and Embase, with fifty three studies included in the review. Associations between parental attachment and adolescent smoking were not found to be a consistent factor reported within the literature (n=2). Alternatively, Tyas and Pederson (1998) examined studies reporting on psychosocial predictors of adolescent smoking. Studies were searched from 1984 to 1996 in General Science Index, Medline, PsycLIT, Sociofile, Sociological Abstracts, and Smoking and Health. In contrast to Wellman et al. (2016), Tyas and Pederson (1998) found that parental attachment was an important predictor of adolescent smoking (n=3), with maternal attachment being a stronger component than paternal attachment. However, this review included both cross-sectional and longitudinal studies and did not find evidence for a prospective association. The methodological quality of the three included studies were not assessed, with conclusions drawn being subject to potential bias. Taking the limitations of these reviews into account, a full systematic review of longitudinal studies examining prospective associations between PCRQ and smoking in adolescence is needed.

4.3.3 Methodology

Methods used for undertaking this systematic review are specified in section 3.5.2. Methods were tailored in terms of the electronic search strategy, exclusion criteria and screening of full papers.

Electronic search: Six electronic databases were searched: Ovid Medline, PsycINFO (PI), ASSIA, ERIC, Web of Science and SCOPUS. No date limit was imposed on this search due to the necessity for a full review. A hand search of additional papers was also undertaken, alongside a separate search of the top 4 contributing journals of included papers. The search parameters used are presented in Table 20. An example of the specific search terms used are presented in Appendix 3.

Table 20: Specification of search parameters for PCRQ and adolescent smoking

Operator	**Definition**
# 1 Keywords	Parent* OR famil* OR child rearing
# 2 Keywords	longitudinal OR cohort OR prospective OR follow up
# 3 Keywords	TI ("smok*" OR "tobacco*" OR "cigarette")
# 4 Boolean operator	#1 AND #2 AND #3
#5 Limits language	English
#6 Limits subjects of studies	Humans AND (adolescen* OR child* OR teenager OR youth OR young OR student OR pupil)
#7 Limits kind of studies	Peer reviewed
#8 Boolean operator	#4 AND #5 AND #6 AND #7
#9 Selection	Removal of duplicates and manual exclusion of articles not meeting inclusion criteria

Exclusion criteria: Papers excluded if they focused upon adult populations, multiple risk behaviours, clinical populations, were cross sectional or not printed in English. Papers were also excluded if they did not focus upon

children and/or adolescents, PCRQ and tobacco use. Table 21 presents the full exclusion criteria.

Table 21: Exclusion criteria specific to the systematic review examining PCRQ and adolescent smoking

	Include	**Exclude**
Population	At first assessment aged<18 years Has to be of school age and/or attended school	Adults Young people 18 and over Clinical samples Criminal samples Teenage sexuality and pregnancy Special educational needs
Exposure	PCRQ Elements of PCRQ including parental attachment, family bonds, parent-child conflict	Family mechanisms PCRQ which primarily focuses on the wider family and not parents Sibling relationships Parental supervision/monitoring Parental rules Parental attitudes to use Parental rules on alcohol use Parental responsibility Family meals
Outcome	Smoking Tobacco use Cigarette use Ever tried smoking, even one puff	Perceptions of smoking Attitudes towards smoking Intention to smoke Vapour smoking Electronic cigarettes Water pipe use

Screening of full papers: Full papers were read in detail and excluded in accordance with the above criteria. This process is illustrated in Figure 7.

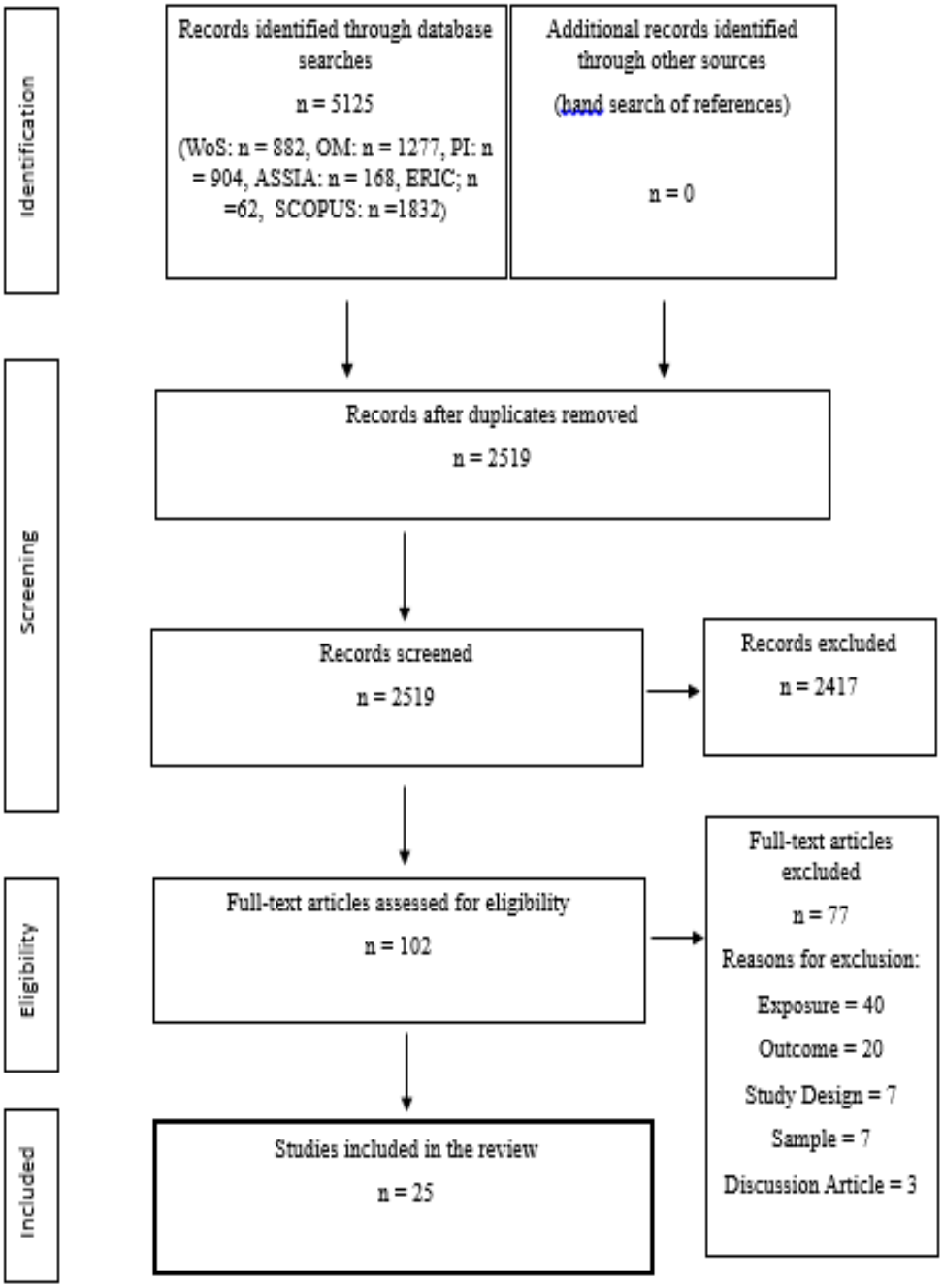

Figure 7: A schematic of the selection of research for inclusion: PCRQ and adolescent smoking[7]

[7] Key: WoS = Web of Science; PM = PubMed; PI = PsycINFO

4.3.4 Results

Twenty-five studies with data from 111,863 participants reported upon the association between PCRQ and smoking. The studies are presented in Table 22. Table 23 shows the NOS ratings for each individual study included in the review.

Of the twenty-five included studies, twenty were undertaken in the USA, three in the UK and two in Taiwan. The studies varied in age at baseline, ranging from age 10 to 16 years. The number of participants in the studies varied from 331 to 14,333. The total follow up period ranged from 6 months to 11 years and the number of waves varied between 2 and 6.

All of the studies were based on adolescent self-report. Little heterogeneity was observed for the measurement of PCRQ across the twenty-five studies. Specifically, only one study examined PCRQ directly (Nowlin et al. 2007) whilst others examined an array of PCRQ concepts including: parent-child conflict (Simons Morton et al. 2003; Liu 2004; Brook et al. 2010); parental support (Chang et al. 2011; Chen et al. 2014; Lakon et al. 2015); parental closeness (Ennett et al. 2010); parent connectedness (Kandel et al. 2004; Mahabee Gittens 2013); family connectedness (Scal et al. 2003; Mahabee Gittens et al. 2011; White and Halliwell 2011); quality of parenting (Nowlin et al. 2007); parent-teen attachment (Skinner et al. 2009); family bonding (Tucker et al. 2002; 2012); family functioning (van den Bree et al. 2004); parental support (Wang et al. 2015); parental communication (Cohen et al. 1994); and parent-child conversations (White 2012).

Interestingly, five studies drew on more than one measurement of PCRQ. Brook et al. (2004) examined maternal conflictual relationship, paternal conflictual relationship and maternal warmth. Gutman et al. (2011) examined positive identification with parents alongside negative family interactions. Hill et al. (2005) examined family involvement, family bonding and family conflict. Kim et al. (2009) examined both family conflict and

family bonding and Wen et al. (2009) examined parental conflicts, parent-child closeness, and parent-child communication. Table 22 demonstrates all of the terms and descriptions used in the measurement of PCRQ and for this review, the term PCRQ refers to all of the terms.

Overall, studies examined smoking frequency (Brook et al. 2004); the onset of adult smoking (Brook et al. 2010); change in smoking status (Cohen et al. 1994; van den Bree et al. 2004; Chang et al. 2011; Chen et al. 2014); past 30 day use (Scal et al. 2003; Wen et al. 2009; Gutman et al. 2011; Lakon et al. 2015; Wang et al. 2016); use in the past year (Kandel et al. 2004; Skinner et al. 2009; White and Halliwell 2011; White 2012); daily smoking (Tucker et al. 2002; Kandel et al. 2004; Liu, 2004; Hill et al. 2005; Kim et al. 2009; White 2012); smoking initiation (Mahabee-Gittens et al. 2011; Tucker et al. 2012); smoking status (Mahabee-Gittens et al. 2013); and smoking stages (Simons-Morton and Haynie 2003). Few studies used validated measures for assessment of smoking outcomes. Only one study used the Fagerstrom Test for Nicotine Dependence (FTND: Heatherton et al. 1991)(Ennett et al. 2010), whilst another used the Tobacco use index (Mahabee Gittens et al. 2013).

The lack of homogeneity across smoking measures was further compounded by some studies using a combination of measures. Two studies used measures of daily smoking and smoking in the past year (Kandel et al. 2004; White and Halliwell 2011). Whilst three studies assessed smoking stages (Simons-Morton and Haynie 2003; van den Bree et al. 2004) alongside the quantity and frequency of cigarette use (Nowlin and Colder 2007). Notably, smoking measures even differentiated between studies when drawing upon the same secondary data sources (e.g. AddHealth). There was also variations in the covariates which were adjusted for across studies. Some studies adjusted for factors including gender, grade, ethnicity and socio-economic status. Whilst others adjusted

for factors including pocket money, family smoking, baseline smoking, school location and satisfaction with weight.

The majority of studies used regression analyses for examining prospective associations between PCRQ and adolescent smoking (Cohen et al. 1994; Tucker et al. 2002;Scal et al. 2003; Simons-Morton and Haynie 2003; Brook et al. 2004; Kandel et al. 2004; Liu 2004; van den Bree et al. 2004; Nowlin and Colder 2007; Wen et al. 2009; Mahabee-Gittens et al. 2011; Tucker et al. 2012; White 2012; Mahabee-Gittens et al. 2013; Chen et al. 2014). Others used structural equation modelling (SEM) (Skinner et al. 2009; Brook et al. 2010; White and Halliwell 2011), hierarchical growth models (HLM) (Ennett et al. 2010; Gutman et al. 2011a), discrete time survival analysis (Hill et al. 2005; Kim et al. 2009), social network analysis (Lakon et al. 2015), accelerated lifetime models (ALT) (Chang et al. 2011) and Stochastic Actor-Based modelling (Wang et al. 2016).

The mean NOS methodological quality score of the included studies was 5.8, (SD = 1.38, range = 3 to 8) out of a maximum score of 9. Eighteen of the twenty five studies were of high methodological quality (72%) (Scal et al. 2003; Kandel et al. 2004; Liu 2004; van den Bree et al. 2004; Hill et al. 2005; Nowlin and Colder 2007; Kim et al. 2009; Wen et al. 2009; Ennett et al. 2010; Gutman et al. 2011; Mahabee-Gittens et al. 2011; White and Halliwell 2011; Tucker et al. 2012; White 2012; Mahabee-Gittens et al. 2013; Chen et al. 2014; Lakon et al. 2015; Wang et al. 2016) and 7 studies were of low methodological quality and presented risk of bias (28%) (Cohen et al. 1994; Tucker et al. 2002; Simons-Morton and Haynie 2003; Brook et al. 2004; Skinner et al. 2009; Brook et al. 2010; Chang et al. 2011). Results of the quality assessment for studies examining PCRQ and the development of adolescent smoking are shown in Table 23.

Table 22: Studies included in the systematic review examining PCRQ and adolescent smoking behaviours

Author Country	Study design	Sample (n)	Method of survey	Objective	Age at Baseline Waves	Outcome	PCRQ	Statistical model	Covariates	Findings[8]
Brook et al. (2004) USA	Longitudinal	Puerto Rican adolescents (n=637)	Self-reported Survey	To examine: "relationships between early risk and protective factors from the domains of family… and later tobacco use."	M = 13.85 2 waves over 5 years	Self-reported frequency of tobacco use	Maternal conflictual relationship Paternal conflictual relationship Maternal warmth	Hierarchical regression analysis	None specified	Maternal conflictual relationship (p= -.15, p<0.001) Paternal conflictual relationship (p= -.12, p<0.001) Maternal warmth NS

[8] NS: Not significant

Brook et al. (2010) USA	Longitudinal	African American and Puerto Rican young adults (n=475)	Self-reported survey	"Adolescent pathways to adult smoking."	M= 14 years 4 waves over 12 years	Wave 1 & 2: Self-reported frequency of tobacco use Wave 4: Self-reported smoking frequency during the past 30 days	Parent-child conflict Two dimensions: 1. Mother-child conflict Father-child conflict	SEM	Gender Age Ethnicity School grade	Parent child conflict & cigarette use in young adulthood (STE=0.21 (4.51), p<0.001)
Chang et al. (2011) Taiwan	Longitudinal	Child and Adolescent Behaviours in Long-term Evolution (CABLE) project (n=2686)	Secondary data	To examine: "the incidence of and risk factors associated with initial experimental smoking."	Grade 4 8 waves over 8 years	Self-reported smoking status	Parental support (6 items)	Accelerated lifetime model (ALT)	None specified	NS
Chen et al. (2014) Taiwan	Longitudinal	Child and Adolescent Behaviours in Long-term Evolution (CABLE) project	Not specified	To examine: "relationships between social structure, social capital and changes in smoking status	Grade 8 2 waves over 1 year	Self-reported smoking status	Parental support	Logistic regression	Gender Academic performance Pocket money Weight satisfaction Paternal	NS

		(n=1937)		from the 8th to 9th grade."					education Parental smoking	
Cohen et al. (1994) USA	Cohort study	Los Angeles school students (cohort 1: n=1034; cohort 2: n=1266)	Surveys completed in classroom setting	To identify: "specific parenting behaviours… associated with the onset of alcohol and tobacco use."	Cohort 1: Grade 5 3 waves over 4 years Cohort 2: Grade 7 2 waves over 3 years	Self-reported smoking status over past 12 months	Parental communication Positive relationships	Logistic regression	None specified	Cohort 1: 5^{th}>6^{th} grade NS 6>7^{th} grade NS 7>8^{th} grade NS Cohort 2: 7>8^{th} grade NS 8>9^{th} grade NS

Ennett et al. (2010) USA	Longitudinal	Census data (n=6544)	Adolescents: In school survey Parents: 25 minute telephone interview	To examine: "social processes involved in youth smoking."	M=13.12 years 5 surveys over two years	Fagerstrom Test for Nicotine Dependence (FTND: Fagerström et al. 1983; Heatherton et al. 1991).	Parental closeness (1 item)	HGM	Age Gender Ethnicity Family structure Parental education	(β = -0.04, SE=0.01, p<0.001)
Gutman et al. (2011) USA	Longitudinal	Maryland Adolescent Development in Context (MADIC) study (n=1102)	Administered at home Waves 1 to 4: face-to-face structured interview Waves 1 to 5: self-report questionnaire	To examine: "growth curve trajectories of cigarette and alcohol use from 13 to 19 years, and investigate how family relations are related to … alcohol and cigarette use."	13 years 5 waves over 7 years	''How many cigarettes have you smoked in the past 30 days?''	Positive identification with parents (4 items) (Family Management Study; Furstenberg et al. 1999)	HLM	None specified	Cigarette Use: negative interactions (0.057) positive identification (-0.094)

Hill et al. (2005) USA	Longitudinal	The Seattle Social Development Project (SSDP) (n=808)	Classroom surveys at ages 10 and 11 and face-to-face interviews from age 13 onwards	To examine: "family influences on the risk of daily smoking initiation from adolescence to young adulthood."	10.8 years 5 waves over 11 years	Daily smoking	Family involvement (9 items) Family bonding (5 items)	Discrete time survival	Gender Ethnicity Poverty Family smoking	Family involvement & smoking initiation NS Family bonding & smoking initiation (LLM = -0.28, $p<0.05$)
Kandell et al. (2004) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=5374)	Secondary data analysis Baseline: In school survey Waves 1 & 2: In home interviews	To examine the: "ethnic-specific predictors of smoking initiation and progression to daily smoking."	Grades 7 - 12 2 waves in 1 year	Smoking onset Daily smoking Number of days smoked in last 30 days	Parent connectedness (13 items)	Survival model	None specified	Parent connectedness & smoking initiation (OR = 0.93, 95% CI = 0.75, 1.16) Parent connectedness & transition to daily smoking (OR = 0.79, 95% CI = 0.64, 0.98)

Kim et al. (2009) USA	Longitudinal	Raising Healthy Children (RHC) project (n=270)	Children: annual in-person surveys Parents: telephone interviews Teachers: survey questionnaires	To: "identify individual and social predictors of progression to daily smoking by the end of high school among youths who initiated smoking by grade 8."	Grades 7 - 12 6 waves in 6 years	Progression to daily smoking:	Family conflict (5 items) Family bonding (8 items)	Discrete time survival	Gender Low income status	NS
Lakon et al. (2015) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=2260)	Secondary data analysis Baseline: In school survey Waves 1 & 2: In home interviews	To examine: "parental influences shaping … smoking."	Grades 7 - 12 2 waves in 1 year	Smoking in the past 30 days	Parental support (6 items)	Social network analysis	None specified	NS
Liu et al. (2004) USA	Longitudinal	National Education Longitudinal Study [NELS] 1988–1990, (n = 13348).	Not specified	To examine: "gender-specific relationships between parent–youth conflict, school	8th Grade 2 waves in 2 years	Cigarette use: one item - amount of cigarettes smoked per day.	Parent–youth conflict (2 items: maternal conflict, paternal conflict)	Multiple Regression	Prior school delinquency Academic performance Ethnicity Parental education	Father & son conflict ($\beta = 0.14, 0.06$, $p<0.05$) Father & daughter conflict

				delinquency and cigarette use."					Parent marital status School location Baseline cigarette use	NS Mother & son conflict NS Mother & daughter conflict (β = 0.18, 0.03, p<0.001)
Mahabee-Gittens et al. (2011) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=4061)	Secondary data analysis Baseline: In school survey Waves 1 & 2: In home interviews	To examine: "the associations among family bonding factors and the initiation of smoking by race/ethnicity and age group among non-smokers at Wave 1."	Grades 7 - 12 2 waves in 1 year	Smoking: one item ''Have you ever tried smoking, even one or two puffs?''	Family connectedness (13 items; Resnick et al. 1997; Sieving et al. 2001). Parent-adolescent communication (4 items; Manlove et al. 2007). Maternal satisfaction (1 item; Slap, et al. 2001)	Logistic regression	Gender Poverty Family structure Parental smoking Smokers at home Peer smoking	Parent-family connectedness and smoking initiation for (Hispanic 15-17 years, high v's low: OR = 0.32, 95% CI = 0.14,0.73) (Hispanic 15-17 years, med v's low: OR = 0.31, 95% CI = 0.11, 0.89) Maternal relationship satisfaction and smoking initiation:

										(African American 12-14 years: OR = 0.40, 95% CI = 0.19, 0.85) (Hispanic 12-14 years; OR = 0.41, 95% CI = 0.20, 0.86) Parental communication NS
Mahabee-Gittens et al. (2013) USA	Longitudinal	National Survey of Parents and Youth (NSPY) (n=6426)	Secondary data analysis	To estimate: "incidence rates of smoking initiation from late childhood through mid-adolescence and identify important parental influences on smoking initiation."	9-16 years 4 waves over 4 years	Smoking status (Bernat et al. 2008: Leatherdale 2008)	Parental connectedness (Hornik et al. 2003; Orwin et al. 2005)	Logistic regression	Ethnicity Gender Parental education Parental smoking Family structure Peer smoking	Parental connectedness P<0.05

Nowlin et al. (2007) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=9463)	Secondary data analysis Baseline: In school survey Waves 1 & 2: In home interviews	To examine: "how ethnicity moderates the relationship between parenting and adolescent cigarette use."	Grades 7 - 12 2 waves in 1 year	Self-reported smoking: quantity/frequency measure over the past 30 days	Quality of parenting (2 items)	Regression	Gender Family income Family composition	Maternal parenting quality and cigarette use frequency (R = -.18, p<0.001) Maternal parenting quality and cigarette use quantity (R = -.14, p<0.001) Paternal parenting quality and cigarette use frequency (R = -.14, p<0.001) Paternal parenting quality and cigarette use quantity (R = -.15, p<0.001)

Scal et al. (2003) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=10844)	Secondary data analysis Baseline: In school survey Waves 1 & 2: In home interviews	To identify: "the risk and protective factors for cigarette smoking among US adolescents."	Grades 7 - 12 2 waves in 1 year	Self-reported past 30 day smoking status	Family connectedness (12 items)	Logistic regression	Ethnicity Welfare status Family structure	Family connectedness and transition to current smoking (7 - 8th grade girls: OR = 0.26, p<0.001) (9-12th grade girls: OR = 0.63, p<0.01) (7-8th grade boys: OR = 0.28, p<0.001) (9-12th grade boys: OR = 0.46, p<0.001) *note: 95% CI not specified*
Simons-Morton & Haynie (2003) USA	Longitudinal	Sixth grade students (n=1081)	Surveys	To identify: "predictors of increases in smoking stages."	Grade 6 2 waves in 7 months	Self-reported smoking stage	Parent-teen conflict (4 items)	Ordinal regression	None specified	NS

Skinner et al. (2009) USA	Longitudinal	Data drawn from 'Parents who care' study (n=331).	Parent & teen: self-completed computer-assisted questionnaires in the presence of research staff	To examine: "the impact of family… risk and protective factors on adolescent smoking across ethnicity."	8th Grade 3 waves in 2 years	Smoked in past year	Parent – teen attachment (28 items from the Inventory of Parent and Peer Attachment; Armsden and Greenberg 1987)	Structural equation modelling	None specified	NS
Tucker et al. (2012) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=2837)	Secondary data analysis Baseline: in school survey Waves 1 & 2: in home interviews	To examine: "individual differences in the tendency to initiate and escalate smoking."	Grades 7 - 12 2 waves in 1 year	Self-reported lifetime use Self-reported regular use in past 30 days	Family bonding: Closeness to mother (7 items) Closeness to father (5 items) Family closeness (3 items)	Logistic regression	Peer smoking	Smoking initiation: family bonding (OR = 0.80, 95% CI = 0.69, 0.92) Smoking progression: (OR = 0.75, 95% CI = 0.61, 0.91)

Tucker et al. (2002) USA	Longitudinal	RAND Adolescent Panel Study (n=6527)	Not specified	To: "investigate the extent to which weak social bonds predict future daily smoking for early non-smokers and experimenters."	Grade 7 2 waves in 5 years	Self-reported lifetime smoking Self-reported daily smoking	Family bonds: whether or not the adolescent would be likely to talk to their parents about a personal problem	Logistic regression	None specified	Talks to parents & Grade 12 frequent smoking amongst: Grade 7 experimental smokers (OR =0.75, 95% CI = 0.60, 0.95); Grade 7 non-smokers (OR = 0.93, 95% CI = 0.60, 1.44)
van den Bree et al. (2004) UK	Longitudinal	National Longitudinal Study of Adolescent Health (n=14333)	Secondary data analysis Baseline: In school survey Waves 1 & 2: In home interviews	"To study the development of smoking behaviour in adolescents using a longitudinal, multivariate design."	Grades 7 - 12 2 waves in 1 year	Stages of Smoking Development	Family functioning: Relations with mother Activities with mother Relations with father Activities with father Independent decision making	Logistic regression	None specified	Initiation of experimental smoking Girls (OR = 0.84, 95% CI = 0.74, 0.95) Boys (NS) Initiation of regular smoking Girls (NS) Boys (NS)

Progression to regular smoking Girls (NS) Boys (NS) Discontinuation of experimental smoking Girls (NS) Boys (NS) Discontinuation of regular smoking Girls (NS) Boys (NS)

Wang et al. (2016) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=2260)	Secondary data analysis Baseline: In school survey Waves 1 & 2: In home interviews	To consider: "salient parental influence on youths' friendship tie choices and substance use."	Grades 7 - 12 2 waves in 1 year	Self-reported past 30 day smoking	Parental support (6 items)	Stochastic Actor-Based modelling	Peer network structural effects	NS
Wen et al. (2009) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=13552)	Secondary data analysis Baseline: In school survey Waves 1 & 2: In home interviews	To examine: "multilevel factors of adolescent smoking after controlling for the baseline smoking behaviour and individual characteristics."	Grades 7 - 12 2 waves in 1 year	Self-reported past 30 day smoking	Parental conflict Parent-child closeness Parent-child communication	Logistic regression	Age Gender Ethnicity	Parental conflict (OR = 1.07, 95% CI = 0.99, 1.16) Parent child closeness (OR = 0.86, 95% CI = 0.77, 0.97) Parent child communication (OR = 1.24, 95% CI = 1.14, 1.34)

White (2012) UK	Prospective	British Youth Panel Survey (n= 1736)	Secondary data analysis Home based questionnaire administered by research team	To test: "the association between a set of parent-specific, familial and peer interactions with smoking experimentation in early adolescence."	M= 11.26 years 2 waves in 3 years	Self-reported smoking experimentation	Frequency of supportive parent–child conversations (2 items) Frequency of parent–child quarrels (2 items)	Logistic regression	Controlled for the effects of other predictors	Mother–child conversations (OR = 0.75, 95% CI = 0.56, 1.00) Father-child conversations (OR = 0.58, 95% CI = 0.42, 0.79) Mother child arguments (OR = 1.22, 95% CI =0.84, 1.80) Father child arguments (OR = 1.34, 95% CI = 0.96, 1.87)

White & Halliwell (2011) UK	Longitudinal	British school children (n=671)	Waves 1 & 2: In school survey supervised by staff and researchers	To examine: "associations between family meals and alcohol and tobacco consumption during early adolescence."	M = 13.26 2 waves in 1 year	Self-reported yearly smoking Self-reported daily smoking	Family connectedness (2 items; Ackard et al. 2004)	SEM	None specified	Family connectedness NS

Ten studies representing 43,181 participants found different elements of PCRQ was associated with a reduced risk of smoking in adolescence (Brook et al. 2004; Kandel et al. 2004; Hill et al. 2005; Wen et al. 2009; Brook et al. 2010; Ennett et al. 2010; Gutman et al. 2011; Tucker et al. 2012; White 2012; Mahabee-Gittens et al. 2013). Brooks et al. (2014) found an association between nonconflictual maternal and paternal relationships at 14 years and smoking at 18 years (maternal: P= -.15, $p<0.001$; paternal P = -.12, $p<0.01$), but not for maternal warmth. Hill et al. (2005) found an association between family bonding at 10-11 years and smoking initiation between 13 to 21 years (LLM = -0.28, $p<0.05$), but not for family involvement. White (2012) found an association between frequent father–child conversations at 11 years and a 42% reduced risk of smoking experimentation at 14 years (OR = 0.58, 95% CI = 0.42, 0.79) but not for frequent mother–child conversations (OR = 0.75, 95% CI = 0.56, 1.00), mother-child quarrels (OR = 1.22, 95% CI = 0.84, 1.80) or father-child quarrels (OR = 1.34, 95% CI =0.96, 1.87). Kandel et al. (2004) found an association between increased levels of parent-child connectedness at age 12 to 17 years and a 21% reduction in the likelihood of transitioning to daily smoking 18 months later (OR = 0.79, 95% CI = 0.64, 0.98) but not for smoking initiation. Wen et al. (2009) also found that high levels of parent child closeness age 12 to 17 years reduced the likelihood of regular smoking 12 months later by 14% (OR = 0.86, 95% CI = 0.77, 0.97) but not parental conflict (OR = 1.07, 95% CI = 0.99, 1.16). However, high levels of parent child communication at age 12 to 17 years were further found to increase the likelihood of regular smoking 12 months later by 24% (OR = 1.24, 95% CI = 1.14, 1.34), being in the opposite direction to that observed by other studies (White 2012).

Six additional studies, representing 54,886 participants, also found increased levels of PCRQ to reduce the risk of smoking in adolescence, but only for specific groups (Tucker et al. 2002; Scal et al. 2003; Liu et al. 2004; van den Bree et al. 2004; Nowlin and Colder 2007; Mahabee-Gittens et al.

2011). Three of the six studies reported associations across gender, but findings were inconsistent. One study reported increased PCRQ at age 12 to 17 years as associated with a 16% reduction in the likelihood of experimental smoking 12 months later amongst girls (OR = 0.84, 95% CI = 0.84, 0.95) but not boys (van den Bree et al. 2004). Another study found strong paternal PCRQ to reduce rates of daily cigarette use (β = .14 (.06)) for boys but not for girls (β = .07 (.04)) and strong maternal PCRQ to reduce daily cigarette use for girls (β = .07 (.04)), but not for boys (β = .08 (.07)) (Liu et al. 2004). The third study found increased levels of PCRQ to be a protective factor for transitions to current smoking across both boys and girls, across differing school years (Scal et al. 2003).

Only one study examined associations between poor PCRQ and adolescent smoking, across baseline smoking status. They found increased levels of PCRQ at 12-13 years old to reduce the likelihood of frequent smoking at 17-18 years old by 25% for those who were experimental smokers at 12-13 years old (OR = 0.75, 95% CI= 0.60, 0.95), but not for non-smokers at 12-13 years old (Tucker et al. 2012). The remaining nine studies, representing 13, 796 participants, did not find an association for the whole group (Simons-Morton and Haynie 2003; Kim et al. 2009; Skinner et al. 2009; Chang et al. 2011; White and Halliwell 2011; Chen et al. 2013; Lakon et al. 2015; Wang et al. 2016) nor any sub group (Cohen et al. 1994).

Table 23: NOS scores for studies examining PCRQ and adolescent smoking behaviours

	Representativeness	Selection of non exposed cohort	Ascertainment of exposure	Outcome not present at start of study	Comparability of cohorts on design basis	Assessment of outcome	Follow up long enough for outcomes to occur	Adequacy of follow up	TOTAL
Brook et al. (2004)	-	*	-	-	**	-	*	-	4
Brook et al. (2010)	-	*	-	-	**	-	*	-	4
Chang et al. (2011)	*	*	*	-	-	-	*	>67%	4
Chen et al. (2014)	*	*	*	-	**	-	*	96.4%	7
Cohen et al. (1994)	*	*	-	-	-	-	*	<50%	3
Ennett et al. (2010)	*	*	*	-	**	-	*	66.8%	6
Gutman et al. (2011)	*	*	*	-	**	-	*	81%	7
Hill et al. (2005)	-	*	*	-	**	-	*	93%	6
Kandel et al. (2004)	*	*	*	-	**	-	*	85%	7
Kim et al. (2009)	-	*	*	-	**	-	*	85%	6
Lakon et al. (2015)	*	*	*	-	**	-	*	85%	7
Liu (2004)	*	*	-	-	**	-	*	77%	6
Mahabee-Gittens et al. (2011)	*	*	*	-	**	-	*	83%	7
Mahabee-Gittens et al. (2013)	*	*	*	-	**	-	*	85%	7
Nowlin et al. (2007)	*	*	*	-	**	-	*	72%	7

Scal et al. (2003)	*	*	*	-	**	-	*	83%	7
Simons Morton et al. (2003)	-	*	-	*	-	-	*	85%	4
Skinner et al.	-	*	-	*	-	-	*	92%	4
Tucker et al. (2012)	*	*	*	-	**	-	*	88%	7
Tucker et al. (2002)	-	*	-	-	**	-	*	67%	4
van den Bree et al. (2004)	*	*	*	-	**	-	*	65%	6
Wang et al. (2015)	*	*	*	-	**	-	*	65%	6
Wen et al. (2009)	*	*	*	*	**	-	*	78%	8
White (2012)	*	*	*	*	-	-	*	90%	6
White and Halliwell (2011)	*	*	-	*	-	-	*	71%	5

4.3.5 Discussion

This review sought to summarize and determine the strength of the effects of PCRQ upon smoking behaviours in adolescence. Twenty-five studies were included, eighteen of which were high quality. The review found moderate evidence for a prospective association between PCRQ and adolescent smoking behaviours. Specifically, ten studies reported a prospective association between PCRQ and smoking in adolescence (40%) (Brook et al. 2004; Kandel et al. 2004; Hill et al. 2005; Wen et al. 2009; Brook et al. 2010; Ennett et al. 2010; Gutman et al. 2011; Tucker et al. 2012; White 2012; Mahabee-Gittens et al. 2013) and six studies reported an association for specific sub groups (24%) (Tucker et al. 2002; Scal et al. 2003; Liu et al. 2004; van den Bree et al. 2004; Nowlin and Colder 2007; Mahabee-Gittens et al. 2011). Only nine studies reported no association (36%) (Cohen et al. 1994; Simons-Morton and Haynie 2003; Kim et al. 2009; Skinner et al. 2009; Chang et al. 2011; White and Halliwell 2011; Chen et al. 2013; Lakon et al. 2015; Wang et al. 2016). Overall, the level of evidence for the existence of an association between PCRQ and smoking was seen to be moderate as more than 60% of the studies agreed on the existence and direction of the relationship between PCRQ and adolescent smoking, across differing levels of use. In the studies which found a significant association there was a strong association between weakened PCRQ and the onset of smoking in the fully adjusted analysis (Scal et al. 2003; Wen et al. 2009). All studies reporting a significant association were of high methodological quality. Only one of the twenty five studies examined associations between PCRQ and nicotine dependence as assessed by the Fagerstrom Test for Nicotine Dependence (FTND: Heatherton et al. 1991). This study found support for an association between PCRQ and nicotine dependence in adolescence.

Limitations of included studies

The studies included in this review presented some limitations. Firstly, there were varied measures of PCRQ, with only a small number using validated questionnaires (Skinner et al. 2009; Gutman et al. 2011; Mahabee-Gittens et al. 2011; White and Halliwell 2011; Mahabee-Gittens et al. 2013). Secondly, there was large variation in measurement of smoking behaviours across studies. Studies used inconsistent reference periods (e.g. the period over which the respondent is instructed to provide information, such as 12 months or 30 days) and differed in the levels of smoking assessed. As such some studies examined smoking escalation from experimental or intermittent use to daily use (Kim et al. 2009), whilst others examined ever puffed a cigarette, smoking initiation or experimental smoking (van den Bree et al. 2004). Thirdly, some studies included only PCRQ in a model to predict smoking, whilst others added factors to examine the multivariate effects of additional factors. Fourthly, some studies excluded participants who missed one or more repeated measures. This may have caused attrition bias as more smokers than non-smokers at baseline were lost to follow up. Twelve of the twenty five studies did use imputation methods to reduce attrition bias (Tucker et al. 2002; Scal et al. 2003; van den Bree et al. 2004; Hill et al. 2005; Wen et al. 2009; Brook et al. 2010; Ennett et al. 2010; Mahabee-Gittens et al. 2011; Tucker et al. 2012; Chen et al. 2014; Lakon et al. 2015; Wang et al. 2016) but thirteen studies failed to use such methods, with attrition bias observed within six of these thirteen studies (Cohen et al. 1994; Brooks et al. 2004; Kim et al. 2009; Chang et al. 2011; White and Halliwell 2011; White 2012). Fifthly, some data were collected in the mid-1990s when rates of adolescent smoking were historically higher than what they are now. Although there is no reason to expect that societal changes would affect the direction of the associations examined in this study, it is possible that their magnitude may change over time (Tucker et al. 2012).

4.3.6 Conclusions

This is the first full systematic review of this area which solely focuses upon longitudinal evidence for associations between PCRQ and adolescent smoking. Twenty-five studies were included in this review, and moderate evidence was found for a prospective association between PCRQ and smoking in adolescence, with sixteen studies observing an association. The methodological quality of these sixteen studies was high, with the majority examining cigarette use in the past 30 days or past year. There was limited evidence which examined associations between PCRQ and more hazardous levels of tobacco use, including nicotine dependence and daily smoking. Future research examining longitudinal associations between PCRQ and different levels of adolescent smoking, would be beneficial.

4.4 Systematic review 3: parent-child relationship quality and the development of adolescent cannabis use

4.4.1 Research questions

This systematic review sought to answer one research question:

1. Is the quality of parent-child relationships associated with experimental and hazardous levels of cannabis use in adolescence?

4.4.2 Background

Guxens et al. (2007) examined the factors associated with adolescent cannabis use onset in a systematic review of cohort studies, published between 1980 and 2004. Thirteen studies met the inclusion criteria, with five of the included studies examining direct associations between PCRQ and cannabis use in adolescence. Evidence across the five studies suggested that poor PCRQ was associated with an increased likelihood of cannabis use onset in adolescence. Given that all five studies were of high methodological quality and findings were consistent, this systematic review did not seek to replicate the findings of Guxens et al (2007). Instead, it sought to replicate the eligibility criteria and methods used in the previous review and update searches to include evidence published up to December 2016. The methodology of the updated review and results are as follows.

4.4.3 Methodology

Methods used for undertaking this systematic review are specified in section 3.5.2. This methodology was tailored in terms of the electronic search strategy, exclusion criteria and screening of full papers.

Electronic search: Six electronic databases (e.g. Ovid Medline, PsycINFO (PI), ASSIA, ERIC, Web of Science and SCOPUS) were searched from May 2004 up to December 2016, using the keywords presented in Table 24. These date limits were imposed to avoid replication of the studies identified by Guxens et al (2007) and to extract more recent evidence. The specific search terms used are presented in Appendix 3.

Table 24: Specification of search parameters for PCRQ and adolescent cannabis use

Operator	Definition
# 1 Keywords	Parent* OR famil* OR child rearing
# 2 Keywords	longitudinal OR cohort OR prospective OR follow up
# 3 Keywords	TI ("cannabis" OR "marijuana" OR "marihuana" OR “hash*”)
# 4 Boolean operator	#1 AND #2 AND #3
#5 Limits language	English
#6 Limits subjects of studies	Humans AND (adolescen* OR child* OR teenager OR youth OR young OR student OR pupil)
#7 Limits kind of studies	Peer reviewed
#8 Limits date	May 2004 – present day
#9 Boolean operator	#4 AND #5 AND #6 AND #7 AND #9
#10 Selection	Removal of duplicates and manual exclusion of articles not meeting inclusion criteria

Exclusion criteria: Papers were excluded if they examined adult populations, multiple risk behaviours, clinical populations, were cross sectional or not printed in English. Papers were also excluded if they did not focus on children and/or adolescents, PCRQ and cannabis use. Table 25 presents the full exclusion criteria.

Screening of full papers: Full papers were read in detail and excluded according to the criteria outlined above. The process is illustrated in Figure 8.

Table 25: Exclusion criteria specific to the systematic review examining PCRQ and adolescent cannabis use

	Include	Exclude
Population	At first assessment aged<18 years Has to be of school age and/or attended school	Adults Young people over 18 Clinical samples Criminal samples Teenage sexuality and pregnancy samples Special educational needs
Exposure	PCRQ Elements of PCRQ including parental attachment, family bonds, parent-child conflict	Family mechanisms PCRQ which primarily focuses on the wider family and not parents Sibling relationships Parental supervision/monitoring Parental rules Parental attitudes to use Parental responsibility Family meals
Outcome	Use of cannabis (including marijuana, hasish, skunk) Any use of cannabis not prescribed	Perceptions on cannabis use Attitudes towards cannabis use Risk behaviour(s) Intention to use cannabis Medical cannabis use THC/cannabis oil

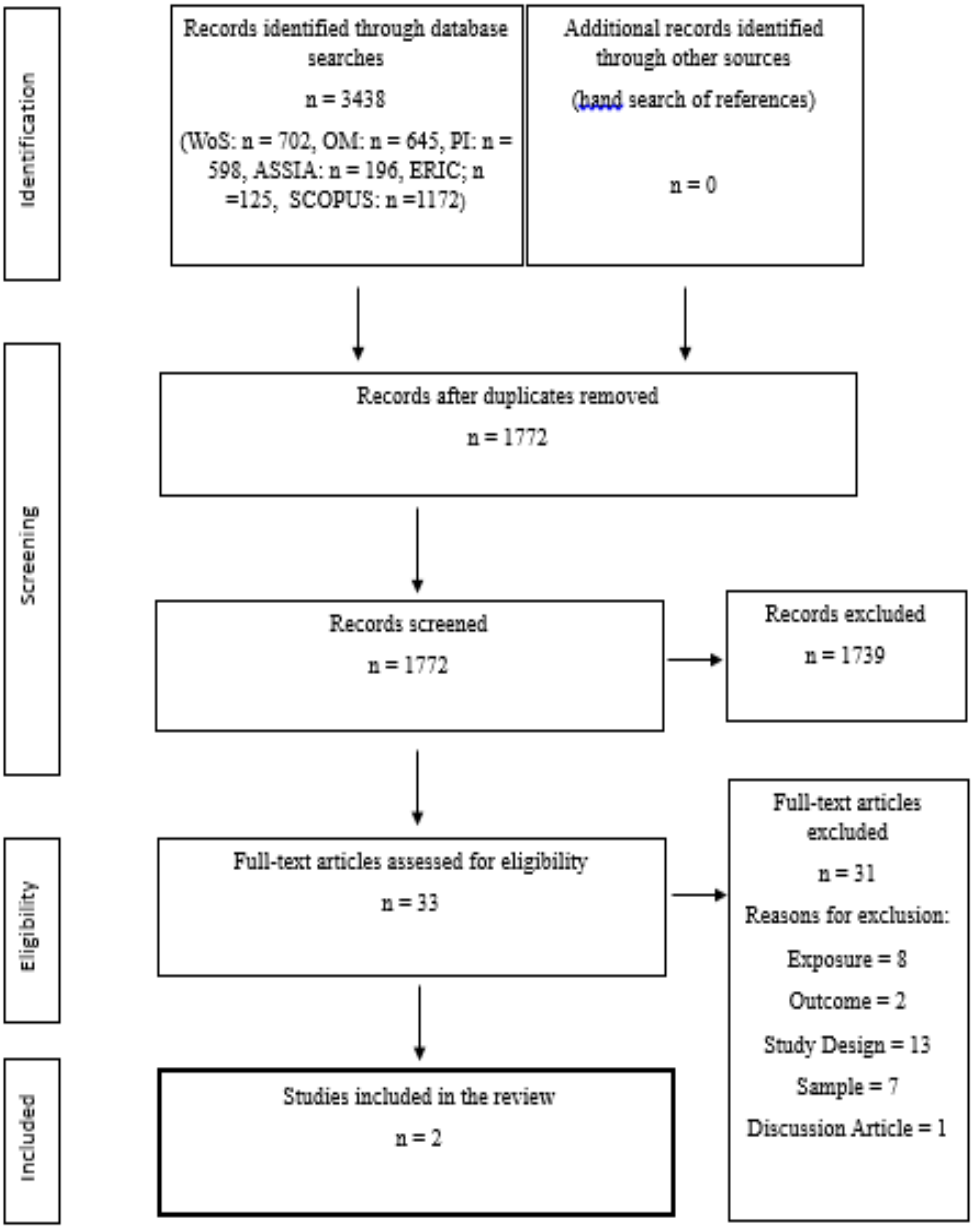

Figure 8: A schematic of the selection of research for inclusion: PCRQ and adolescent cannabis use[9]

[9] Key: WoS = Web of Science; PM = PubMed; PI = PsycINFO

4.4.4 Results

Only two studies reported associations between PCRQ and adolescent cannabis use (Ellickson et al. 2004; Lac et al. 2011). Table 26 presents the terms and descriptions used in the measurement of PCRQ and adolescent cannabis use. Both studies included in this review were undertaken in the USA. The studies examined differing ages at baseline, ranging from ages 12 to 17 years. The number of participants in the studies were 909 and 1,369. The total follow up period ranged from 1 to 3 years and the number of waves varied between 2 and 6.

Heterogeneity across measures of PCRQ was observed with studies examining talking to a parent about a personal problem (Ellickson et al. 2004) and parental communication (Lac et al. 2011). However, for measurement of adolescent cannabis use, no heterogeneity was observed with all studies examining lifetime use. To assess associations between PCRQ and adolescent cannabis use, both studies used regression-based approaches (Ellickson et al. 2004; Lac et al. 2011).

Results of the quality assessment for studies examining PCRQ and the development of adolescent cannabis use are shown in Table 27. The methodological quality of the two studies included in the review was high, with a mean score of 7 (SD=1, range 6 to 8). Low attrition was observed across the two included studies, specifically being 81% (Ellickson et al. 2004) and 70% (Lac et al. 2011).

The two included studies reported inconsistent findings. Ellickson et al. (2004) examined associations between talking to parents about personal problems at age 12-13 years and ever using cannabis up until age 15-16 years. In models adjusting for baseline use, they found that increased levels of talking to parents at age 12-13 years reduced the likelihood of ever using

cannabis at age 13-14 years by 40% (OR = 0.6, 95% CI = 0.5, 0.9). However, this effect was not persistent for talking to parents at age 13-14 years and ever using cannabis at age 14-15 years (OR = 0.9, 95% CI = 0.6, 1.3), nor talking to parents age 14-15 years and ever using cannabis at age 15-16 years (OR = 0.9, 95% CI = 0.6, 1.5). Lac et al. (2011) examined associations between PCRQ at age 14-15 years and ever using cannabis at age 16-17 years. After controlling for other predictors in the model, they found increased levels of PCRQ at age 14-15 years to reduce the likelihood of ever using cannabis at age 16-17 years ($\beta = -0.07$, $p<0.01$). They additionally found a gender x PCRQ interaction ($\beta = -0.06$, $p<0.01$) whereby, boys with lower levels of parental communication used cannabis at a higher rate than girls. However, for boys with higher levels of parental communication, cannabis use dropped to a rate almost comparable to that of girls. Hence, the protective effects of communication interacted with gender. Hence, girls' cannabis use was low regardless of their levels of parent–child communication, but boys showed higher levels of cannabis use only when parent–child communication was poor.

4.4.5 Discussion

This systematic review identified two longitudinal studies reporting on associations between PCRQ and adolescent cannabis use between May 2004 and December 2016. One study found a direct association between PCRQ and adolescent cannabis use (Lac et al. 2011) and one only found an association for a specific sub group (Ellickson et al. 2004). Thus, only weak evidence was presented for a prospective association between PCRQ and adolescent cannabis use.

Table 26: Studies included in the systematic review examining PCRQ and adolescent cannabis use

Author Country	Study Design	Sample (n)	Method of survey	Objective	Age at Baseline Waves	Outcome	PCRQ	Statistical model	Covariates	Findings[10]
Ellickson et al. (2004) USA	Longitudinal	Project ALERT control sample (n=909)	Self-administered surveys	"To identify similarities and differences in risk factors for marijuana use initiation across grades."	Grades 7 – 8 Waves 1, 3, 5 & 6 in 3 years	Self-reported marijuana use: ever tried marijuana	Talks to parents about personal problem	Logistic regression	Baseline use	Grade 7 Talks to parents & Grade 8 use (OR = 0.6, 95% CI = 0.5, 0.9) Grade 8 Talks to parents & Grade 9 use (OR = 0.9, 95% CI = 0.6, 1.3) Grade 9 Talks to parents & Grade 10 use (OR = 0.9, 95% CI = 0.6, 1.5)
Lac et al. (2011) USA	Longitudinal	Latino students, with data from the California	In school survey with trained researchers	To examine: "associations between family factors	Grade 9 2 waves in 2 years	Self-reported lifetime marijuana use	Parental communication (4 items; Cohen et al. 1994)	Hierarchical multiple regression	All other effects	Parental communication (β = -0.07, p<0.01)

[10] NS: Not significant

	Board of Education (n = 1369)	and marijuana.”

Table 27: NOS scores for studies examining PCRQ and cannabis use

	Representativeness	Selection of non exposed cohort	Ascertainment of exposure	Outcome of interest not present at study start	Comparability of cohorts on design basis	Assessment of outcome	Follow up long enough for outcomes to occur	Adequacy of follow up cohort	TOTAL
Ellickson et al. (2004)	*	*	*	*	**	-	*	81%	8
Lac et al. (2011)	*	*	-	-	**	-	*	70%	6

Limitations of the review

Only two studies met the inclusion criteria for this review. It is plausible that some studies may have missed due to the restriction imposed by using only studies published in English. However, many systematic reviews use a language restriction and no evidence suggests that this restriction leads to bias (Visser et al. 2012). Further, due to restrictions of the search to electronic databases and to year of publication, some recent studies may have been missed. This is reflected in the small sample sizes in comparison to other reviews examining different substance using outcomes. It is possible to navigate this limitation through use of secondary data.

4.4.6 Conclusions

The last systematic review of this area found a moderate prospective association between PCRQ and adolescent cannabis use. In this present update of the review, which included an additional two studies with 2,278 participants, there was only weak evidence of a positive association. This could be partly due to only a small number of studies being identified, but both were of high methodological quality. Further, the timing of the assessment of PCRQ and cannabis use may have influenced the findings of the review as the two included studies assessed PCRQ and cannabis use at different ages in adolescence. Additionally, neither of the included studies examined cannabis dependence. Considering the limited amount of evidence available, future research would be well positioned to examine associations between PCRQ and levels of adolescent cannabis use.

4.5 Summary and implications for this study

This chapter presents the systematic reviews which examined PCRQ and adolescent use of alcohol, tobacco and cannabis. Chapter 5 presents the systematic reviews which examined school connectedness and adolescent use of alcohol, tobacco and cannabis.

Chapter 5: Systematic reviews of the association of school connectedness with adolescent alcohol, tobacco and cannabis use

5.1. Chapter overview

This chapter presents the results of three additional systematic reviews. The reviews examined prospective associations between school connectedness and adolescent alcohol, tobacco and cannabis use, respectively. They further examined the role of school connectedness as a moderator for associations between PCRQ and adolescent use of each substance type. For consistency, this chapter follows the same structure as Chapter Four.

5.2 Systematic review 1: school connectedness and the development of adolescent alcohol use

5.2.1 Research questions

This systematic review was guided by two research questions:

1. Is school connectedness associated with experimental and hazardous levels of alcohol use in adolescence?
2. Does school connectedness moderate existing associations between PCRQ and adolescent alcohol use?

5.2.2 Background

Fletcher et al. (2008) reviewed intervention and observational studies examining associations between school institutional factors and adolescent drug use, including use of alcohol, tobacco and/or cannabis, published between 1985 and March 2006. In total, four intervention and eighteen observational studies were included in the review. Two observational studies were found to specifically report upon school connectedness and

adolescent use of other illicit drugs including alcohol (n=2). Both studies were of high methodological quality and found adolescents with lower levels of school connectedness had higher levels of alcohol consumption. This review was advantageous in that it assessed the methodological quality of included studies. However, the primary focus of the review was adolescent cannabis use and studies examining adolescent alcohol use were only included if they also included cannabis using outcomes. This limited the review as had the inclusion criteria been widened to include all studies reporting specifically on alcohol using outcomes, different conclusions may have been drawn. As such, a full systematic review of studies examining school connectedness and adolescent alcohol use was necessary. The methodology and the results of the systematic review are as follows.

5.2.3 Methodology

The methodology used for this review is detailed in section 3.5.2. The electronic search strategy, exclusion criteria and screening of full papers were tailored to this review as follows:

Electronic search: Six electronic databases were searched: Ovid Medline, PsycINFO (PI), ASSIA, ERIC, Web of Science and SCOPUS. Each database were searched from January 1980 up to December 2016, using the keywords shown in Table 28. The full search terms are displayed in Appendix 3.

Exclusion criteria: Papers were excluded if they focused upon: adult populations; multiple risk behaviours; clinical/vulnerable populations; were cross sectional; or not printed in English. Papers were also excluded if they did not focus upon children and/or adolescents, school connectedness and alcohol use. Table 29 presents the full exclusion criteria.

Screening of full papers: Full papers were read in detail and excluded in line with the exclusion criterion. This process is illustrated in Figure 9.

Table 28: Specification of search parameters for school connectedness and adolescent alcohol use

Operator	**Definition**
# 1 Keywords	school* OR education* OR teacher
# 2 Keywords	longitudinal OR cohort OR prospective OR follow up
# 3 Keywords	TI ("alcohol*" OR "drink*" OR "binge")
# 4 Boolean operator	#1 AND #2 AND #3
#5 Limits language	English
#6 Limits subjects of studies	Humans AND (adolescen* OR child* OR teenager OR youth OR young OR student OR pupil)
#7 Limits kind of studies	Peer reviewed
#8 Boolean operator	#4 AND #5 AND #6 AND #7
#9 Selection	Removal of duplicates and manual exclusion of articles not meeting inclusion criteria

Table 29: Exclusion criteria specific to the systematic review examining school connectedness and adolescent alcohol use

	Include	Exclude
Population	At first assessment aged<18 years Has to be of school age and/or attended school	Adults Young people 18 and over Clinical samples Criminal samples Teenage sexuality and pregnancy Special educational needs
Exposure	School connectedness School commitment Perceived opportunities to participate Sense of belonging Quality of teacher-child relationships School attachment School engagement	School interventions School level drinking Academic performance/ attainment School substance policies Attendance Type of school attended Aspirations following school
Outcome	Alcohol Drinking Binge drinking Experimental drinking Sip of alcoholic beverage	Perceptions/perceptions towards alcohol use Alcohol related violence Drink driving (DUI) Risk behaviours Intention to drink alcohol

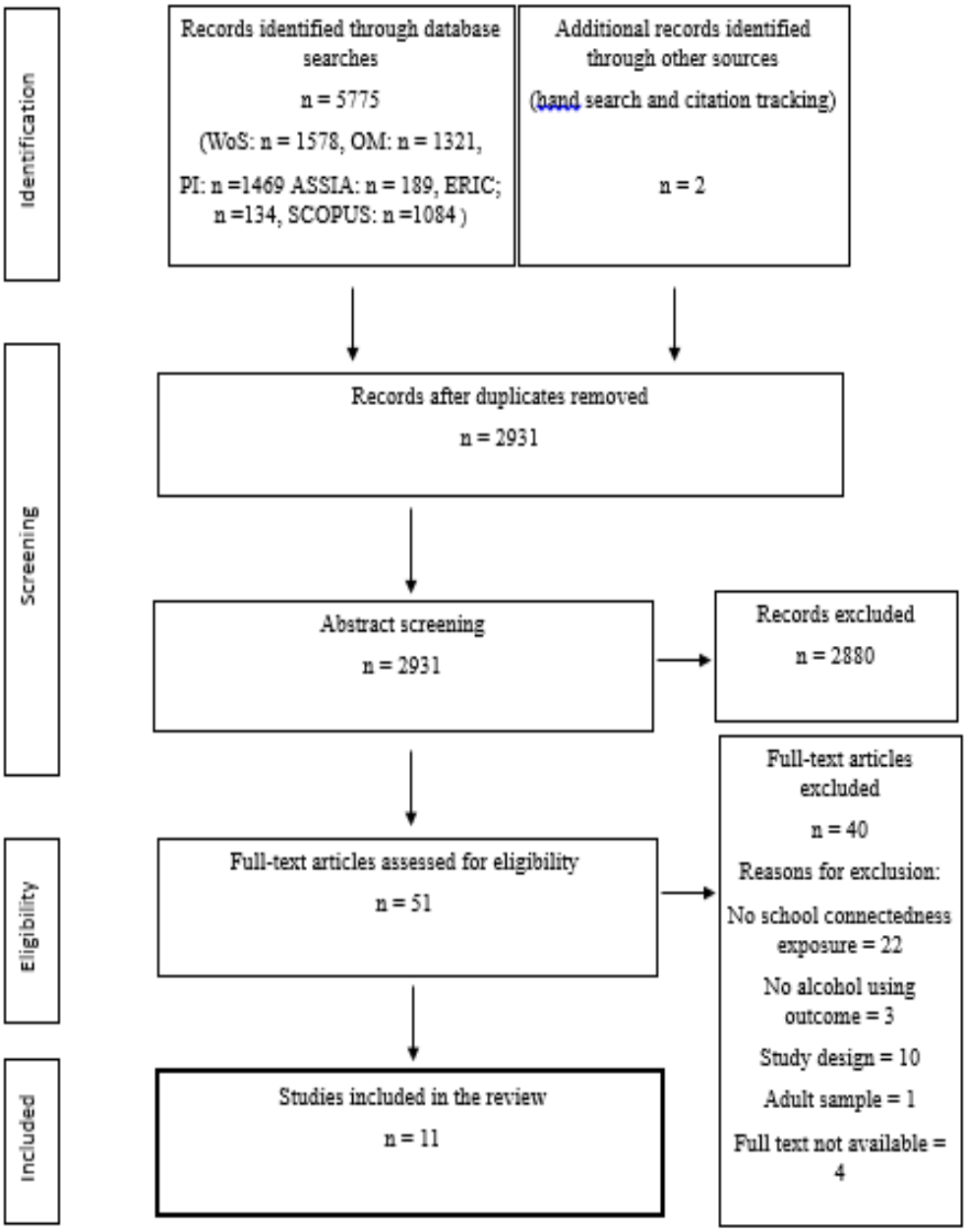

Figure 9: A schematic of the selection of research for inclusion: school connectedness and adolescent alcohol use11

[11] Key: WoS = World of Science; PM = PubMed; PI = PsychINFO

5.2.4 Results

Eleven studies with data from 67,356 participants were included in this review. All reported on prospective associations between school connectedness and adolescent alcohol use. The eleven studies are summarised in Table 30. The NOS ratings for each study are presented in Table 31.

Of the eleven included studies, eight were undertaken in the USA, one in the Netherlands, one in Italy and one in the UK. The studies varied in age at baseline, ranging from age 10 years to 14 years. The number of participants in the studies varied from 161 to 36,625. The total follow up period ranged from 1 to 7 years and the number of waves of assessment varied between 2 and 9.

All of the eleven studies assessed school connectedness and alcohol use through adolescent self-report. Table 30 presents all of the descriptions used as measures of school connectedness.

Heterogeneity was observed across the eleven included studies for measures of alcohol use. Three studies examined alcohol use in the past year (Crosnoe 2006; Botticello 2009; Perra et al. 2012), four studies examined alcohol use in the last 30 days (Bryant et al. 2003; Henry 2009; Cleveland et al. 2012; Giannotta and Ozdemir 2013), and one study examined problematic drinking over the past two weeks (Cocker and Borders 2001). Of the remaining three studies, two examined the frequency and quantity of alcohol use in terms of a quantity frequency index (QF: Mason et al. 2007; Roebroek and Koning 2016), and one examined the age of initiation alongside ever sipped alcohol (Hawkins et al. 1997). No studies used validated measures for the assessment of alcohol use.

For the analysis of associations between school connectedness and adolescent alcohol use, various statistical approaches were used. This included logistic regression models (Botticello et al. 2009; Perra et al. 2012), growth models (Henry et al. 2009), hierarchical linear modelling growth curve analysis (Bryant et al. 2003), multivariate cross lagged models (Crosnoe 2006; Cleveland et al. 2012), cross-lagged autoregressive models (Roebroek and Koning 2016), structural equation models (Hawkins et al. 1997; Cocker and Borders 2001; Giannotta and Ozdemir 2013) and path analysis (Mason et al. 2007). Notably, there was large variation in the covariates adjusted for across studies. Some studies adjusted for demographic factors including gender, grade, parental education and socio-economic status, whilst others made no adjustment for such factors.

Results of the quality assessment for studies examining associations between school connectedness and adolescent alcohol use are shown in Table 30. The mean NOS methodological quality score of the eleven included studies was 5.73 (SD = 1.35, range = 4 to 8) out of a maximum score of 9. Nine studies were of high quality (Hawkins et al. 1997; Coker and Borders 2001; Bryant et al. 2003; Crosnoe 2006; Mason et al. 2007; Boticello 2009; Henry et al. 2009; Perra et al. 2012), with only two being deemed low quality and presenting risk for considerable bias (Cleveland et al. 2012; Giannotta and Ozdemir 2013).

Of the studies deemed high quality, there were some concerns surrounding comparability as two studies failed to adjust for any major potential confounders (Coker 2001; Roebroek and Koning 2015). There were additional concerns surrounding attrition as two additional studies had rates less than 70%. Specifically, one study had attrition of 63.6% (Bryant et al. 2003), the other of 57.8% (Henry et al. 2009). However, this was not problematic as the retained sample size was sufficient for statistical analyses. All other high-quality studies had response rates of above 70%.

Table 30: Studies included in the systematic review examining school connectedness and adolescent alcohol use

Author Country	Study design	Sample (n)	Method of survey	Objective	Age at baseline Waves	Outcome	School connectedness	Statistical model	Covariates	Findings[12]
Boticello (2009) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=10,574)	Baseline: In school survey Wave 1 & 2 : In home interview with computer assisted technology	To examine: "the association between school context and adolescent alcohol misuse."	11-17 years 2 waves in 1 year	Self-reported level of alcohol misuse: number of days of use, number of days had 5+ drinks on any occasion, and number of days of drunkenness in the past year	School cohesion (3 items) Perceived safety at school (1 item)	Logistic regression	Gender, age, ethnicity, family SES, peer alcohol use and availability of alcohol in the home	Perceived school cohesion: (moderate drinking; RRR = 0.89, 95% CI = – 0.54, 1.49) (heavy drinking; RRR = 0.25, 95% CI= – 0.12, 0.50) Safety at school: (moderate drinking; RRR = 1.27, 95%

[12] NS: Not significant

										CI – 1.04, 1.56) (heavy drinking; RRR = 0.88, 95% CI – 0.57, 1.36)
Bryant et al (2003) USA	Longitudinal	Monitoring the future study (n=1897)	In classroom questionnaire	To examine "…. school attitudes at age 14 as predictors of concurrent substance use and change in substance use."	14 years 4 waves in 6 years	Self-reported alcohol use over past 30 days	School bonding (two items: Bryant et al. 2000)	Growth model (MQG = 0.06, NS)	All other variables within the model	School bonding & growth in alcohol use (MQG = 0.06) NS

Cleveland et al. (2012) USA	Two longitudinal, school-based studies	PROSPER (n=8744)	School administered questionnaires by trained university-based data collectors	To examine: "developmental changes in the relative influence of risk and protective factors (RPFs) across individual, family, peer, school, and community domains on adolescent alcohol use."	M=12.3 5 waves in 5 years	PROSPER: Self-reported alcohol use over the last month	PROSPER: School protection (7 items)	Multivariate cross-lagged models	School membership	PROSPER: Grades 6 & 7 (β = -0.04, p<0.01) Grades 9 & 10 (β = -0.07, p<0.001).
		ASAPS (n=8051)	Self-administered surveys		M=12.5 5 waves in 5 years	ASAPS: Self-reported alcohol use over past 30 days	ASAPS: School protection (9 items)		School membership	ASAPS: Grades 7 & 8 (β = -0.06, p<0.001) Grades 9 & 10 (β = -0.06, p<0.05).
Cocker and Borders (2001) USA	Longitudinal	National Education Longitudinal Study (NELS:88) (n=17,424)	Surveys completed by students, parents, teachers and school administrator	"To create and test a comprehensive model of adolescent problem drinking."	8th Grade 4 waves in 8 years	Self-reported alcohol use over past two weeks	School climate	SEM (problem drinking; SFL = 0.011, NS)	None specified	NS

Crosnoe (2006) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=11,927)	To examine "whether academic failure was a risk factor for adolescent drinking, and vice versa, and identify the mechanisms underlying longitudinal associations. "	Grades 7 - 12 2 waves in 1 year	Self-reported alcohol use over past year	School attachment (Moody and White 2003) Teacher bonding (3 items)	Multivariate cross-lagged models	Gender, age, ethnicity, family structure, parental education, school sector and school level	School attachment & alcohol use (β = −.06, NS) Teacher bonding & alcohol use (β = .12, p < .001)

Giannotta and Ozedemir (2013) Italy	Longitudinal	Three randomly selected schools (n=161)	School based questionnaire by trained researchers	To examine: "the relationship between school bonding and alcohol use."	11.14 years 3 waves over 2 years	Self-reported alcohol use over past 30 days (quantity frequency measure)	School bonding (Fend and Schur 1991; Hawkins et al. 2001) Two dimensions: 1. attachment to school (2 items) 2. commitment (1 item)	Cross-lagged autoregressive model	Gender	School bonding in Grade 6 & Grade 7 alcohol use ($\beta = -.25$, $p < .001$) School bonding in Grade 7 & Grade 8 alcohol use ($\beta = .05$, NS)
Hawkins et al. (1997) USA	Longitudinal	Seattle Development Project/18 Seattle elementary schools in high-crime neighbourhood (n=808)	Students and their caretakers self-report assessments	To examine: "the effects of age of alcohol use initiation and psychological risk factors on subsequent	5th Grade (10-11 years) 9 waves in 7 years	Self-reported alcohol misuse: The Drink and Driving Scale; The Heavy Drinking Scale; and the Alcohol	School Bonding (6 items)	SEM	None specified	School bonding & alcohol misuse ($\beta = 0.05$, NS) School bonding & age of alcohol initiation

				alcohol misuse."		Problems Scale				(β =0.151, p<0.05)
Henry et al (2009) USA	Control group of larger prevention study	US school children (n=1,064)	Pencil and paper survey	To examine: attachment to family, school and peers, and adolescent use of alcohol.	12.3 years 4 waves in 2 years	Self-reported alcohol use over the last month	School attachment (4 items)	Growth model	Gender, ethnicity, age at baseline, nesting of students in schools	School attachment & alcohol use: Within person school attachment (Est = -0.14, SE = 0.05) Between person school attachment (Est = -0.85, SE = 0.08)

Mason et al. (2007) USA	Longitudinal	Project Family (Spoth and Redmond, 2002) (n=429)	Family in-home assessment involving structured interaction tasks/additional questionnaires	To examine: "the effects of early adolescent delinquency on psychosocial functioning in family, school, and peer contexts, on alcohol use."	11 years 6 waves in 7 years	*At 16 years* Self-reported alcohol use: quantity frequency *At 18 years* Parent and self-report of problem use in the past 12 months	Prosocial school orientation Three dimensions: 1. school bonding (five items) 2. Educational aspirations (one item) 3. Grades (one item)	Path model comparisons	Parental education, early onset substance use in wave 1	Prosocial school orientation W4 & W6 alcohol use NS Prosocial school orientation W4 & W6 problem alcohol use NS
Perra et al. (2012) UK	Longitudinal	Belfast Youth Development Study (n=5371)	Surveys were administered on the school site using pen-and-paper self-completion questionnaires	"To examine whether school engagement, quality of relationships with teachers, educational aspirations …. are independently associated with future substance use."	13/14 years 2 waves in 2 years	Self-reported alcohol use over past year Two dimensions: 1. drunkenness in the last year; 2. weekly drunkenness	School Disengagement (4 items) Relationships with teachers (1 item)	Logistic regression	Socio-demographic, family and neighbourhood variables	School disengagement & drunk in last year (OR = 1.06, 95% CI = 1.02-1.10) School disengagement & weekly drunkenness (OR = 1.02, 95% CI = .99 - 1.05)

	Teacher relationship & drunk in last year (OR = 0.75, 95% CI = 0.56-1.02) Teacher relationship & weekly drunkenness (OR = 0.91, 95% CI = 0.68-1.21)

Roebroek and Koning (2016) Netherlands	Control group of trial	Preventing Heavy Alcohol Use in Adolescents (n=906)	Digital questionnaire	To examine: "the reciprocal relation between school engagement and alcohol" use.	12.3 years 4 waves in 3 years	Self-reported weekly alcohol consumption: Drawn from the Quantity-Frequency Index (Straus and Bacon, 1953).	School engagement (5 items)	Cross-lagged autoregressive model (T1: r=−0.07, p=0.019; T2: r=−0.13, p<0.001;T3: r= −0.08, p=0.03)	None specified	T1 School engagement & T2 alcohol use (r =−0.07, p<0.05) T2 School engagement & T3 alcohol use (r =−0.13, p<0.001) T3 School engagement & T4 alcohol use (r =−0.08, p<0.05)

Table 31: NOS scores for studies examining school connectedness and alcohol use

	Representativeness	Selection of non-exposed cohort	Ascertainment of exposure	Outcome of interest not present study start	Comparability of cohorts on the basis of design	Assessment of outcome	Follow up long enough for outcomes to occur	Adequacy of follow up cohort	TOTAL
Boticello (2009)	*	*	*	-	**	-	*	71%	7
Bryant et al. (2003)	*	*	-	-	**	-	*	63.57%	5
Cleveland et al. (2012)	*	*	*	-	-	-	*	65.7%	4
Cocker et al. (2001)	*	*	-	*	-	-	*	71%	5
Crosnoe (2006)	*	*	*	*	**	-	*	72.0%	8
Giannotta and Ozdemir (2013)	-	*	*	-	-	-	*	82.6%	4
Hawkins et al. (1997)	-	*	-	-	**	-	*	85.0%	5
Henry et al. (2009)	*	*	-	-	**	-	*	57.8%	5
Mason et al. (2007)	*	*	-	*	**	-	*	71%	7
Perra et al. (2012)	*	*	-	-	**	-	*	78%	6
Roebuck and Koning (2015)	*	*	*	*	-	*	*	86.4%	7

All eleven studies reported direct associations between school connectedness and adolescent alcohol use. Five studies representing 29, 842 participants, found poor school connectedness to be associated with an increased risk of alcohol consumption in adolescence (Crosnoe 2006; Botticello 2009; Henry et al. 2009; Perra et al. 2012; Roebroek and Koning 2016). This was for adolescent use of alcohol in the past week (Roebroek and Koning 2016), month (Botticello 2009; Henry et al. 2009) and year (Crosnoe 2006; Perra et al. 2012).

However, in one of these studies, findings were equivocal across levels of adolescent alcohol use. Botticello (2009) found that increased levels of school connectedness in Grade 7 (ages 12 to 13) reduced the risk of Grade 12 (ages 17 to 18) heavy drinking (five or more drinks in one occasion) by 75% (OR = 0.25, 95% CI= 0.12, 0.50), but not Grade 12 moderate drinking (drinking a few times a month or less but never consuming five drinks or more on occasion or becoming intoxicated: OR = 0.89, 95% CI= – 0.54, 1.49).

Perra et al. (2012) found that in models adjusting for socio-demographic, family and neighbourhood variables, low levels of school connectedness at age 13 to 14 years, increased the likelihood of being drunk in the last year at age 15 years by 4% (OR = 1.04, 95% CI= 1.01, 1.08), but had no effect on the likelihood of weekly drunkenness (OR = 1.00, 95% CI= 0.97, 1.03). Further, positive relationships with teachers reduced the likelihood of being drunk in the last year by 40% (OR = 0.60, 95% CI = 0.44, 0.81), but not weekly drunkenness (OR = 0.75, 95% CI= 0.54, 1.04).

Two additional studies, representing 8,905 participants, found that low levels of school connectedness increased the risk of adolescent alcohol

consumption, but only for specific grades (Cleveland et al. 2012; Gianotta and Ozdemir 2013). Cleveland et al. (2012) found that lower levels of school connectedness in Grade 6 (ages 11 to 12) were associated with increased alcohol use in Grade 7 (ages 12 to 13) ($\beta = -0.04$, $p<0.01$), and lower levels of school connectedness in Grade 9 (ages 14 to 15) were associated with increased alcohol use in Grade 10 (ages 15 to 16) ($\beta = -0.07$, $p<0.001$). No association was observed for Grade 7 (ages 12 to 13) school connectedness and Grade 8 (ages 13 to 14) alcohol use nor Grade 8 (ages 13 to 14) school connectedness and Grade 9 (ages 14 to 15) alcohol use. In an alternative adolescent sample, they found that lower levels of school connectedness in Grade 7 (ages 12 to 13) were associated with increased alcohol use in Grade 8 (ages 13 to 14) ($\beta = -0.06$, $p<0.001$), and lower levels of school connectedness in Grade 9 (ages 14 to 15) were associated with increased alcohol use in Grade 10 (ages 15 to 16) ($\beta = -0.06$, $p<0.05$). No association was observed for Grade 8 (ages 13 to 14) school connectedness and Grade 9 (ages 14 to 15) alcohol use, nor Grade 10 (ages 15 to 16) school connectedness and Grade 11 (ages 16 to 17) alcohol use. Whilst, Gianotta and Ozdemir (2013) found school bonding in Grade 6 (ages 11 to 12) to negatively predict alcohol use in Grade 7 (ages 12 to 13) ($\beta = -.25$, $p < .001$), but not in Grade 8 (ages 13 to 14) ($\beta = .05$, ns).

The remaining four studies, representing 28,609 participants, did not find an association between school connectedness and adolescent alcohol use. Specifically, Bryant et al. (2003) found school bonding as not associated with rates of growth in alcohol use from 14 to 20 years (MQG = 0.06). Whilst Cocker and Borders (2001), Hawkins et al. (1997) and Mason et al. (2007) all found school connectedness to not be associated with the development of problematic drinking in adolescence.

No studies examined school connectedness as a moderator of the association between PCRQ and adolescent alcohol use. Notably, one study did observe the interaction between school connectedness and perceived parental support with adolescent alcohol use. However, the model specifically examined parental support as a moderator for associations between school engagement and alcohol consumption (Roebuck and Koning 2015). They found that for adolescents with low-parental support, school engagement was not associated with alcohol use 1 year later, but for adolescents with high-parental support, school engagement had a negative effect on alcohol consumption 1 year later ($r=-0.14$, $p<0.001$ and $r=-0.15$, $p<0.01$).

5.2.5 Discussion

This review firstly sought to summarise the strength of the evidence on the association between school connectedness and adolescent alcohol use. Eleven studies were included, nine of which were of high quality (Hawkins et al. 1997; Coker and Borders 2001; Bryant et al. 2003; Crosnoe 2006; Mason et al. 2007; Boticello 2009; Henry et al. 2009; Perra et al. 2012). Overall, moderate evidence was presented for a prospective association between school connectedness and adolescent alcohol use. Five studies reported a negative association, whereby low levels of school connectedness were linked to increased levels of adolescent alcohol use (Crosnoe 2006; Botticello 2009; Henry et al. 2009; Perra et al. 2012; Roebroek and Koning 2016), two studies reported an association but only for specific sub groups (Cleveland et al. 2012; Gianotta and Ozdemir 2013) and four studies reported no association (Hawkins et al. 1997; Cocker and Borders 2001; Bryant et al. 2003; Mason et al. 2007). Of the five studies reporting a negative association between school connectedness and adolescent alcohol use, associations were weak within the fully adjusted analyses. The findings from this review support the earlier conclusions of Fletcher et al. (2008) whereby adolescents with lower levels of school

connectedness had higher levels of alcohol consumption. However, the findings of this review are more in depth than those of Fletcher et al. due to firstly synthesising evidence from a larger number of studies and secondly, by assessing the methodological quality of all included studies, by way of the Newcastle Ottawa Scale.

This review found no studies which examined school connectedness as a moderator for associations between PCRQ and adolescent alcohol use.

Limitations of the studies

The studies included in this review presented some notable limitations. Firstly, issues presented in terms of the generalisability of findings to wider contexts. For example, one study examined alcohol use amongst a small sample of Italian adolescents (Giannotta and Ozdemir 2013), another examined alcohol use amongst adolescents who were predominantly white and from lower–middle class backgrounds (Mason et al. 2007) and another reported levels of alcohol consumption at age 17-18 years not comparable to the general population (Hawkins et al. 1997). Further, some studies drew samples from the control arms of school-based trials and the eligibility criterion may have affected the representativeness of the sample (Cleveland et al. 2012). Secondly, issues presented in terms of attrition whereby adolescents who were missing alcohol using outcomes were more likely to use alcohol at an earlier age, causing less variation in outcome measures and the most at risk adolescents potentially being underrepresented (Bryant et al. 2003; Botticello et al. 2009). Also, some studies reported selective attrition whereby less educated families were more likely to leave the study, and one study observed that these families had lower levels of school connectedness than those remaining within the sample (Mason et al. 2007). Hence, the effects of school connectedness may have been underestimated across the included studies. Thirdly, the measurement of school connectedness differed across studies whereby

some studies emphasised teacher bonding (Coker and Borders 2001; Perra et al. 2012), whilst others focused on connectedness to peers or the academic institution. This had the potential to yield different results and combination of such factors could have led to diluted conclusions or increased if the reverse was true. Further, the assessment of adolescent alcohol use also differed across studies. Research studies using the same measures of alcohol using outcomes would have been beneficial.

Limitations of the review

Despite a detailed search strategy being used, some studies may have been missed due to the restriction of the search to six electronic databases. Further, the review was reliant on the authors' descriptions of the exposures and outcomes examined, thus effect sizes were reported inconsistently across studies, and in some cases not reported. Hence, *p*-values were relied upon to denote the statistical significance of associations.

5.2.6 Conclusion

In the present review, moderate evidence was found for a prospective association between school connectedness and adolescent alcohol use. Five studies reported an association, two studies reported an association but only for specific groups and four studies reported no association. The quality of studies according to the NOS was high. Most studies examined the onset of alcohol consumption, with only five studies examining frequency of use or hazardous levels of use. Little evidence was found for an association with hazardous levels of use.

The evidence reviewed suggests that school connectedness is associated with adolescent alcohol consumption, but associations may differ across varying intensities of alcohol use. Further, no studies were found to

examine the effects of school connectedness as a moderator for associations between PCRQ and adolescent alcohol use. Given these gaps in the knowledge base, future research would be well positioned to examine associations between school connectedness and levels of adolescent alcohol use, particularly examining the moderating effect of school connectedness upon associations between PCRQ and levels of adolescent alcohol use.

5.3 Systematic review 2: school connectedness and the development of adolescent smoking

5.3.1 Research questions

The second systematic review sought to answer two questions:

1. Is school connectedness associated with experimental and hazardous levels of cigarette smoking in adolescence?
2. Does school connectedness moderate associations between PCRQ and cigarette smoking in adolescence?

5.3.2 Background

Two existing reviews examined associations between school connectedness and adolescent cigarette smoking. In a critical review of the literature, Tyas and Pederson (1998) synthesised the sociodemographic, environmental, behavioural and personal risk factors associated with adolescent cigarette smoking. Only one study was found to report on associations between school connectedness and smoking status, whereby those less connected to school were more likely to smoke cigarettes in adolescence than those who were connected to school. Fletcher et al. (2008) examined intervention and observational studies reporting on school institutional factors and cigarette smoking in adolescence. Studies were searched up until March 2006. They found an association between school connectedness and adolescent smoking (n=3), whereby adolescents

with low levels of school connectedness were more likely to smoke than those who were strongly connected to school. The studies were seen to be of high methodological quality, due to minimising problems arising from confounding via adjustment or restriction. The evidence presented across included studies was consistent. Even so, the primary focus of the review was adolescent cannabis using behaviours and studies solely examining adolescent smoking outcomes were only included if they also examined cannabis using outcomes. This may have meant studies solely reporting on tobacco use would have been missed. Taking into account these limitations, a full systematic review of longitudinal studies examining associations between school connectedness and adolescent smoking was necessary.

5.3.3 Methodology

The methodology used to undertake this systematic review has been specified in section 3.5.2. This methodology was tailored for this review in terms of the electronic search strategy, exclusion criteria and screening of full papers.

Electronic search: Six electronic databases were searched: Ovid Medline, PsycINFO (PI), ASSIA, ERIC, Web of Science and SCOPUS. Each was searched from 1980 up to December 2016, using the keywords shown in Table 32. An example of the specific search terms used are presented in Appendix 3.

Exclusion criteria: Papers were excluded if they: focused upon adult populations, multiple risk behaviours, clinical populations, were cross sectional, or not printed in English. Papers were further excluded if they did not focus upon children and/or adolescents, school connectedness and tobacco use. Table 33 presents the full exclusion criteria.

Screening of full papers: Full papers were read in detail and excluded according to the criteria presented in Table 33. This process has been illustrated in Figure 10.

Table 32: Specification of search parameters for school connectedness and adolescent smoking

Operator	**Definition**
# 1 Keywords	school* OR education* OR teacher
# 2 Keywords	longitudinal OR cohort OR prospective OR follow up
# 3 Keywords	TI ("smok*" OR "tobacco*" OR "cigarette")
# 4 Boolean operator	#1 AND #2 AND #3
#5 Limits language	English
#6 Limits subjects of studies	Humans AND (adolescen* OR child* OR teenager OR youth OR young OR student OR pupil)
#7 Limits kind of studies	Peer reviewed
#8 Boolean operator	#4 AND #5 AND #6 AND #7 AND #8
#9 Selection	Removal of duplicates and manual exclusion of articles not meeting inclusion criteria

Table 33: Exclusion criteria specific to the systematic review examining school connectedness and adolescent smoking

	Include	Exclude
Population	At first assessment aged<18 years Has to be of school age and/or attended school	Adults Young people 18 and over Clinical samples Criminal samples Teenage samples examining sexuality/pregnancy Special educational needs
Exposure	School connectedness School commitment Perceived opportunities to participate in school Sense of belonging Teacher-child relationships School engagement School attachment School bonding	School interventions School level smoking Academic performance and attainment School substance policies Attendance Type of school attended Aspirations following school
Outcome	Smoking Tobacco use Cigarette use Ever tried smoking, even one puff	Perceptions of smoking Attitudes towards smoking Intention to smoke Vapour smoking Electronic cigarettes Water pipe use

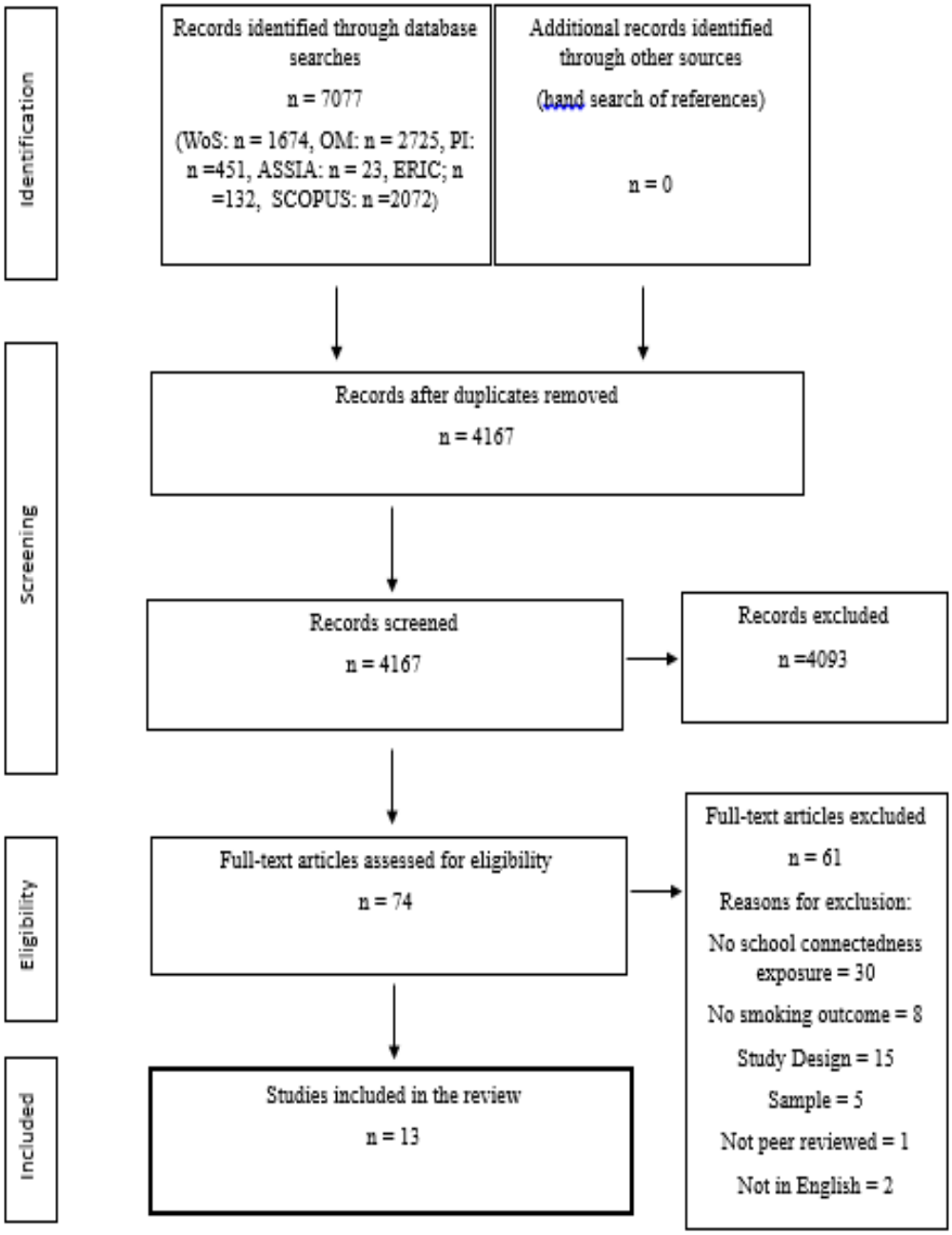

Figure 10: A schematic of the selection of research for inclusion: school connectedness and adolescent smoking[13]

[13] Key: WoS = World of Science; PM = PubMed; PI = PsycINFO

5.3.4 Results

Thirteen studies, with data from 78,562 participants, reported upon the association between school connectedness and adolescent smoking. The characteristics of each study are presented in Table 34. Table 35 presents the NOS ratings for each study included in the review.

Of the thirteen studies included in the review, five were undertaken in the USA, 4 in the UK, 1 in Australia, 1 in Taiwan, 1 in China and 1 in Korea. The studies varied in age at baseline, ranging from birth to Grades 7-12. The number of participants in the studies varied from 270 to 15,770. The total follow up period ranged from 1 year to 26 years and the number of waves varied between 2 and 7.

There was some heterogeneity in measures of school connectedness whereby three studies directly examined the factor of school connectedness (Bond et al. 2007; Henderson et al. 2008; Xie et al. 2013), whilst others measured concepts of: school attachment (Chen et al. 2014; Andersson and Maralani 2015; Hen et al. 2016); school bonding (Bryant et al. 2000; Ennett et al. 2010); school (dis)engagement (Perra et al. 2012; Staff et al. 2016); school dissatisfaction (van den Bree et al. 2004); school related consciousness (Hagger-Johnson et al. 2012); and school commitment (Kim et al. 2009). Two studies examined teacher-pupil relationships in addition to the original school connectedness measures (Perra et al. 2012; Xie et al. 2013). This provided a more robust indicator of an adolescent's orientation to school. The majority of school connectedness measures were assessed through adolescent report with only one study using teacher report (Andersson and Maralani 2015). Table 22 demonstrates all of the terms and descriptions used for the measurement of school connectedness.

Table 34: Studies included in the systematic review examining school connectedness and adolescent smoking

Author Country	Study design	Sample (n)	Method of survey	Objective	Age at baseline Waves	Outcome	School connectedness	Statistical model	Covariates	Findings[14]
Andersson and Maralami (2015) USA	Cohort study	1970 British Cohort Study (n= 5657)	Secondary data analysis	To examine: "educational experiences smoking initiation and quitting during adolescence."	Birth 6 waves over 26 years	Self-reported cigarette use over past three months	School attachment (4 items)	Nested linear probability models (LPMs)	SES Maternal age Birth weight Parity Congenital conditions Cognitive, social, emotional and school factors	School attachment and never smoked regularly (β = - 0.107, p < .01)

[14] NS: Not significant

Bond et al. (2007) Australia	Longitudinal	Gatehouse project (n=2678)	At baseline: Supervised in school survey Follow up interviews: computer-assisted telephone interviews	"To examine associations between … school engagement in early secondary school and substance use…2–4 years later."	Year 8 3 waves over 3 years	Self-reported smoking in the past week	School connectedness scale (Henderson et al. 1980)	Logistic regression	baseline school connectedness	Smoke (OR = 1.6; 95% CI: 1.2 - 2.1; p < .001) Regular smoking (OR = 1.9; 95% CI: 1.4 - 2.7; p < .001)
Bryant et al. (2000) USA	National panel data	Monitoring the Future Project (n = 3056)	Baseline: In-school questionnaires Follow up: Postal surveys	To examine: "relations among academic achievement, school bonding, school misbehaviour, and cigarette use from 8th to 12th grade."	Grade 8 3 waves over 4 years	Self-reported cigarette use in past 30 days.	School bonding (3 items: Finn 1989; Hawkins et al. 1997; Hirschi 1969)	SEM	None specified	School bonding and cigarette use NS

Chen et al. (2014) Taiwan	Longitudinal	Child and Adolescent Behaviors in Long-term Evolution (CABLE) project (n = 1937)	Not specified	"To examine relationships between social structure, social capital and changes in smoking status from the 8th to 9th grade in Taiwan."	Grade 8 2 waves over 1 year n = 1937	Self-reported lifetime smoking status	School attachment	Logistic regression	Demographic factors not fully specified social structure	School attachment and becoming a smoker (OR = 0.80, 95% CI = 0.69, 0.94)
Ennett et al. (2010) USA	Longitudinal	Census data including longitudinal survey and a random sample of parents (n=6544)	Adolescent sample: In school survey Parent sample: Telephone survey	To: "apply … Bronfenbrenner's ,,, theory to [the] development of youth cigarette smoking."	M=13.12 years 5 waves over two years	Self-reported past smoking status in the past six months (Fagerstrom Test for Nicotine Dependence ; Heatherton et al. 1991)	School closeness (3 items)	Linear growth model	Gender Ethnicity Family structure Parental education High school enrolment	School closeness and adolescent smoking NS

Hagger-Johnson et al. (2012) UK	Longitudinal	Longitudinal Study of Young People in England (LSYPE) (n=15770)	1. Interview 2. Parental interview 3. Household information file	"To establish whether school-related conscientiousness was associated with the onset and change in … cigarette smoking frequency."	Year 9 (13-14 years) 4 waves in 4 years	Self-reported lifetime smoking	School related conscientiousness	Latent growth curve modelling (LGCM)	Parental SES Parental monitoring Frequency out with friends Psychiatric morbidity Birth weight	School conscientiousness And increased smoking frequency among smokers (β = .20 (.18))
Han et al. (2016) Korea	Longitudinal	Korea Youth Panel Survey (N=3449)	Not specified	To examine: "the relationship between attachment and the onset of substance use."	2nd year middle school 5 waves in 6 years	Self-reported cigarette use in lifetime. Categorical variable. Derived from data.	Teacher attachment(3 items)	Discrete time-survival analysis with logistic regression	Sex Family income, Parental education Family structure Peer substance use	Teacher attachment & cigarette use (RRR = 0.11, SE = 0.05)

Henderson et al. (2008) Scotland	Longitudinal	Two successive cohorts (n=5092)	Questionnaires administered in school by trained researchers	To examine: "whether school characteristics can account for school differences in smoking rates."	13-14 years (M=14yrs 2months) 2 waves in 2 years	Self-reported lifetime cigarette use	Attitude to school (2 items) Teacher-pupil relationship (2 items)	Multi level modelling	Pupil-level and school level characteristics alongside baseline smoking	Odds of being a smoker Attitude to school (OR = 1.45, 95% CI = 1.35, 1.51) Teacher pupil relationships (OR = 1.13, 95% CI = 1.04, 1.17)
Kim et al. (2009) USA	Longitudinal	Raising Healthy Children (RHC) project (n=270)	In-person surveys with students, telephone interviews with parents	"To identify… predictors of progression to daily smoking by the end of high school among youths who initiated smoking by grade 8."	1st or 2nd Grade Annual follow up through 18 years	Self-reported progression to daily smoking through use in the last month	School commitment (2 items)	Discrete time survival	Gender SES	School commitment & smoking progression NS

Perra et al. (2012) UK	Longitudinal	Belfast Youth Development Study (n=2968)	In school self-completed questionnaires, under the supervision of BYDS research-staff	"To examine whether students' school engagement, relationships with teachers, …are associated with various measures of subsequent substance use."	13/14years 2 waves in 2 years	Self-reported smoking over the past 12 months	School Disengagement (4 items) Relationships with teachers (1 item)	Logistic regression	Socio-demographic factors Family factors Neighbourhood factors	School disengagement: smoking in the last year (OR = 1.02, 95% CI = 0.98, 1.07) daily smoking (OR = 1.00, 95% CI = 0.96, 1.04) Teacher-pupil relationship: smoking in last year (OR = 0.91, 95% CI = 0.73, 1.14) daily smoking (OR = 0.49, 95% CI = 0.31, 0.79)

Staff et al. (2016) UK	Longitudinal	Millennium Cohort Study MCS (n=13287)	Not specified	To examine: "the association between early [cigarette] use initiation and age 11 school engagement."	9 months 5 waves in 11 years	Self-reported lifetime cigarette use	School engagement (10 items)	Logistic regression	SES Parental substance use Child characteristics Child behaviours	School engagement and smoking initiation (OR = 1.04, 95% CI = 0.71, 1.52)
van den Bree et al. (2004) USA	Longitudinal	National Longitudinal Study of Adolescent Health (n=14333) Waves 1 & 2	Computer-assisted personal interview in the presence of trained researchers	"To study the development of smoking behaviour."	Grades 7 - 12 2 waves in 1 year	Stages of smoking development (1 item)	School Dissatisfaction (1 item)	Logistic regression	None specified	Experimental/regular smoking initiation Girls=NS Boys= NS Progression to regular smoking Girls=NS Boys= NS Discontinuation of experimental/regular

										smoking Girls=NS Boys= NS
Xie et al. (2013) China	Longitudinal	Chinese adolescents drawn from the Wuhan Smoking Prevention Program (WSPT) (n=3521)	Questionnaire	"To identify developmental trajectories of cigarette use and risk factors associated with the distinct developmental courses of smoking in Chinese early adolescents from age 12 to 16 years."	Grades 7-9 2 waves in 2 years	Self-reported lifetime cigarette use Self-reported cigarette use in the past 30 days.	School connectedness	Growth mixture modelling	Gender Urbanicity Parental education School enrolment	Stable light/occasional smokers (OR = 0.73, 95% CI = 0.6, .88) Accelerating smokers (OR = 0.59, 95% CI = 0.35, 1.02) Stable light/occasional smokers v's accelerating smokers (OR = 0.82, 95% CI = 0.6, 0.88).

There was heterogeneity in measures of adolescent smoking. Three studies assessed having ever smoked (Xie et al. 2013; Andersson and Maralani 2015; Staff et al. 2016), three studies assessed cigarette use in the last 12 months (Perra et al. 2012; Chen et al. 2014; Han et al. 2016) and others assessed more recent levels of use. This included current smoking (Henderson et al. 2008), daily smoking (Kim et al. 2009), past week smoking (Bond et al. 2007) and smoking in the past 30 days (Bryant et al. 2000). Two additional studies used measures of past 30 day use in conjunction with having ever smoked (van den Bree et al. 2004; Xie et al. 2013). This enabled adolescent smoking to be assessed through use of mutually exclusive categories whereby categories included 0 for lifetime non-smokers (e.g. never smoked), 1 for recent non-smokers (ever puffed a cigarette but not during the past 30 days), 2 for recent occasional users (smoked less than 10 days during the past 30 days), and 3 for recent frequent users (smoked on 10 or more days in the past 30 days) (Xie et al. 2013). Only one study utilised a validated measure of nicotine dependence – the Fagerstrom Test for Nicotine Dependence (FTND: Heatherton et al. 1991)(Ennett et al. 2010). This enabled adolescent smoking to be assessed over the past 3 months, on a continuum from never smoked to the emergence of dependence. All studies used adolescent self-report for the assessment of smoking behaviours.

A range of statistical approaches were used to analyse associations between school connectedness and adolescent smoking behaviours. Five studies used more “traditional” regression analysis (van den Bree et al. 2004; Bond et al. 2007; Perra et al. 2012; Chen et al. 2014; Staff et al. 2016). Others used more “sophisticated” methods including multi-level modelling (Henderson et al. 2008; Ennett et al. 2010), structural equation modelling (SEM) (Bryant et al. 2000), nested linear probabaility models (Andersson and Maralani 2015), latent class growth modelling (LCGM) (Hagger-Johnson et al. 2012), discrete time survival analysis (Kim et al.

2009; Han et al. 2016) and growth mixture modelling (Xie et al. 2013). There was variation in the covariates that were adjusted for across studies. Primarily studies adjusted for demographic factors including: gender, grade, parental education and socio-economic status. However, there was no standardised approach and two studies made no adjustments.

Results of the quality assessment for studies examining PCRQ and the development of adolescent smoking are shown in Table 23. The mean NOS methodological quality score was 6.08, (SD = 0.64, range = 5 to 7) out of a maximum score of 9. All of the thirteen studies were of high quality (Bryant et al. 2000; van den Bree et al. 2004; Bond et al. 2007; Henderson et al. 2008; Kim et al. 2009; Ennett et al. 2010; Hagger-Johnson et al. 2012; Perra et al. 2012; Xie et al. 2013; Chen et al. 2014; Andersson and Maralani 2015; Han et al. 2016; Staff et al. 2016). As seen in Table 23, two studies received a total score of 5, eight studies received a total score of 6, and three studies received a total score of 7. No studies received a total score of 8 or 9.

Even though all thirteen studies were of high methodological quality, two studies failed to demonstrate that the outcome of interest was not present at the start of study. Four studies additionally reported high levels of attrition, with sample retention being at 34% (Andersson and Maralani 2015), 65% (van den Bree et al. 2004), 66.8% (Ennett et al. 2010) and 69.5% (Henderson et al. 2008). This may have led to an under or overestimation in the association between school connectedness and smoking was different in those who remained compared to those lost to follow up (Bond et al. 2007, Bryant et al. 2000)

Table 35: NOS scores for studies examining school connectedness and adolescent smoking

	Representativeness	Selection of non exposed cohort	Ascertainment of exposure	Outcome of interest not present at study start	Comparability of cohorts on design basis	Assessment of outcome	Follow up long enough for outcomes to occur	Adequacy of follow up	TOTAL
Andersson and Maralami (2015)	*	*	*	-	**	-	*	34%	6
Bond et al. (2007)	-	*	*	-	*	-	*	90%	5
Bryant et al (2000)	*	*	*	-	*	-	*	79%	6
Chen et al. (2014)	*	*	*	-	**	-	*	96.4%	7
Ennett et al. (2010)	*	*	*	-	**	-	*	66.8%	6
Hagger-Johnson et al. (2012)	*	*	*	-	**	-	*	98%	7
Hans et al. (2016)	*	*	-	-	**	-	*	71.3%	6
Henderson et al. (2008)	*	*	-	*	**	-	*	69.5%	6
Kim et al. (2009)	-	*	-	-	**	-	*	84.4%	5
Perra et al. (2012)	*	*	-	-	**	-	*	78%	6
Staff et al. (2016)	*	*	-	-	**	-	*	81.4%	6
van den Bree et al. (2004)	*	*	*	-	**	-	*	65%	6
Xie et al. (2013)	*	*	-	*	**	-	*	88.2%	7

Six studies, representing 22,334 participants, found school connectedness to be linked to adolescent smoking (Bond et al. 2007; Henderson et al. 2008; Xie et al. 2013; Chen et al. 2014; Andersson and Maralani 2015; Han et al. 2016). However, the effects of school connectedness differed across studies.

Of those studies examining having ever smoked in adolescence, Chen et al. (2014) found that those with higher levels of school connectedness in Grade 8 (ages 13 to 14) were 20% less likely to change from a being non-smoker to a smoker in Grade 9 (ages 14 to 15) (OR = 0.80, 95% CI= 0.69, 0.94). Whilst Henderson et al. (2008) found that adolescents with lower levels of school connectedness at 13-14 years were 45% more likely to start smoking at 15-16 years (OR = 1.45, 95% CI = 1.35, 1.51). They further found that adolescents with weak teacher-pupil relationships at 13-14 years were 13% more likely to start smoking at 15-16 years (OR = 1.13, 95% CI = 1.04, 1.17). Andersson and Maralani (2015) found that adolescents reporting low levels of school connectedness at age 16, had an increased risk of being a smoker at age 16 ($\beta = -0.08$, $p < .01$) and an increased risk of being a smoker at age 26 ($\beta = -0.05$, $p < .05$). In contrast, Han et al. (2016) found increased teacher-pupil relationships at 13-14 years as associated with a decreased average age of cigarette smoking.

For studies reporting on smoking progression, Xie et al. (2013) found that adolescents with high levels of school connectedness were 27% less likely to be in the trajectory group of stable light/occasional smokers (OR = 0.73, 95% CI = 0.6, 0.88). However, there was no consistent effect of school connectedness between stable light/occasional smokers and increasing smokers (OR = 0.82, 95% CI = 0.48, 1.39), or non-smokers and increasing smokers (OR = 0.59, 95% CI = 0.35, 1.02).

For studies reporting upon both ever smoking and smoking progression, Bond et al. (2007) found that adolescents with low school connectedness in

Grade 8 (ages 13 to 14) were 60% more likely to have ever smoked in Grade 10 (15 to 16 years) (OR = 1.60, 95% CI= 1.20, 2.10) and 90% more likely to become regular smokers (OR = 1.90, 95% CI= 1.40, 2.70) than those with high school connectedness.

An additional two studies, representing 18,826 participants, found low levels of school connectedness were associated with an increased the risk of smoking behaviours in adolescence, but only for specific groups. Hagger-Johnson et al. (2012) found that for both boys and girls, low levels of school connectedness in Year 9 (ages 13 to 14) was linked to Year 10 (ages 14 to 15) and Year 12 (ages 16 to 17) smoking initiation (β = –.40/–.44). However, no effect was found for cigarette use frequency, for either gender. Whilst Bryant et al. (2000) found that low levels of school connectedness in Grade 8 (ages 12 to 13) was linked to increased cigarette use in Grade 12 (ages 16 to 18) for Grade 8 (ages 12 to 13) early initiators, but not for Grade 8 (ages 12 to 13) non-smokers.

The remaining five studies, representing 37,402 participants, did not find an association between school connectedness and adolescent smoking in the whole group nor in a sub group analysis by participant gender (van den Bree et al. 2004; Kim et al. 2009; Ennett et al. 2010; Perra et al. 2012; Staff et al. 2016). Interestingly, Perra et al. (2012) did find that in unadjusted models, school disengagement and student–teacher relationships at 13-14 years were both linked to increased daily smoking at 15-16 years. Those disengaged from school at 13-14 years were 13% more likely to smoke daily at 15-16 years (OR = 1.13, 95% CI = 1.09, 1.16) and those who had positive teacher relationships at 13-14 years were 36% less likely to smoke daily at 15-16 years (OR = 0.64, 95% CI = 0.52, 0.80). However, these effects disappeared in the fully adjusted models (school disengagement: OR = 1.02, 95% CI = 0.98, 1.07; teacher relationships: OR = 0.92, 95% CI = 0.66, 1.27).

No studies examined the moderating influence of school connectedness upon associations between PCRQ and adolescent smoking, nor any wider school based factors.

5.3.5 Discussion

Thirteen studies were included in this review, all of which were of high methodological quality. Six studies reported a prospective association between school connectedness and adolescent smoking (Bond et al. 2007; Henderson et al. 2008; Xie et al. 2013; Chen et al. 2014; Andersson and Maralani 2015; Han et al. 2016), two studies reported a prospective association for specific sub-groups (Bryant et al. 2000; Hagger-Johnson et al. 2012) and five studies reported no association (van den Bree et al. 2004; Kim et al. 2009; Ennett et al. 2010; Perra et al. 2012; Staff et al. 2016). In the six studies reporting an association, there was an association between school connectedness and the onset of smoking in the fully adjusted analysis, with all six studies in agreement on the existence and direction of the relationship between school connectedness and adolescent smoking. Evidence further suggested that adolescent with lower levels of school connectedness were more likely to smoke experimentally, be light/occasional smokers and progress to regular smoking in young adulthood. These findings are in accordance with the two prior reviews identified for this area (Tyas et al. 1998; Fletcher et al. 2008).

Limitations of included studies

The studies included in this review presented some limitations. Firstly, as aforementioned, four studies had high levels of attrition (van den Bree et al. 2004; Henderson et al. 2008; Ennett et al. 2010; Andersson and Maralani 2015). An additional two studies found those lost to follow up had lower levels of school connectedness and higher smoking rates at baseline (Bryant et al. 2000; Bond et al. 2007), or were males with lower

GPAs at baseline (Bryant et al. 2000). This limits the generalisability of findings to wider populations.

Secondly, there was a lack of consistency in measures of school connectedness across studies (see Table 34). Some studies examined school connectedness through one item (van den Bree et al. 2004; Xie et al. 2013; Chen et al. 2014), whilst others examined it through two (Henderson et al. 2008; Kim et al. 2009) or more items (Bryant et al. 2000; Han et al. 2006; Bond et al. 2007; Ennett et al. 2010; Hagger-Johnson et al. 2012; Perra et al. 2012; Andersson and Maralani 2015; Staff et al. 2016).

Thirdly, there was wide variation in the measurement of smoking behaviours across studies: three studies examined ever smoked (Xie et al. 2013; Andersson and Maralani 2015; Staff et al. 2016); three examined cigarette use in the last 12 months (Perra et al. 2012; Chen et al. 2014; Han et al. 2016); one examined current smoking (Henderson et al. 2008); one examined daily smoking (Kim et al. 2009); one examined smoking in the past week (Bond et al. 2007); one examined smoking in the past 30 days (Bryant et al. 2000); two examined past 30 day use in addition to having ever smoked (van den Bree et al. 2004; Xie et al. 2013); and one used the FTND, a validated measure of nicotine dependence (Ennett et al. 2010). Even though the FTND is a validated measure, it is somewhat dated as questions contained are not applicable to smoking behaviours observed within society today (e.g. smoking in private spaces in some countries). However, this was the only study to examine nicotine dependence using a validated measure.

Limitations of the review

Despite a detailed search strategy being used, some studies may have been missed due to the restriction of the search to six electronic databases. Further, only studies published in English were included in the review. Even so, these restrictions are used within many systematic reviews and the specification of such limits is a requirement of the PRISMA statement.

5.3.6 Conclusions

This is the first full systematic review which specifically examined prospective associations between school connectedness and smoking in adolescence. A large number of studies were included in this review (n=13) and overall, strong evidence was found for a prospective association between school connectedness and adolescent smoking. However, the strength of this evidence differed across smoking outcomes whereby there was stronger evidence for an association of school connectedness with progression to daily smoking than with experimental smoking behaviours. No studies were identified which examined school connectedness as a moderator for associations between PCRQ and smoking in adolescence.

5.4 Systematic review 3: school connectedness and the development of adolescent cannabis use

5.4.1 Research questions

This systematic review sought to answer two research questions:

1. Is school connectedness associated with the onset, frequency and hazardous levels of cannabis use in adolescence?

2. Does school connectedness moderate the association between parent-child relationship quality and adolescent cannabis use?

5.4.2 Background

Fletcher et al. (2008) reviewed intervention and observational studies reporting on school level effects for adolescent drug use, published between 1980 and March 2006. Four intervention studies and eighteen observational studies were included in the review, with observational studies reporting both disengagement from school and poor teacher–student relations as independently associated with adolescent cannabis use after adjustment for students' demographic characteristics, socio-economic status and prior drug use. This review presents a sufficient synthesis of evidence for the examination of longitudinal associations between school connectedness and adolescent cannabis use up until March 2006. The present review examined studies published after this date.

5.4.3 Methodology

The methodology used for undertaking this systematic review is specified in section 3.5.2. This methodology was tailored in terms of the electronic search strategy, exclusion criteria and screening of full papers.

Electronic search: Six electronic databases were searched: Ovid Medline, PsycINFO (PI), ASSIA, ERIC, Web of Science and SCOPUS. Each was searched from April 2006 up to December 2016, using the keywords shown in Table 36. These date limits were imposed on the search to avoid replication of the studies identified by Fletcher et al. (2008) and to extract more recent evidence.

Table 36: Specification of search parameters for school connectedness and adolescent cannabis use

Operator	Definition
# 1 Keywords	school* OR education* OR teacher
# 2 Keywords	longitudinal OR cohort OR prospective OR follow up
# 3 Keywords	TI ("cannabis" OR "marijuana" OR "marihuana" OR “hash*”)
# 4 Boolean operator	#1 AND #2 AND #3
#5 Limits language	English
#6 Limits subjects of studies	Humans AND (adolescen* OR child* OR teenager OR youth OR young OR student OR pupil)
#7 Limits kind of studies	Peer reviewed
#8 Limits year	April 2006 – Present day
#9 Boolean operator	#4 AND #5 AND #6 AND #7
#10 Selection	Removal of duplicates and manual exclusion of articles not meeting inclusion criteria

Exclusion criteria: As previously detailed, papers were excluded if they focused upon adult populations, multiple risk behaviours, clinical populations, were cross sectional or not printed in English. Papers were also excluded if they did not focus upon children and/or adolescents, school connectedness and cannabis use. Table 37 presents the full exclusion criteria.

Screening of full papers: Full papers were read in detail and excluded according to the criteria outlined in Table 37. Studies included are listed in Table 38. This process is illustrated in Figure 11.

Table 37: Exclusion criteria specific to the systematic review examining school connectedness and adolescent cannabis use

	Include	**Exclude**
Population	Time point of 1st wave <18 years Has to be of school age and/or attended school	Adults Young people over 18 Clinical samples Criminal samples Teenage sexuality and pregnancy samples Medical cannabis use (cancer treatment, pain management, etc.) Special educational needs
Exposure	School connectedness School commitment Perceived opportunities to participate in school Sense of belonging Teacher-child relationships School engagement School attachment School bonding	School interventions with no focus on school mechanisms – only delivered in school Academic performance and attainment School substance policies Attendance Type of school attended Aspirations following school
Outcome	Use of cannabis (including marijuana, hashish, skunk) Any use of cannabis not prescribed	Perceptions on cannabis use Attitudes towards cannabis use Risk behaviour(s) Intention to use cannabis Medical cannabis use THC Cannabis oil

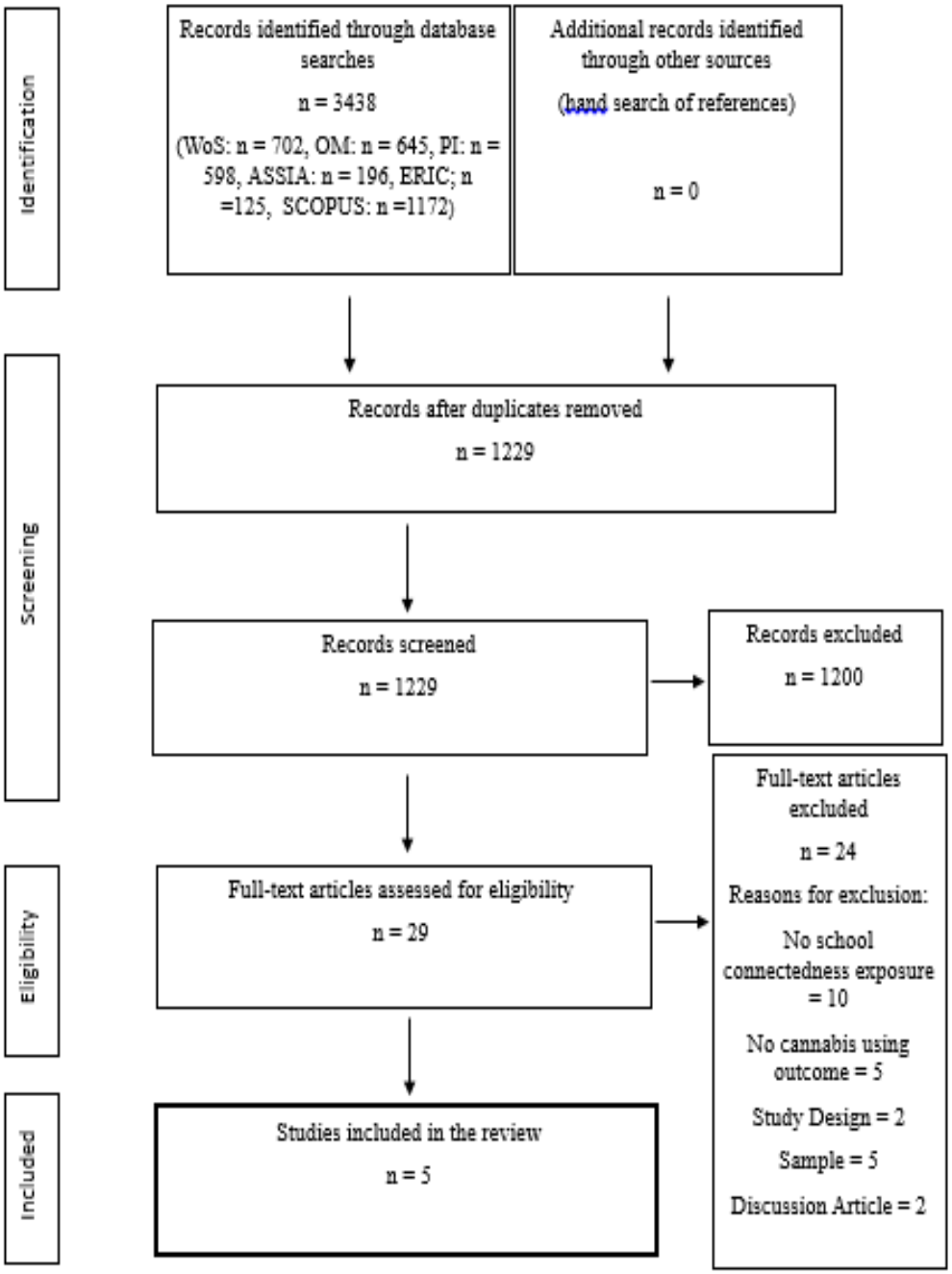

Figure 11: A schematic of the selection of research for inclusion: school connectedness and adolescent cannabis use [15]

[15] Key: WoS = World of Science; PM = PubMed; PI = PsycINFO

5.4.4 Results

Five studies reported direct associations between school connectedness and adolescent cannabis use. Table 38 shows all of the terms and descriptions used in the measurement of school connectedness and cannabis use in adolescence.

Of the five studies included in this review, three studies were undertaken in the USA, one in the UK and one in Australia. The studies varied in age at baseline, ranging from Grades 7-12 to 14 years. The number of participants in the studies varied from 419 to 7,754. The total follow up period ranged from 1 to 2 years and all studies followed adolescents for a total of 2 waves.

Across the five included studies, there was heterogeneity in the measurement of school connectedness. Specifically, two studies directly examined school connectedness but examined different dimensions (Bond et al. 2007; Prado et al. 2009), two studies examined school attachment (Benner et al. 2015; Vogel et al. 2015) and one study examined school (dis)engagement (Perra et al. 2012). In this review, school connectedness refers to all of these terms.

Heterogeneity was also observed across measures of adolescent cannabis use. One study examined cannabis use in the last six months (Bond et al. 2007), another examined use in the last 30 days (Vogul et al. 2015), and others examined lifetime use (Prado et al. 2009), lifetime use in combination with past 30 day use (Benner et al. 2015) and past year use in combination with weekly cannabis use (Perra et al. 2012). All measures were drawn from adolescent self-reports.

Less heterogeneity was observed in the statistical approaches used to analyse associations between school connectedness and cannabis use. Two studies used regression methods (Bond et al. 2007; Perra et al. 2012), two studies used structural equation modelling (SEM) (Prado et al. 2009; Benner et al. 2015) and one study used latent class growth modelling (LCGM) (Vogel et al. 2015).

Primarily studies were seen to adjust for gender, ethnicity and family factors. Only one study adjusted for adolescent lifetime substance use in Wave 1 (Prado et al. 2009).

Results of the quality assessment for studies examining school connectedness and adolescent cannabis use are shown in Table 39. The mean NOS methodological quality score was 6.8, (SD = 1.10, range = 5 to 8) out of a maximum score of 9. All five studies were of high methodological quality whereby one study obtained a total score of 5 (Bond et al. 2007), three studies obtained a total score of 7 (Prado et al. 2009; Perra et al. 2012; Vogul et al. 2015) and one study obtained a total score of 8 (Benner et al. 2015). No studies were awarded the maximum score of 9.

Even though all studies were deemed of high quality, four of the five studies did present potential biases as cannabis use was not adjusted for at baseline. Only one study controlled for baseline cannabis use (Benner et al. 2015). There were no limitations in regards to study attrition, with all five studies reporting adequate rates of retention, ranging from 78% to 90%.

Table 38: Studies included in the systematic review examining school connectedness and adolescent cannabis use

Author Country	Study design	Sample (n)	Method of survey	Objective	Age at baseline Waves	Outcome	School connectedness	Statistical Analysis	Covariates	Findings[16]
Benner et al. (2015) USA	Longitudinal	AddHealth Waves 1 & 2 (n=7731)	In home interviews	To examine: 'the links between socioemotional distress and …. marijuana initiation and use'	Grades 7 - 12 2 waves in 1 year	Age of first marijuana use Lifetime marijuana use Past 30 day marijuana use	School attachment	SEM	Gender Ethnicity School grade Family structure Parental education Alcohol use	School attachment & cannabis use (never vs initiated) NS
Bond et al. (2007) Australia	Longitudinal	Gatehouse project (n=2678)	At baseline: In school questionnaire supervised by the research team Follow up: computer-assisted	'To examine associations between social relationships and school engagement in early secondary school and… substance	Year 8/M=14 years 2 waves in 2 years	Marijuana use: any use in the previous 6 months.	School connectedness	Logistic regression	Baseline school connectedness	Smoking (OR = 1.6, 95% CI = 1.2, 2.1) regular smoking (OR = 1.9, 95% CI = 1.4 ,2.7)

[16] NS: Not significant

			telephone interviews	use… 2–4 years later'						
Perra et al. (2012) UK	Longitudinal	Belfast Youth Development Study (n=5371)	In school self-completed questionnaires, under the supervision of the BYDS research-team	To examine whether: 'school engagement, relationships with teachers… are associated with… subsequent substance use'	13/14 years 2 waves in 2 years	Cannabis use in the last year Weekly cannabis use	School Disengagement Relationships with teachers	Logistic regression	Socio-demographic factors Family factors Neighbourhood factors	School disengagement and cannabis use p<0.05 Relationship with teachers & cannabis use p<0.05
Prado et al. (2009) USA	Longitudinal	AddHealth (n= 742) Waves 1 & 2	In home interviews	'To examine whether the effects of nativity on Hispanic adolescent substance use is mediated by…	Grades 7 - 12 2 waves in 1 year	W1. Ever used marijuana W2.Used marijuana since Wave 1 interview	Mediator: School connectedness	SEM	Gender and adolescent lifetime substance use at Wave 1	School connectedness and alcohol use p<0.05 School connectedness and tobacco use p<0.05

				school connectedness'						School connectedness and cannabis use p<0.05
Vogul et al. (2015) USA	Longitudinal	AddHealth (n=7754) Waves 1 & 2 T1, T2, T3	In home interviews	"To examine the moderating influence of school connectedness ..on the association between peer network status and marijuana use."	Grades 7 - 12 2 waves in 1 year	Marijuana use: past 30 day use	Moderator: School attachment	HLM growth curve models	Age, gender and ethnicity.	School connectedness and cannabis use NS

All five studies included in this review, representing 24,276 participants, reported upon school connectedness as a risk or protective factor for cannabis use. Four of the five included studies found associations between school connectedness and adolescent cannabis use (Bond et al. 2007; Prado et al. 2009; Perra et al. 2012; Benner et al. 2015). Specifically, Bond et al. (2007) found Grade 8 adolescents (ages 13 to 14) with low levels of school connectedness were more likely to use cannabis in Grade 10 (ages 15 to 16). Alternatively, Benner et al. (2015) found that in models adjusting for gender, ethnicity, nativity status, cognitive ability, family structure, parent education, school sector, school location, peer substance use and baseline alcohol use, adolescents in Grades 7 through 12 (ages 12 to 18) with low levels of school connectedness were 13% more likely to use cannabis 18 months later (Wave 1 never used cannabis & Wave 2 initiated cannabis use: OR = 1.13, 95% CI = Not reported, $p<.05$). Using the same data, Prado et al. (2009) also found that in models adjusting for gender and lifetime substance use at baseline, adolescents in Grades 7 through 12 (ages 12 to 18) with low levels of school connectedness were more likely to have used cannabis 18 months later ($\beta = -0.15$, $p<0.05$). Whilst, Perra et al. (2012) found that after adjusting for socio-demographic, family and neighbourhood characteristics and baseline substance use, positive teacher-pupil relationships at 13-14 years reduced the likelihood of cannabis use at 15-16 years by 35% (OR = 0.65, 95% CI = 0.47, 0.88), whilst school disengagement at 13-14 years increased the likelihood of cannabis use at 15-16 years by 4% (school disengagement: OR = 1.04, 95% CI = 1.01, 1.08).

Only one study, representing 7754 participants, did not find a beneficial association between school connectedness and adolescent cannabis use. Vogel et al. (2015) found that for Grades 7 through 12 adolescents (ages 12 to 18), school connectedness was not linked to changes in cannabis use 18

months later after adjusting for age, gender and race (OR = 1.01, 95% CI = 0.84, 1.23).

No studies examined the moderating effect of school connectedness upon associations between PCRQ and adolescent cannabis use. One study did examine the mediational properties of school connectedness whereby PCRQ was not directly related to adolescent cannabis use, but instead indirectly related through school connectedness (unstandardized point estimate = −0.011, 95% CI= −0.020, −0.002: Prado et al. 2009). However, the hypothesis linking PCRQ and school connectedness was unclear.

5.4.5 Discussion

This review firstly sought to summarise the strength of the evidence on the association of school connectedness on adolescent cannabis use. Five studies were included in the review, all of which were of high quality, representing 24,276 participants. Overall, moderate evidence was presented for a prospective association between school connectedness and adolescent cannabis use with four of the five included studies presenting support for an association (Bond et al. 2007; Prado et al. 2009; Perra et al. 2012; Benner et al. 2015). No studies reported upon associations with problematic levels of cannabis use nor cannabis dependence.

This review secondly sought to summarise and determine the strength of evidence for school connectedness as a moderator for associations between PCRQ and adolescent alcohol use. This review found no evidence to support such interactions.

Table 39: NOS scores for studies examining school connectedness and adolescent cannabis use

	Representativeness	Selection of non exposed cohort	Ascertainment of exposure	Outcome of interest was not present at the start of the study	Comparability of cohorts on design basis design	Assessment of outcome	Follow up long enough for outcomes to occur	Adequacy of follow up cohort	TOTAL
Benner et al.(2015)	*	*	*	*	**	-	*	>85%	8
Bond et al. (2007)	*	*	*	-	-	-	*	90%	5
Perra et al. (2012)	*	*	*	-	**	-	*	78%	7
Prado et al. (2009)	*	*	*	-	**	-	*	88.2%	7
Vogul et al. (2015)	*	*	*	-	**	-	*	>85%	7

Overall, the findings of this review are in support of the previous review by Fletcher et al. (2008) in which two school connectedness dimensions (e.g. school disengagement and poor teacher-student relationships) were associated with the onset of cannabis use. However, this review extends such findings by presenting more recent evidence for the role of school connectedness upon adolescent cannabis use. No evidence was found as to whether the effects of school connectedness varied across different frequencies of cannabis use. Further research is needed to isolate such effects.

Limitations of studies

The five included studies of this review presented some minor limitations. Firstly, even though the majority of studies did adjust for several important confounders, it is plausible that these may still have been subject to unmeasured confounding. Secondly, even though paths were revealed between school connectedness and adolescent cannabis use, due to the design of the studies and the research questions examined, the samples were restricted to students who remained in the same school across the study period. Examination of those lost to attrition may have revealed different associations. Thus, the identified paths only provide crude indications of causal processes and the causality of associations remains far from clear. Even so, this review fills an important gap in the evidence base by systematically examining high quality longitudinal studies reporting upon school connectedness and adolescent cannabis use over the last 10 years.

5.4.6 Conclusion

Overall, this review presents moderate evidence for an association between school connectedness and adolescent cannabis use. The studies included in the review present reasonably consistent evidence in favour of an association between school connectedness and adolescent cannabis

use. However, additional research is needed to examine whether school connectedness moderates the association between PCRQ and cannabis use in adolescence.

5.5 Summary and implications for this study

This chapter presents the systematic reviews which examined school connectedness and adolescent use of alcohol, tobacco and cannabis. The next chapter presents the results from the ALSPAC study which examined PCRQ, school connectedness and experimental and hazardous alcohol use in adolescence.

Chapter 6: Results from ALSPAC study of PCRQ, school connectedness and alcohol use in adolescence

6.1 Chapter overview

As discussed in Chapters 3 and 4, weakened PCRQ has been linked to increased alcohol use in adolescence. School connectedness has also been linked to alcohol use in adolescence, whereby higher levels of school connectedness have been found to be associated with reduced alcohol use. Following systematic reviews of the literature, evidence in support of a prospective association between PCRQ and adolescent alcohol use was inconclusive, whilst moderate evidence was presented for a prospective association between school connectedness and adolescent alcohol use. This chapter presents the results of the ALSPAC analysis examining associations between PCRQ at 9 years of age, school connectedness at 11 years of age and alcohol use at 17 years of age.

6.2 Study aims and hypothesis

In accordance with the research questions of this thesis, this study sought to answer:

1. Do higher levels of PCRQ at 9 years of age reduce the likelihood of experimental and hazardous alcohol use at 17 years of age?
2. Do increased levels of school connectedness at 11 years of age reduce the likelihood of experimental and hazardous alcohol use at 17 years of age?
3. To what extent does school connectedness at 11 years moderate associations between PCRQ at 9 years and experimental or hazardous alcohol use at 17 years?

6.3 Results: PCRQ, school connectedness and experimental alcohol use

This section presents the findings of the analysis for the outcome of experimental alcohol use derived from the question 'have you ever had a whole alcoholic drink' at 17 years of age.

6.3.1 Sample size

The sample size for complete case analysis of experimental alcohol use was 4,196. The variables used in these models were:

Covariates: KZ021, C755, C645a, c804, j556f, pm3190, pe410, g750, p3190.

Experimental alcohol use: FJAL050.

PCRQ: ccf104, ccf111, ccf118, ccf125, ccf133, ccf141, ccf149, ccf157, ccf160, ccf165.

School connectedness: ccj100, ccj105.

6.3.2 Descriptive statistics

To assess the impact of imputation, descriptive statistics were examined for both the complete case data and the imputed data. Descriptive statistics for each variable are presented in Table 40.

Table 40 shows that the imputed values were very close to complete case values, with the majority having differences of less than 1%. All analyses presented in this chapter are based on the imputed dataset.

Table 40: The number, proportion of missing data and descriptive statistics for participants who answered the question, “Have you ever had an alcoholic drink” (n=4,196)

Variables	N	Missing (%)	Observed data (%)	Imputed data (%)
Covariates				
Sex M%	4196	0	44	44.02
Child’s ethnic group	3772	10.10		
White			95.73	95.40
Non-white			4.27	4.60
Mum’s highest educational qualification	3826	8.82		
CSE			11.11	11.06
Vocational			7.19	7.36
O level			34.03	33.96
A Level			28.02	28.12
Degree			19.65	19.49
Maternal Social Class	3366	19.78		
I & II			45.51	44.21
III (manual & non-manual)			45.63	46.14
IV & V (including armed forces)			8.85	9.65
Total Behavioural Diff Score – Recoded	3512	16.30	8.42 (0.07)	8.47(0.07)
Maternal drinking at child age 1yr 9 months	2446	40.24		
Never drinks alcohol			9.77	10.63
Very occasionally drinks			38.10	38.40

Occasionally drinks			41.86	40.92
1-2 glasses per day			9.57	9.30
3-9 glasses per day			0.70	0.74
Maternal alcohol consumption at child aged 9 years	1843	56.53		
Never			6.62	8.25
< Once a week			25.39	26.99
>= Once a week			43.79	42.23
Daily			24.20	22.53
Paternal drinking at child age 1 year	3458	17.59		
Never drinks alcohol			4.77	4.96
Very occasionally drinks			26.43	27.14
Occasionally drinks			46.33	45.71
1-2 glasses per day			17.44	17.16
3-9 glasses per day			4.71	4.72
10+ glasses per day			0.32	0.31
Paternal drinking at child age 9 years	3215	18.85		
Never drinks alcohol			4.67	4.80
< Once a week			18.48	18.78
>= Once a week			40.56	40.47
Daily			36.30	35.95
Outcome				
YP has ever had a drink	4196	0		
Yes	3982		94.9	94.9
No	214		5.1	5.1

Exposure/ Moderator				
PCRQ	3216	23.36		
Median			48.00	47.00
IQR (25th centile, 75th centile)			(45 to 50)	(44 to 49)
School Connectedness				
Child's school is a place where they are popular with other pupils	3467	17.37		
Agree	1614		46.55	45.79
Mostly agree	1465		42.26	42.01
Mostly disagree	272		7.85	8.26
Disagree	116		3.35	3.94
Child's school is a place where other pupils accept them for who they are	3455	17.66		
Agree	2176		62.98	61.88
Mostly agree	1091		31.58	31.96
Mostly disagree	131		3.79	4.10
Disagree	57		1.65	2.05

Experimental alcohol use

The outcome variable experimental alcohol use examined the number of participants reporting whether they had ever had a whole alcoholic drink. Overall, 94.9% of participants reported experimental use at 17 years of age.

PCRQ

To assess PCRQ at 9 years of age, a total score was calculated from ten individual items. The mean PCRQ total score was 45.77 (SD = 5.16) and the median score was 47, with an inter-quartile range of 5, minimum of 11 and maximum of 50.

School connectedness

School connectedness at 11 years was assessed through being: (1) popular in school; and (2) accepted in school. For 'popular in school', the majority of participants agreed (45.79%), or mostly agreed (42.01%) that school is a place where they are popular with other pupils. For 'accepted in school' the majority of participants of agreed (61.88%) that school is a place where other pupils accept them as they are.

6.3.3 Results

Tables 41, 42 and 43 present the results of the logistic regression analyses which examined whether PCRQ at 9 years of age or school connectedness at 11 years of age predicted experimental alcohol use at 17 years of age.

Table 41: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools with experimental alcohol use

	Imputed data set (n = 4196)							
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	1.01	0.99			0.99	0.98	0.98	0.97
	(0.98, 1.04)	(0.96, 1.03)			(0.96, 1.02)	(0.95, 1.02)	(0.94, 1.02)	(0.93, 1.01)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.41	0.45	0.40	0.43	0.11	0.10
			(0.29, 0.58)	(0.31, 0.65)	(0.28, 0.58)	(0.30, 0.63)	(0.01, 1.53)	(0.01, 1.59)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.03	1.03
							(0.97, 1.09)	(0.97, 1.10)

* Indicates reference group

Model 1: PCRQ and experimental alcohol use.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 3: Popular in school and experimental alcohol use.
Model 4: Popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 5: PCRQ, popular in school and experimental alcohol use.
Model 6: PCRQ, popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 7: PCRQ, popular in school, PCRQ * popular in school and experimental alcohol use.
Model 8: PCRQ, popular in school, PCRQ * popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.

Table 42: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are accepted in schools with experimental alcohol use

	Imputed data set (n = 4196)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	1.01 (0.98, 1.04)	0.99 (0.96, 1.03)			1.00 (0.97, 1.03)	0.99 (0.95, 1.02)	0.98 (0.93, 1.03)	0.97 (0.92, 1.03)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.59 (0.44, 0.80)	0.61 (0.45, 0.84)	0.59 (0.43, 0.80)	0.60 (0.43, 0.82)	0.23 (0.01, 5.20)	0.25 (0.01, 6.49)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							1.02 (0.95, 1.09)	1.02 (0.95, 1.09)

* Indicates reference group

Model 1: PCRQ and experimental alcohol use.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 3: Accepted in school and experimental alcohol use.
Model 4: Accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 5: PCRQ, accepted in school and experimental alcohol use.
Model 6: PCRQ, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 7: PCRQ, accepted in school, PCRQ * accepted in school and experimental alcohol use.
Model 8: PCRQ, accepted in school, PCRQ * accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.

Table 43: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental alcohol use

	Imputed data set (n = 4196)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	1.01	0.99			0.99	0.97	0.97	0.97
	(0.98, 1.04)	(0.96, 1.03)			(0.96, 1.02)	(0.91, 1.02)	(0.91, 1.02)	(0.91, 1.02)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.47	0.52	0.46	0.50	0.11	0.10
			(0.33,0.69)	(0.35,0.76)	(0.32,0.67)	(0.33,0.74)	(0.01,1.97)	(0.01,2.05)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.71	0.72	0.70	0.70	0.54	0.67
			(0.51, 0.97)	(0.51, 1.00)	(0.50, 0.96)	(0.50, 0.98)	(0.02, 15.81)	(0.02, 24.00)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.03	1.04
							(0.97, 1.10)	(0.97, 1.11)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							1.01	1.00
							(0.93, 1.08)	(0.93, 1.08)

* Indicates reference group

Model 1: PCRQ and experimental alcohol use.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 3: Popular in school, accepted in school and experimental alcohol use.
Model 4: Popular in school, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 5: PCRQ, popular in school, accepted in school and experimental alcohol use.
Model 6: PCRQ, popular in school, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.
Model 7: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school and experimental alcohol use.
Model 8: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and experimental alcohol use.

Do higher levels of PCRQ at 9 years of age reduce the likelihood of experimental alcohol use at 17 years of age?

Table 41 shows there was little evidence of a beneficial association between increased levels of PCRQ at 9 years of age and a reduced likelihood of experimental alcohol use at 17 years of age in the unadjusted (OR = 1.01, 95% CI = 0.98, 1.04) or adjusted models.

Do increased levels of school connectedness at 11 years of age reduce the likelihood of experimental alcohol use at 17 years of age?

Table 41 shows that young people who disagreed that school was a place where they were popular with other pupils at 11 years of age were 59% less likely to have used alcohol experimentally at 17 years of age than those who agreed (OR = 0.41, 95% CI = 0.29, 0.58). Adjusting for potential confounders had little effect in the strength of the association (OR = 0.45, 95% CI = 0.31, 0.65). The addition of PCRQ, alongside the covariates, also had little impact (OR = 0.43, 95% CI = 0.30, 0.63). Table 42 shows young people who disagreed that school is a place where other pupils accept them for who they are at 11 years of age were 41% less likely to have used alcohol experimentally at 17 years of age than those who agreed (OR = 0.59, 95% CI = 0.44, 0.80). Adjusting for potential confounders (OR = 0.61, 95% CI = 0.45, 0.84) and PCRQ (OR = 0.60, 95% CI = 0.43, 0.82) had little effect on the strength of the association.

To what extent does school connetedness at 11 years moderate associations between PCRQ at 9 years and experimental alcohol use at 17 years?

Table 41 shows there was little evidence of an interaction between PCRQ at 9 years of age and whether participants felt popular in school at 11 years of age in predicting the odds of experimentally using alcohol at 17 years of age (OR = 1.03, 95% CI = 0.97, 1.09). Nor between PCRQ and whether

participants felt accepted at school at 11 years of age in predicting the odds of experimentally using alcohol at 17 years of age (OR = 1.02, 95% CI = 0.95, 1.09) (see Table 42). Table 43 shows there was little evidence of an interaction between PCRQ at 9 years of age and being popular in school (OR = 1.03, 95% CI = 0.97, 1.10) or accepted in school (OR = 1.01, 95% CI = 0.93, 1.08) at 11 years of age in predicting the odds of experimentally using alcohol at 17 years of age.

Covariates

Table 6, Appendix 9 shows there were a number of associations observed within the fully adjusted models. The odds of experimentally using alcohol were higher in young people who were non-white (OR = 1.89, 95% CI = 1.06, 3.37) and whose mother's drank at least once a week (OR = 2.29, 95% CI = 1.22, 4.32) or on a daily basis (OR = 3.69, 95% CI = 1.69, 8.03) at 9 years of age. Young people whose fathers drank occasionally when they were 1 year 9 months were twice as likely to experimentally use alcohol at 17 years of age than those whose fathers did not drink (OR = 2.08, 95% CI = 1.01, 4.28). All other covariates presented weak to null associations with the risk of experimentally using alcohol.

6.4 Results: PCRQ, school connectedness and hazardous alcohol use

This section presents the findings of the analysis of PCRQ, school connectedness and hazardous alcohol use

6.4.1 Sample size

The sample size for complete case analysis was 3,852. The variables used in the models were:

> Covariates: KZ021, C755, C765m C645a, c800, c804, pm3190, pe410, g750, p3190.
>
> Hazardous alcohol use: FJAL1000, FJAL1050, FJAL1100, FJAL1150, FJAL1350, FJAL1400, FJAL1450, FJAL1550, FJAL1900, FJAL1950.
>
> PCRQ: ccf104, ccf111, ccf118, ccf125, ccf133, ccf141, ccf149, ccf157, ccf160, ccf165.
>
> School connectedness: ccj100, ccj105, ccj133, ccj142.

6.4.2 Descriptive statistics

To assess the impact of imputation, descriptive statistics were examined for both the complete case data and the imputed data. Table 44 shows that imputed values were very close to the complete case values, with all further analyses based on the imputed dataset.

Hazardous alcohol use

The mean AUDIT score was 7.92 (SD = 4.74). The median AUDIT score was 7, with an inter-quartile range of 5, minimum of 1 and maximum of 40.

PCRQ

The mean score was 45.59 (SD = 5.41), median score was 47, with an inter-quartile range of 5, minimum of 11 and maximum of 50.

Table 44: The number, proportion of missing data and descriptive statistics for participants who answered all items of the AUDIT questionnaire (n=3,852)

Variables	N	Missing (%)	Observed data (%)	Imputed data (%)
Covariates				
Sex % boys	3852	0	43.9	43.87
Child's ethnic group	3472	9.87		
White			95.97	95.50
Non-white			4.03	4.50
Mum's highest educational qualification	3522	8.57		
CSE			10.79	10.86
Vocational			7.07	7.11
O level			34.10	34.10
A Level			28.34	28.31
Degree			19.70	19.63
Maternal Social Class	3109	19.29		
I & II			45.77	44.49
III			45.42	45.92
IV, V (including Army)			8.81	9.59
Total Behavioural Diff Score – Recoded	3239	15.9	8.32 (0.08)	8.39 (0.07)
Maternal drinking at child age 1yr 9 months	2249	41.61		
Never drinks alcohol			9.20	10.38
< Once a week			38.06	38.11
>= Once a week			42.51	41.59

1-2 glasses, nearly every day			9.60	9.27
3-9 glasses, every day			.62	0.65
Maternal alcohol consumption at child aged 9 years	1696	55.97		
Never drinks alcohol			6.31	7.62
< Once a week			24.54	26.12
>= Once a week			44.25	43.29
Daily			24.90	22.97
Paternal drinking at child age 1yr 9 months	3184	17.34		
Never drinks alcohol			4.24	4.54
Very occasionally drinks			26.22	26.82
Occasionally drinks			47.05	46.73
1-2 glasses per day			17.46	17.06
3-9 glasses per day			4.74	4.60
10+ glasses per day			.28	0.26
Paternal drinking at child age 9 years	2962	22.92		
Never drinks alcohol			4.39	4.77
< Once a week			18.30	18.86
>= Once a week			40.61	40.54
Daily			36.70	35.83
Outcomes (TF4 Clinic)				
Frequency YP has a drink containing alcohol	3852	0		
Monthly or less	1033		26.82	26.82
Two or Four times a month	1818		47.20	47.20

Two or three times a week	875		22.72	22.72
Four or more times a week	126		3.27	3.27
Number of drinks containing alcohol YP has on a typical day	3852	0		
1 or 2	837		21.73	21.73
3 or 4	1098		28.50	28.50
5 or 6	1000		25.96	25.96
7 to 9	581		15.08	15.08
10+	336		8.72	8.72
Frequency YP has 6 or more drinks on one occasion	3852	0		
Never	516		13.40	13.40
Once or twice	905		23.49	23.49
Less than monthly	881		22.87	22.87
Monthly or less	1002		26.01	26.01
Weekly	536		13.91	13.91
Daily or almost daily	12		0.31	0.31
Frequency YP was not able to stop drinking once started, in past year	3852	0		
Never	2828		73.42	73.42
Once or twice	558		14.49	14.49
Less than monthly	194		5.04	5.04
Monthly or less	161		4.18	4.18
Weekly	98		2.54	2.54
Daily or almost daily	13		0.34	0.34
Frequency YP was unable to do what was normally expected of them due to drinking, in past year	3852	0		
Never	2903		75.36	75.36

Once or twice	713		18.51	18.51
Less than monthly	131		3.40	3.40
Monthly or less	76		1.97	1.97
Weekly	26		0.67	0.68
Daily or almost daily	3		0.08	0.08
Frequency YP has needed a first drink in the morning to get them going after a heavy drinking session, in past year	3852	0		
Never	3616		93.87	93.87
Once or twice	158		4.10	4.10
Less than monthly	36		0.93	0.94
Monthly or less	24		0.62	0.62
Weekly	13		0.34	0.34
Daily or almost daily	5		0.13	0.13
Frequency YP has had a feeling of guilt or remorse after drinking in the past year	3852	0		
Never	2629		68.25	68.25
Once or twice	929		24.12	24.12
Less than monthly	165		4.28	4.28
Monthly or less	88		2.28	2.28
Weekly	33		0.86	0.86
Daily or almost daily	8		0.21	0.21
Frequency YP has been unable to remember what happened the night before because they had been drinking	3852	0		
Never	1666		43.25	43.25
Once or twice	1475		38.29	38.29

Less than monthly	382		9.92	9.92
Monthly or less	238		6.18	6.18
Weekly	75		1.95	1.95
Daily or almost daily	16		0.42	0.41
YP or someone else been injured as a result of YP drinking	3852	0		
No	3165		82.17	82.17
Yes but not in the past year	259		6.72	6.72
Yes during the past year	428		11.11	11.11
Relative or friend or other health worker has been concerned about YP's drinking or suggest they cut down	3852	0		
No	3687		95.72	95.72
Yes but not in the past year	51		1.32	1.32
Yes during the past year	114		2.96	2.96
Exposure/Moderator				
PCRQ	2963	23.11		
Median			48	47
IQR (25th centile, 75th centile)			(45 to 50)	(44 to 49)
School Connectedness				
Child's school is a place where they are popular with other pupils	3197	17.00		
Agree	1519		47.51	45.88
Mostly agree	1342		41.98	41.57
Mostly disagree	238		7.44	8.21
Disagree	98		3.07	4.34
Child's school is a place where other pupils accept them for who they are	3183	17.37		
Agree	2039		64.06	61.87

Mostly agree	983	30.88	31.56
Mostly disagree	115	3.61	4.27
Disagree	46	1.45	2.29

School connectedness

Table 44 shows that for 'popular in school' the majority of participants agreed (45.88%) or mostly agreed (41.57%) that school was a place where they are popular with other pupils. For 'accepted in school', the majority of participants agreed that school was a place where other pupils accept them as they are (61.87%).

6.4.3 Results

Tables 45, 46 and 47 show the results of the linear regression analyses which examined associations between PCRQ at 9 years of age, school connectedness at 11 years of age and hazardous drinking at 17 years of age.

Do higher levels of PCRQ at 9 years of age reduce the likelihood of hazardous alcohol use at 17 years of age?

Table 45 shows little evidence of a beneficial association between increased levels of PCRQ at 9 years of age and a reduced likelihood of hazardous drinking of 17 years of age in the unadjusted models (β = -0.02, 95% CI = -0.06, 0.01) or adjusted models.

Do increased levels of school connectedness at 11 years of age reduce the likelihood of hazardous alcohol use at 17 years of age?

Table 45 shows that young people who disagreed that school was a place where they were popular with other pupils at 11 years of age had total AUDIT scores 1.09 units lower at 17 years of age than those who agreed that they were popular in school (β = -1.09, 95% CI = -1.56, -0.61). The addition of covariates to the model had little effect. The addition of PCRQ to the model widened the confidence interval (β = -1.21, 95% CI = -1.70, 0.72).

Table 45: β coefficient and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools with hazardous drinking

	Imputed dataset (n = 3852)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	-0.02	-0.02			-0.04	-0.03	-0.03	-0.02
	(-0.06, 0.01)	(-0.05, 0.02)			(-0.07, 0.00)	(-0.06, 0.01)	(-0.07, 0.01)	(-0.06, 0.02)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			-1.09	-1.14	-1.19	-1.21	0.35	0.16
			(-1.56, -0.61)	(-1.62, -0.66)	(-1.67, -0.70)	(-1.70, -0.72)	(-4.01, 4.71)	(-4.22, 4.55)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							-0.04	-0.03
							(-0.13, 0.06)	(-0.13, 0.07)

* Indicates reference group

Model 1: PCRQ and hazardous drinking.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 3: Popular in school and hazardous drinking.
Model 4: Popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 5: PCRQ, popular in school and hazardous drinking.
Model 6: PCRQ, popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 7: PCRQ, popular in school, PCRQ * popular in school and hazardous drinking.
Model 8: PCRQ, popular in school, PCRQ * popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.

Table 46: β coefficient and 95% confidence intervals for the association of PCRQ, whether participants are accepted in schools with hazardous drinking

	Imputed data set (n = 3852)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
	β (95%CI)	β (95%CI)	β (95%CI)	β (95%CI)	β (95%CI)	β (95%CI)	β (95%CI)	β (95%CI)
PCRQ	-0.02 (-0.06, 0.01)	-0.02 (-0.05, 0.02)			-0.03 (-0.06, 0.01)	-0.02 (-0.05, 0.02)	-0.02 (-0.07, 0.03)	-0.01 (-0.06, 0.03)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			-0.05 (-0.39, 0.30)	-0.07 (-0.42, 0.28)	-0.10 (-0.45, 0.25)	-0.10 (-0.45, 0.25)	0.36 (-2.47, 3.19)	0.30 (-2.58, 3.19)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							-0.01 (-0.07, 0.05)	-0.01 (-0.07, 0.05)

* Indicates reference group

Model 1: PCRQ and hazardous drinking.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 3: Accepted in school and hazardous drinking.
Model 4: Accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 5: PCRQ, accepted in school and hazardous drinking.
Model 6: PCRQ, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 7: PCRQ, accepted in school, PCRQ * accepted in school and hazardous drinking.
Model 8: PCRQ, accepted in school, PCRQ * accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.

Table 47: β coefficient and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools with hazardous drinking

	Imputed data set (n = 3852)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	-0.02	-0.02			-0.03	-0.03	-0.02	-0.02
	(-0.06, 0.01)	(-0.05, 0.02)			(-0.07, 0.00)	(-0.06, 0.01)	(-0.07, 0.02)	(-0.06, 0.03)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			-1.17	-1.21	-1.24	-1.26	0.17	-0.01
			(-1.67, -0.06)	(-1.72, -0.71)	(-1.75, -0.73)	(-1.77, -0.75)	(-4.47, -4.81)	(-4.69, 4.66)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.19	0.17	0.13	0.13	0.59	0.58
			(-0.18, 0.55)	(-0.20, 0.54)	(-0.23, 0.50)	(-0.24, 0.50)	(-2.45, 3.62)	(-2.53, 3.68)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							-0.03	-0.03
							(-0.14, 0.07)	(-0.14, 0.08)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							-0.01	-0.01
							(-0.08, 0.06)	(-0.08, 0.06)

* Indicates reference group

Model 1: PCRQ and hazardous drinking.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 3: Popular in school, accepted in school and hazardous drinking.
Model 4: Popular in school, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 5: PCRQ, popular in school, accepted in school and hazardous drinking.
Model 6: PCRQ, popular in school, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.
Model 7: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school and hazardous drinking.
Model 8: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal drinking at 1 year 9 months, maternal drinking at 9 years, paternal drinking at 1 year 9 months and paternal drinking at 9 years) and hazardous drinking.

Table 46 shows that young people who disagreed that school was a place where other pupils accept them for who they are at 11 years of age were no more likely to be hazardous drinkers at 17 years of age than those who agreed that they were accepted by other pupils (β = -0.05, 95% CI = -0.39, 0.30). Adjusting for covariates and the addition of PCRQ to the model, had little effect on coefficients.

To what extent does school connetedness at 11 years moderate associations between PCRQ at 9 years and hazardous levels of alcohol use at 17 years?

Table 45 shows there was little evidence of an interaction between PCRQ at 9 years of age and being popular in school at 11 years of age, in predicting hazardous alcohol use at 17 years of age (β =-0.04, 95% CI = -0.13, 0.06). Thus, the association between PCRQ and the risk of hazardous drinking did not vary according to whether young people felt popular with other pupils at school or not. Table 46 also shows there was little evidence of an interaction between PCRQ at 9 years of age and being accepted in school at 11 years of age, in predicting hazardous alcohol use at 17 years of age (β =-0.01, 95% CI = -0.07, 0.05). Table 47 further shows there was little evidence of an interaction between PCRQ at 9 years of age, 'school is a place where I am popular with other pupils' (β =-0.03, 95% CI = -0.14, 0.07) and 'school is a place where other pupils accept me for who I am' (β =-0.01, 95% CI = -0.08, 0.06) at 11 years of age in predicting the odds of hazardous drinking at 17 years of age. The addition of covariates to the model had no effect on either association.

Covariates

Table 2, Appendix 11 shows there were a number of associations within the fully adjusted model of analyses 1. Young people were less likely to be hazardous drinkers at 17 years of age, if they were female (β = -0.38, 95%

CI = -0.68, -0.07), had mother's whose minimum educational qualification at birth was an A-level (β =-0.66, 95% CI = -1.29, -0.03), or had mother's whose minimum educational qualification at birth was a degree (β =-0.92, 95% CI = -1.62, -0.22). These associations persisted across subsequent analyses (see Tables 4 & 6, Appendix 11).

6.5 Summary and implications for this study

This chapter presented the study results for analyses of associations between PCRQ, school connectedness and alcohol using outcomes of experimental alcohol use and hazardous drinking. Firstly, no evidence was found for an association between PCRQ at 9 years of age and experimental or hazardous alcohol use at 17 years of age. Secondly, mixed evidence was presented for an association between school connectedness and experimental and hazardous alcohol use in adolescence. Specifically, being less popular at school at 11 years of age was associated with a reduced likelihood of using alcohol at experimental and hazardous levels. In contrast, being accepted in school was only associated with experimental alcohol use and not hazardous alcohol use, with lower levels of being accepted in school associated with a reduced likelihood of using alcohol experimentally. Overall, evidence was consistent for experimental alcohol using outcomes but inconsistent for hazardous using outcomes. Thirdly, there was no evidence for school connectedness as a moderator for associations between PCRQ and experimental or hazardous alcohol use.

Chapter 7: Results from ALSPAC study of PCRQ, school connectedness and tobacco use in adolescence

7.1 Chapter overview

Weakened parent-child relationship quality (PCRQ) and school connectedness have both been linked to increased smoking in adolescence. Following two distinct systematic reviews (see Chapters 3 and 4), moderate evidence was found in support of an association between PCRQ and adolescent smoking and strong evidence was found in support of an association between school connectedness and adolescent smoking. Notably, no evidence was found as to whether school connectedness moderates associations between PCRQ and adolescent smoking, in addition to only limited evidence being provided for associations between PCRQ, school connectedness and nicotine dependence. This study seeks to fill these gaps.

7.2 Study aims and hypotheses

This study sought to answer three questions:

1. Do higher levels of PCRQ at 9 years of age reduce the likelihood of experimental smoking and nicotine dependence at 17 years of age?
2. Do increased levels of school connectedness at 11 years of age reduce the likelihood of experimental smoking and nicotine dependence at 17 years of age?
3. To what extent does school connectedness at 11 years moderate associations between PCRQ at 9 years and experimental smoking or nicotine dependence at 17 years?

7.3 Results: PCRQ, school connectedness and experimental smoking

This section presents the findings of the ALSPAC analysis for PCRQ at 9 years, school connectedness at 11 years and experimental smoking at 17yrs.

7.3.1 Sample size

The sample size for complete case analysis of experimental smoking was 4,200. The variables used in the models were as follows:

Covariates: KZ021, C755, C765m C645a, c800, c804, g840, j556f.

Experimental smoking: FJSM050.

PCRQ: ccf104, ccf111, ccf118, ccf125, ccf133, ccf141, ccf149, ccf157, ccf160, ccf165.

School connectedness: ccj100, ccj105, ccj133, ccj142.

7.3.2 Descriptive statistics

Descriptive statistics were examined for both the complete case data and the imputed data with all differences between them being less than 1% (see Table 48). All analyses presented in this chapter are based on the imputed dataset.

Experimental smoking

As detailed in Section 3.6.3.1, experimental smoking was assessed with one item at 17 years of age: Have you ever smoked a whole cigarette (including roll ups)? At 17 years, 51.14% of participants reported smoking experimentally.

Table 48: The number, proportion of missing data and descriptive statistics for participants who answered the question "Have you ever smoked a whole cigarette" (n=4,200)

Variables	N	Missing (%)	Observed data (%)	Imputed data (%)
Covariates				
Sex M%	4200	0	44.00	43.95
Child's ethnic group	3775	10.12		
White			95.76	95.35
Non-white			4.24	4.65
Mum's highest educational qualification	3829	8.83		
CSE			11.10	11.21
Vocational			7.18	7.25
O level			34.00	33.99
A Level			28.05	28.02
Degree			19.67	19.54
Maternal Social Class	3368	19.81		
I & II			45.55	43.69
III (manual & non-manual)			45.61	46.40
IV & V (including armed forces)			8.85	9.90
Total Behavioural Diff Score – Recoded	3514	16.33	8.42 (0.07)	8.47 (0.08)
Number of cigarettes mum smokes	3586	14.62		
None			84.72	84.04
1-4			3.51	3.52
5-9			2.90	3.02

10-14			3.40	3.51
15-19			2.79	2.96
20-24			1.90	2.06
25-29			0.64	0.72
>30			0.14	0.18
Number of cigarettes father smokes	3429	18.36		
None			80.05	78.87
<10			5.69	5.82
10-19			7.58	7.90
20+			6.68	7.41
Outcomes(TF3 Clinic)				
Young person smokes tobacco	4200	0		
Yes			51.14	51.14
No			48.86	48.86
Exposures/Moderators				
Parent-Child Relationship Quality	3220	20.49		
Median			48.00	47.00
IQR (25^{th} centile; 75^{th} centile)			(45 to 50)	(45 to 50)
School connectedness				
Child's school is a place where they are popular with other pupils	3470	17.38		
Agree	1616		46.57	46.07
Mostly agree	1466		42.25	41.91
Mostly disagree	272		7.84	8.29
Disagree	116		3.34	3.74
Child's school is a place where other pupils accept them for who they are	3460	17.62		

Agree	2180	63.01	62.30
Mostly agree	1092	31.56	31.77
Mostly disagree	131	3.79	4.03
Disagree	57	1.65	1.90

PCRQ

The mean PCRQ score at 9 years of age was 46.35 (SD = 4.39). The median score was 48, with an inter-quartile range of 5, minimum of 14 and maximum of 50.

School connectedness

Table 48 shows that the majority of participants agreed that school is a place where they are popular with other pupils (46.07%). The majority of participants also agreed that school is a place where other pupils accept them as they are (62.30%).

7.3.3 Results

Tables 49, 50 and 51 display the results of the logistic regression analyses examining associations between PCRQ at 9 years of age, school connectedness at 11 years of age and experimental smoking at 17 years of age.

Do higher levels of PCRQ at 9 years of age reduce the likelihood of experimental smoking at 17 years of age?

Table 49 shows there was little evidence of a beneficial association between high levels of PCRQ at 9 years of and smoking experimentally at 17 years in the unadjusted (OR = 0.99, 95% CI = 0.98, 1.01) or adjusted models (OR = 0.99, 95% CI = 0.98, 1.01).

Do increased levels of school connectedness at 11 years of age reduce the likelihood of experimental smoking at 17 years of age?

Young people who disagreed that school was a place where they were popular with other pupils were 28% less likely to have smoked experimentally at 17 years of age than those who agreed (OR = 0.72, 95%

CI = 0.58, 0.90) (see Table 49). The addition of covariates to the model had little effect on the strength of the association (OR = 0.70, 95% CI = 0.55, 0.87), as did the addition of PCRQ (OR = 0.70, 95% CI = 0.56, 0.87).

There was little evidence of an association between young people who disagreed that school was a place where other pupils accept them for who they are and smoking experimentally at 17 years (OR = 0.95, 95% CI = 0.83, 1.09) (see Table 50).

To what extent does school connectedness at 11 years moderate associations between PCRQ at 9 years and experimental smoking at 17 years?

There was no evidence of an interaction between PCRQ at 9 years and being popular in school at 11 years, in predicting the odds of experimental smoking at 17 years (OR = 1.01, 95% CI = 0.98, 1.05) (see Table 49). There further was no evidence of an interaction between PCRQ at 9 years and being accepted in school at 11 years, in predicting the odds of experimental smoking at 17 years (OR = 1.01, 95% CI = 0.98, 1.04) (see Table 50). Overall, there was no evidence of beneficial associations between the interaction of PCRQ at 9 years of age and popular in school at 11 years, the interaction of PCRQ at 9 years of age and accepted in school at 11 years, and experimental smoking at 17 years in the unadjusted or adjusted models (see Table 51).

Table 49: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools with experimental smoking

	Imputed data set (n = 4200)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.99	0.99			0.99	0.99	0.99	0.98
	(0.98, 1.01)	(0.98, 1.01)			(0.97, 1.00)	(0.97, 1.00)	(0.97, 1.00)	(0.97, 1.00)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.72	0.70	0.70	0.67	0.40	0.39
			(0.58, 0.90)	(0.55, 0.87)	(0.56, 0.87)	(0.54, 0.85)	(0.08, 1.96)	(0.07, 1.99)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.01	1.01
							(0.98, 1.05)	(0.98, 1.05)

* Indicates reference group

Model 1: PCRQ and experimental smoking.
Model 2: PCRQ, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 3: Popular in school and experimental smoking.
Model 4: Popular in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 5: PCRQ, popular in school and experimental smoking.
Model 6: PCRQ, popular in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 7: PCRQ, popular in school, PCRQ * popular in school and experimental smoking.
Model 8: PCRQ, popular in school, PCRQ * popular in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.

Table 50: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are accepted in schools with experimental smoking

	Imputed data set (n = 4196)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.99	0.99			0.99	0.99	0.99	0.99
	(0.98, 1.01)	(0.98, 1.01)			(0.98, 1.00)	(0.98, 1.00)	(0.97, 1.01)	(0.97, 1.01)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.95	0.95	0.94	0.94	0.68	0.75
			(0.83, 1.09)	(0.83, 1.09)	(0.81, 1.07)	(0.81, 1.08)	(0.19, 2.48)	(0.21, 2.72)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							1.01	1.00
							(0.98, 1.04)	(0.98, 1.03)

* Indicates reference group

Model 1: PCRQ and experimental smoking.
Model 2: PCRQ, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 3: Accepted in school and experimental smoking.
Model 4: Accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 5: PCRQ, accepted in school and experimental smoking.
Model 6: PCRQ, accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 7: PCRQ, accepted in school, PCRQ * accepted in school and experimental smoking.
Model 8: PCRQ, accepted in school, PCRQ * accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.

Table 51: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental smoking

	Imputed data set (n = 4200)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.99	0.99			0.99	0.99	0.98	0.98
	(0.98, 1.01)	(0.98, 1.01)			(0.97, 1.00)	(0.97, 1.00)	(0.96, 1.01)	(0.96, 1.01)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.72	0.69	0.70	0.67	0.42	0.38
			(0.57, 0.90)	(0.54, 0.87)	(0.56, 0.88)	(0.53, 0.85)	(0.08, 2.24)	(0.07, 2.16)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			1.01	1.02	1.00	1.00	0.92	1.05
			(0.88, 1.17)	(0.88, 1.18)	(0.86, 1.15)	(0.87, 1.16)	(0.24, 3.54)	(0.27, 4.05)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.01	1.01
							(0.97, 1.05)	(0.97, 1.05)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							1.00	1.00
							(0.97, 1.03)	(0.97, 1.03)

* Indicates reference group

Model 1: PCRQ and experimental smoking.
Model 2: PCRQ, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 3: Popular in school, accepted in school and experimental smoking.
Model 4: Popular in school, accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 5: PCRQ, popular in school, accepted in school and experimental smoking.
Model 6: PCRQ, popular in school, accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.
Model 7: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school and experimental smoking.
Model 8: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and experimental smoking.

Covariates

Appendix 13, Table 2 shows there were a number of associations within the fully adjusted models. Young people were 23% to 40% less likely to have smoked experimentally at 17 years of age if their mother's highest educational qualification at birth was an A-level (OR = 0.77, 95% CI = 0.59, 0.99) or degree (OR = 0.60, 95% CI = 0.45, 0.80). However, young people were more likely to have smoked experimentally at 17 years of age if they were female (OR = 1.36, 95% CI = 1.20, 1.54), had mothers who smoked 1-4 cigarettes per day (OR = 1.66, 95% CI = 1.14, 2.43), 5-9 cigarettes per day (OR = 1.54, 95% CI = 1.01, 2.34), 10-14 cigarettes per day (OR = 1.76, 95% CI = 1.19, 2.60), or 25-29 cigarettes per day (OR = 3.44, 95% CI = 1.13, 10.49) when they were 1 year 9 months of age. Young people were also more likely to have smoked experimentally at 17 years of age if they had fathers who smoked 10-19 cigarettes per day (OR = 1.34, 95% CI = 1.01, 1.78) or 20+ cigarettes per day (OR = 1.56, 95% CI = 1.15, 2.12) when they were 1 year 9 months of age.

7.4 Results: PCRQ, school connectedness and nicotine dependence

This section presents the findings of the ALSPAC analysis for PCRQ at 9 years, school connectedness at 11 years and nicotine dependence at 17 years.

7.4.1 Sample Size

The sample size for complete case analysis of experimental smoking was 521 (see Section 3.6.3.1). The variables used in the models were as follows:

Covariates: KZ021, C755, C765m C645a, c800, c804, g840, j556f.

Nicotine dependence: FJSM550, FJSM600, FJSM650, FJSM700, FJSM750, FJSM400.

PCRQ: ccf104, ccf111, ccf118, ccf125, ccf133, ccf141, ccf149, ccf157, ccf160, ccf165.

School connectedness: ccj100, ccj105, ccj133, ccj142.

7.4.2 Descriptive statistics

To assess the impact of imputation, descriptive statistics were examined for both the complete case data and the imputed data (see Table 52). There were a number of notable differences between observed and imputed values for measures of school connectedness, but as differences were less than a 5% change in values, this was not problematic given that the majority of imputed values across all variables were within a 1% range of observed values. All further analyses are based on the imputed dataset.

Table 52: The number, proportion of missing data and descriptive statistics for participants who answered all items of the Fagerstrom Test of Nicotine Dependence (FTND: Heatherton et al. 1991) (n=521)

Variables	**N**	**Missing (%)**	**Observed data (%)**	**Imputed data (%)**
Covariates				
Sex % boys	521	0	40.7	40.69
Child's ethnic group	456	12.48		
White			95.83	95.73
Non-white			4.17	4.27
Mum's highest educational qualification	467	10.36		
CSE			18.20	19.36
Vocational			8.99	9.13
O level			37.47	36.19
A Level			24.20	23.65
Degree			11.13	11.68
Maternal Social Class	385	26.10		
I & II			38.18	37.19
III (manual & non-manual)			49.35	47.17
IV & V (including armed forces)			12.47	15.64
Total Behavioural Diff Score - Recoded	432	17.08	9.47 (0.24)	9.62 (0.29)
Number of cigarettes mum smokes	427	18.04		
None			69.32	69.26
1-4			4.22	4.27

5-9			5.39	5.44
10-14			7.73	7.75
15-19			8.43	8.40
20-24			3.28	3.22
25-29			1.64	1.66
Cigarettes per day partner smokes	397	23.80		
None			66.75	65.83
<10			5.79	6.06
10-19			14.36	13.17
20+			13.10	14.94
Outcomes(TF4 Clinic)				
Smoking				
Number of cigarettes YP smokes every day on average	521	0	9.73 (0.27)	9.73 (0.27)
How soon after waking up YP smokes first cigarette	521	0		
<=5 mins			10.56	10.56
6-30 mins			28.02	28.02
31-60 mins			23.03	23.03
>1 hour			38.39	38.39
YP finds it difficult to refrain from smoking in places where it is forbidden	521	0		
Yes			21.31	21.31
No			78.69	78.69
Cigarette YP would most hate to give up	521	0		
The first one/morning			36.47	36.47

All others			63.53	63.53
YP smokes more frequently during first hours after waking than during the rest of the day	521	0		
Yes			19.58	19.58
No			80.42	80.42
YP smokes if they are so ill that they are in bed most of the day	521	0		
Yes			34.36	34.36
No			65.64	65.64
Exposures/Moderators				
Parent-Child Relationship Quality				
Median	385	26.10	47.00	47.00
IQR (25^{th} centile, 75^{th} centile)			(44 to 50)	(44 to 50)
School connectedness				
Child's school is a place where they are popular with other pupils	423	18.81		
Agree	213		50.35	46.88
Mostly agree	165		39.01	35.01
Mostly disagree	33		7.80	8.12
Disagree	12		2.84	9.99
Child's school is a place where other pupils accept them for who they are	422	19.00		
Agree	267		63.27	58.79
Mostly agree	125		29.62	27.33
Mostly disagree	20		4.74	5.76

Disagree	10	2.37	8.12

Nicotine dependence

Nicotine dependence was assessed through summing the six items of the FTND. The mean FTND score was 2.94 (SD = 1.90). The median FTND score was 2, with an inter-quartile range of 3, minimum of 1 and maximum of 10. As detailed in section 3.6.3.1, total FTND scores were categorised as a dichotomous measure whereby a total score of <5 suggested no nicotine dependence and >= 5 suggested nicotine dependence (Brook et al. 2009; Cornelius et al. 2012). Of those who had ever smoked a whole cigarette or roll up at 17 years of age, 79.27% were not nicotine dependent in comparison to 20.73% who were.

PCRQ

The mean PCRQ score was 45.98 (SD = 4.64). The median PCRQ score was 47, with an inter-quartile range of 6, minimum of 23 and maximum of 50.

School connectedness

Table 52 shows that the majority of participants agreed that school was a place where they were popular with other pupils (46.88%). The majority of participants also agreed (58.79%) or mostly agreed (27.33%) that school was a place where other pupils accept them as they are.

7.4.3 Results

Logistic regression analyses tested if PCRQ at 9 years or school connectedness at 11 years predicted nicotine dependence at 17 years, and whether school connectedness interacted with PCRQ to moderate associations between PCRQ at 9 years and nicotine dependence at 17 years. Tables 53, 54 and 55 display the results of the analyses.

Do higher levels of PCRQ at 9 years of age reduce the likelihood of nicotine dependence at 17 years of age?

Table 53 shows that there was no evidence of a beneficial association between a high levels of parent and child relationship quality and nicotine dependence at 17 years of age (OR = 0.98, 95% CI = 0.95, 1.01).

Do increased levels of school connectedness at 11 years of age reduce the likelihood of nicotine dependence at 17 years of age?

Table 53 shows that young people who disagreed that school was a place where they were popular with other pupils at 11 years, no more likely to be nicotine dependent at 17 years than those who agreed (OR = 1.19, 95% CI = 0.64, 2.21).

Table 54 shows that young people who disagreed that school was a place where other pupils accept them for who they are at 11 years, were no more likely to be nicotine dependent at 17 years than those who agreed (OR = 1.02, 95% CI = 0.63, 1.64).

Table 53: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in school with nicotine dependence

	Imputed data set (n = 524)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.98	0.99			0.98	0.99	0.97	0.97
	(0.95, 1.01)	(0.95, 1.02)			(0.95, 1.01)	(0.95, 1.02)	(0.93, 1.01)	(0.93, 1.01)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			1.19	1.06	1.10	1.00	0.18	0.12
			(0.64, 2.21)	(0.54, 2.07)	(0.58, 2.09)	(0.50, 2.01)	(0.00, 7.75)	(0.00, 6.30)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.05	1.05
							(0.96, 1.14)	(0.96, 1.15)

* Indicates reference group

Model 1: PCRQ and nicotine dependence.
Model 2: PCRQ, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 3: Popular in school and nicotine dependence.
Model 4: Popular in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 5: PCRQ, popular in school and nicotine dependence.
Model 6: PCRQ, popular in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 7: PCRQ, popular in school, PCRQ * popular in school and nicotine dependence.
Model 8: PCRQ, popular in school, PCRQ * popular in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.

Table 54: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are accepted in schools with nicotine dependence

	Imputed data set (n = 524)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.98	0.99			0.98	0.99	0.97	0.98
	(0.95, 1.01)	(0.95, 1.02)			(0.94, 1.01)	(0.95, 1.02)	(0.93, 1.02)	(0.93, 1.03)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			1.02	0.99	0.98	0.97	0.52	0.45
			(0.63, 1.64)	(0.59, 1.65)	(0.61, 1.59)	(0.58, 1.62)	(0.02, 15.58)	(0.01, 15.38)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							1.01	1.02
							(0.94, 1.10)	(0.94, 1.10)

* Indicates reference group

Model 1: PCRQ and nicotine dependence.
Model 2: PCRQ, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 3: Accepted in school and nicotine dependence.
Model 4: Accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 5: PCRQ, accepted in school and nicotine dependence.
Model 6: PCRQ, accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 7: PCRQ, accepted in school, PCRQ * accepted in school and nicotine dependence.
Model 8: PCRQ, accepted in school, PCRQ * accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.

Table 55: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with nicotine dependence

	Imputed data set (n = 524)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.98 (0.95, 1.01)	0.99 (0.95, 1.02)			0.98 (0.95, 1.01)	0.99 (0.95, 1.02)	0.97 (0.92, 1.02)	0.97 (0.92, 1.03)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			1.20 (0.63, 2.27)	1.06 (0.53, 2.14)	1.11 (0.57, 2.16)	1.02 (0.50, 2.07)	0.18 (0.00, 11.11)	0.13 (0.00, 8.87)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.98 (0.60, 1.60)	0.97 (0.57, 1.65)	0.96 (0.58, 1.58)	0.96 (0.57, 1.63)	0.88 (0.02, 38.74)	0.83 (0.02, 38.78)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.05 (0.95, 1.15)	1.05 (0.95, 1.06)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							1.00 (0.92, 1.09)	1.00 (0.92, 1.09)

* Indicates reference group

Model 1: PCRQ and nicotine dependence.
Model 2: PCRQ, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 3: Popular in school, accepted in school and nicotine dependence.
Model 4: Popular in school, accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 5: PCRQ, popular in school, accepted in school and nicotine dependence.
Model 6: PCRQ, popular in school, accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.
Model 7: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school and nicotine dependence.
Model 8: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school, gender, ethnicity, behavioural difficulties, maternal education, maternal social class, maternal smoking at 1 year 9 months, paternal smoking at 1 year 9 months and nicotine dependence.

To what extent does school connectedness at 11 years moderate associations between PCRQ at 9 years and nicotine dependence at 17 years?

Table 53 shows there was little evidence of an interaction between PCRQ at 9 years and being popular at school at 11 years in predicting the odds of nicotine dependence at 17 years (OR = 1.05, 95% CI = 0.96, 1.14). Table 54 shows there was little evidence of an interaction between PCRQ at 9 years and being accepted in school at 11 years in predicting the odds of nicotine dependence at 17 years (OR = 1.01, 95% CI = 0.94, 1.10). Table 55 shows there was little evidence of an interaction between PCRQ at 9 years and the variables 'school is a place where I am popular with other pupils' (OR = 1.05, 95% CI = 0.96, 1.14) and 'school is a place where other pupils accept me for who I am' (OR = 1.01, 95% CI = 0.94, 1.10) at 11 years in predicting the odds of nicotine dependence at 17 years.

Covariates

Tables 2, 4 and 6, Appendix 15 show that in the adjusted models, there was no evidence of a beneficial association between of any of the individual covariates and nicotine dependence at 17 years of age.

7.5 Summary and implications for this study

This chapter presented the study results for analyses of associations between PCRQ, school connectedness and smoking outcomes of ever smoked and nicotine dependence. There was no evidence of a beneficial association between PCRQ at 9 years of age and experimental smoking nor nicotine dependence at 17 years of age. There was an association between being popular with other pupils at 11 years of age and experimentally smoking at 17 years of age whereby young people who disagreed that school was a place where they were popular with other pupils were less likely to experimentally smoke. However, this association was not

consistent and no association was found for nicotine dependence. Further, there was no evidence of a beneficial association between being accepted in school at 11 years of age and experimentally smoking or becoming nicotine dependent at 17 years of age. Hence, overall, evidence for an association was mixed. There was no evidence for school connectedness as a moderator for associations between PCRQ and experimental smoking nor nicotine dependence.

Chapter 8: Results from ALSPAC study of PCRQ, school connectedness and cannabis use in adolescence

8.1 Chapter overview

Weakened PCRQ and school connectedness have both been linked to increased cannabis use in adolescence (Guxens et al. 2007). Following two distinct systematic reviews (see Chapters 3 and 4), weak evidence was found for a prospective association between PCRQ and adolescent cannabis use whilst moderate evidence was found for a prospective association between school connectedness and adolescent cannabis use. Overall, evidence for both areas was limited with only a few studies included in each review and no studies examining cannabis dependence. Additionally, no studies examined how school connectedness moderated associations between PCRQ and experimental cannabis use or cannabis dependence. Thus, this study seeks to fill these gaps in understanding.

8.2 Study aims and hypotheses

This study sought to answer three questions:

1. Do higher levels of PCRQ at 9 years of age reduce the likelihood of experimental cannabis use and cannabis dependence at 17 years of age?
2. Do increased levels of school connectedness at 11 years of age reduce the likelihood of experimental cannabis use and cannabis dependence at 17 years of age?
3. To what extent does school connectedness at 11 years moderate associations between PCRQ at 9 years and experimental cannabis use or cannabis dependence at 17 years?

8.3 Results: PCRQ, school connectedness and experimental cannabis use

This section presents the findings of the ALSPAC analysis for PCRQ at 9 years, school connectedness at 11 years and experimental cannabis use at 17 years.

8.3.1 Sample size

The sample size for complete case analysis of ever used cannabis was 4,158. The variables used in the models were as follows:

Covariates: KZ021, C755, C645a, c804, j556f, l3042, pm1052.

Experimental cannabis use: FJDR050.

PCRQ: ccf104, ccf111, ccf118, ccf125, ccf133, ccf141, ccf149, ccf157, ccf160, ccf165.

School connectedness: ccj100, ccj105, ccj133, ccj142.

8.3.2 Descriptive statistics

To assess the impact of imputation, descriptive statistics were examined for both the complete case data and the imputed data. Table 56 shows that imputed values were very close to complete case values, with the majority of differences being less than 1%. Therefore, all subsequent analyses presented in this chapter are based on the imputed dataset.

Experimental cannabis use

As detailed in Section 3.6.3.1 experimental cannabis use was assessed with one test item at 17 years of age: have you ever tried cannabis? Table 56 shows that 41.03% of participants reported experimentally using cannabis at 17 years of age.

Table 56: The number, proportion of missing data and descriptive statistics for participants who answered the question, “Have you ever tried cannabis” (n=4,158)

Variables	**N**	**Missing (%)**	**Observed data (%)**	**Imputed data (%)**
Covariates				
Sex (% boys)	4158	0	45.8	43.99
Child’s ethnic group	3738	10.10		
White			95.80	95.50
Non White			4.20	4.50
Mum’s highest educational qualification	3792	8.80		
CSE			11.16	11.25
Vocational			7.17	7.22
O level			34.02	33.94
A Level			28.06	28.02
Degree			19.59	19.58
Maternal Social Class	3336	19.77		
I & II			45.44	48.24
III (manual & non-manual)			45.68	42.02
IV & V (incl. armed forces)			8.87	9.74
Total Behavioural Diff Score – Recoded	3481	16.28	8.48 (0.11)	8.50 (0.12)
Mother has taken cannabis/marihuana since study child's 5th birthday	3366	19.05		
No			92.44	92.50
Yes			7.56	7.50

Father has taken cannabis/marihuana in last 2 years	3439	17.29		
No			88.13	88.09
Yes			11.87	11.91
Outcomes(TF4 Clinic)				
Cannabis				
YP has ever tried cannabis	4158	0		
Yes	1706		41.0	41.03
No	2452		59.0	58.97
Exposure/Moderator				
PCRQ				
Median	3192	23.24	48.00	47.00
(IQR: 25th centile; 75th centile)			(45 to 50)	(44 to 50)
School connectedness				
Child's school is a place where other pupils accept them for who they are	3427	17.58		
Agree	2161		63.06	62.04
Mostly agree	1082		31.57	31.88
Mostly disagree	129		3.76	4.13
Disagree	55		1.60	1.95
Child's school is a place where they are popular with other pupils	3458	17.32		
Agree	1599		46.51	45.81
Mostly agree	1451		42.20	42.01
Mostly disagree	272		7.91	8.31
Disagree	116		3.37	3.86

PCRQ

To assess PCRQ at 9 years of age, a total score was calculated from ten individual items (see Section 5.6.2). The mean score was 45.82 (SD = 5.08). The median score was 47, with an inter-quartile range of 6, minimum of 12 and maximum of 50.

School connectedness

Table 56 shows that the majority of participants agreed (45.81%) or mostly agreed (42.01%) that school was a place where they are popular with other pupils. The table also shows that the majority of participants also agreed that school is a place where other pupils accepted them as they are (62.04%).

8.3.3 Results

Logistic regression analyses tested if PCRQ at 9 years or school connectedness at 11 years predicted experimental cannabis use at 17 years, and whether school connectedness interacted with PCRQ to moderate associations between PCRQ at 9 years and experimental cannabis use at 17 years. Tables 57, 58 and 59 present the results of the analyses.

Do higher levels of PCRQ at 9 years of age reduce the likelihood of experimental cannabis use at 17 years of age?

Table 57 shows that there was a negligible effect of PCRQ upon experimental cannabis use at 17 years of age (OR = 0.98, 95% CI = 0.96, 0.99).

Do increased levels of school connectedness at 11 years of age reduce the likelihood of experimental cannabis use at 17 years of age?

Table 57 shows that young people who disagreed that school was a place where they were popular with other pupils were 17% less likely to have experimentally used cannabis at 17 years of age than those who agreed (OR = 0.83, 95% CI = 0.67, 1.02). Adjusting for potential confounders increased the strength of the association (OR = 0.71, 95% CI = 0.51, 0.99). The addition of PCRQ, alongside the covariates, further increased the strength of the association whereby young people who disagreed that school was a place where they were popular with other pupils were 37% less likely to have experimentally used cannabis at 17 years of age than those who agreed (OR = 0.63, 95% CI = 0.45, 0.88).

Table 58 shows that there was no evidence of a beneficial association between young people who disagreed that school was a place where they were accepted by other pupils and experimental cannabis use (OR = 1.01, 95% CI = 0.88, 1.16). Adjustment for PCRQ alongside the covariates, strengthened the association so that young people who disagreed that school was a place where they were accepted by other pupils were 7% less likely to have experimentally used cannabis at 17 years of age, than those who agreed (OR = 0.93, 95% CI = 0.75, 1.14), but not to a level of significance.

Table 57: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools with experimental cannabis use

	Imputed data set (n = 4158)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.98	0.96			0.98	0.96	0.97	0.96
	(0.96, 0.99)	(0.94, 0.98)			(0.96, 0.99)	(0.93, 0.98)	(0.96, 0.99)	(0.93, 0.98)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.83	0.71	0.77	0.63	0.59	0.61
			(0.67, 1.02)	(0.51, 0.99)	(0.62, 0.96)	(0.45, 0.88)	(0.12, 2.93)	(0.04, 8.95)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.01	1.00
							(0.97, 1.04)	(0.94, 1.06)

* Indicates reference group

Model 1: PCRQ and experimental cannabis use.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 3: Popular in school and experimental cannabis use.
Model 4: Popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 5: PCRQ, popular in school and experimental cannabis use.
Model 6: PCRQ, popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 7: PCRQ, popular in school, PCRQ * popular in school and experimental cannabis use.
Model 8: PCRQ, popular in school, PCRQ * popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.

Table 58: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are accepted in schools with experimental cannabis use

	Imputed data set (n = 4158)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.98 (0.96, 0.99)	0.96 (0.94, 0.98)			0.98 (0.96, 0.99)	0.96 (0.94, 0.98)	0.97 (0.95, 0.99)	0.96 (0.93, 0.99)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			1.01 (0.88, 1.16)	1.00 (0.81, 1.23)	0.97 (0.84, 1.11)	0.93 (0.75, 1.14)	0.62 (0.17, 2.32)	0.80 (0.11, 5.93)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							1.01 (0.98, 1.04)	1.00 (0.96, 1.05)

* Indicates reference group

Model 1: PCRQ and experimental cannabis use.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 3: Accepted in school and experimental cannabis use.
Model 4: Accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 5: PCRQ, accepted in school and experimental cannabis use.
Model 6: PCRQ, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 7: PCRQ, accepted in school, PCRQ * accepted in school and experimental cannabis use.
Model 8: PCRQ, accepted in school, PCRQ * accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.

Table 59: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental cannabis use

	Imputed data set (n = 4158)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.98	0.96			0.98	0.96	0.97	0.96
	(0.96, 0.99)	(0.94, 0.98)			(0.96, 0.99)	(0.93, 0.98)	(0.95, 0.99)	(0.93, 0.99)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.81	0.69	0.77	0.63	0.67	0.61
			(0.65, 1.02)	(0.49, 0.97)	(0.62, 0.96)	(0.44, 0.89)	(0.12, 3.73)	(0.03, 10.69)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			1.05	1.07	1.01	1.01	0.72	1.02
			(0.91, 1.21)	(0.86, 1.33)	(0.88, 1.17)	(0.81, 1.26)	(0.18, 2.95)	(0.12, 8.77)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.00	1.00
							(0.97, 1.04)	(0.97, 1.04)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							1.01	1.00
							(0.98, 1.04)	(0.95, 1.05)

* Indicates reference group

Model 1: PCRQ and experimental cannabis use.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 3: Popular in school, accepted in school and experimental cannabis use.
Model 4: Popular in school, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 5: PCRQ, popular in school, accepted in school and experimental cannabis use.
Model 6: PCRQ, popular in school, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.
Model 7: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school and experimental cannabis use.
Model 8: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and experimental cannabis use.

To what extent does school connetedness at 11 years moderate associations between PCRQ at 9 years and experimental cannabis use at 17 years?

Table 57 shows there was little evidence of an interaction between PCRQ at 9 years of age and being popular in school at 11 years of age in predicting the odds of experimental cannabis use at 17 years of age (OR = 1.01, 95% CI = 0.97, 1.04). Table 58 shows there was little evidence of an interaction between PCRQ at 9 years of age and being accepted in school at 11 years of age, in predicting the odds of experimental cannabis use at 17 years of age (OR = 1.01, 95% CI = 0.98, 1.04). Table 59 shows there was little evidence of an interaction between PCRQ at 9 years of age and being popular in school (OR = 1.00, 95% CI = 0.97, 1.04) and being accepted at school (OR = 1.01, 95% CI = 0.98, 1.04) at 11 years of age in predicting the odds of experimental cannabis use at 17 years. The addition of covariates to the model had negligible effect on these associations.

Covariates

Table 6, Appendix 17 shows that there were a number of associations within the fully adjusted models. The odds of experimentally using cannabis at 17 years of age was higher in young people whose mother's had used cannabis (OR = 2.52, 95% CI = 1.22, 5.17), or father's had used cannabis (OR = 2.68, 95% CI = 1.74, 4.13).

8.4 Results: PCRQ, school connectedness and cannabis dependence

This section presents the findings of the ALSPAC analysis for PCRQ at 9 years, school connectedness at 11 years and cannabis dependence at 17 years.

8.4.1 Sample Size

The sample size for complete case analysis of cannabis dependence was 1,165. The variables used in the models were as follows:

Covariates: KZ021, C755, C645a, c804, j556f, l3042, pm1052.

Cannabis dependence: FJDR1000, FJDR1050, FJDR1100, FJDR1150, FJDR1200, FJDR1250.

PCRQ: ccf104, ccf111, ccf118, ccf125, ccf133, ccf141, ccf149, ccf157, ccf160, ccf165.

School connectedness: ccj100, ccj105, ccj133, ccj142.

8.4.2 Descriptive statistics

Table 60 shows that imputed values were very close to complete case values, with the difference between the two values primarily being less than 1%. Thus, all analyses presented in this chapter are based on the imputed dataset.

Cannabis dependence

Cannabis dependence was assessed through the Cannabis Abuse Screening Test (CAST: Legleye et al. 2007) (see Section 3.6.3.1). The mean CAST score was 2.59 (SD = 4.12). The median CAST score was 1, with an inter-quartile range of 4, minimum of 0 and maximum of 24.

Table 60: The number, proportion of missing data and descriptive statistics for participants who answered all six items of the Cannabis Abuse Screening Test (CAST) (n=1,165)

Variables	**N**	**Missing (%)**	**Observed data (%)**	**Imputed data (%)**
Covariates				
Sex M%	1165	0	50.40	50.39
Child's ethnic group	1051	9.79		
White			96.57	95.37
Non-white			3.43	4.63
Mum's highest educational qualification	1064	8.67		
CSE			10.62	11.22
Vocational			5.83	5.98
O level			29.79	29.55
A Level			30.36	29.91
Degree			23.40	23.34
Maternal Social Class	943	19.06		
I & II			49.95	48.24
IIII (manual and non-manual)			41.89	42.02
IV & V (including armed forces)			8.17	9.74
Total Behavioural Diff Score – Recoded	976	16.22	8.39 (0.14)	8.50 (0.16)
Mother has taken cannabis/marihuana since study child's 5th birthday	952	18.28		
No			92.44	92.50
Yes			7.56	7.50

Father has taken cannabis/marihuana in last 2 years	497	57.34		
No			88.13	88.09
Yes			11.87	11.91
Outcomes (TF4 Clinic)				
Cannabis				
YP has ever used cannabis before midday, in the past 12 months	1165	0		
Never	667		57.25	57.25
Rarely	268		23.00	23.00
From time to time	153		13.13	13.13
Fairly often	52		4.46	4.46
Very often	25		2.15	2.15
YP has ever used cannabis when they were alone, in the past 12 months	1165	0		
Never	880		75.54	75.54
Rarely	145		12.45	12.45
From time to time	75		6.44	6.44
Fairly often	44		3.78	3.78
Very often	21		1.80	1.80
YP has ever had memory problems when they used cannabis, in the past 12 months	1165	0		
Never	803		68.93	68.93
Rarely	161		13.82	13.82
From time to time	119		10.21	10.21
Fairly often	59		5.06	5.06
Very often	23		1.97	1.97

YP has friends or family members tell them they ought to reduce their cannabis use, in the past 12 months	1165	0		
Never	942		80.86	80.86
Rarely	84		7.21	7.21
From time to time	78		6.70	6.70
Fairly often	32		2.75	2.75
Very often	29		2.49	2.49
YP has ever tried to reduce or stop their cannabis use without succeeding, in the past 12 months	1165	0		
Never	1015		87.12	87.12
Rarely	73		6.27	6.27
From time to time	37		3.18	3.18
Fairly often	23		1.97	1.97
Very often	17		1.46	1.46
YP has ever had problems because of their use of cannabis (argument/fight/accident/bad result at school etc), in the past 12 months	1165	0		
Never	1010		86.70	86.70
Rarely	73		6.27	6.27
From time to time	58		4.98	4.98
Fairly often	17		1.46	1.46
Very often	7		0.60	0.60
Exposures/Moderator				
PCRQ				
Median	896	23.09	47	47

IQR (25th centile; 75th centile)			(45 to 49)	(45 to 49)
School connectedness				
Child's school is a place where they are popular with other pupils	980	15.88		
Agree	448		45.71	43.47
Mostly agree	424		43.27	42.21
Mostly disagree	83		8.47	9.58
Disagree	25		2.55	4.73
Child's school is a place where other pupils accept them for who they are	975	16.31		
Agree	592		60.72	57.40
Mostly agree	327		33.54	33.42
Mostly disagree	41		4.21	5.33
Disagree	15		1.54	3.85

Total scores were categorised as a dichotomous measure using a cut-off score of 3 (Legleye et al. 2011). Participants scoring <= 2 were assigned a score of 0 'no addiction risk', and those scoring =>3 were assigned a score of 1 'addiction risk'. Of all participants who had experimentally used cannabis at 17 years of age, 68.58% presented no addiction risk.

PCRQ

PCRQ at 9 years of age was examined using a total score. The mean PCRQ score was 46.02 (SD = 4.56). The median PCRQ score was 47, with an inter-quartile range of 4, minimum of 14 and maximum of 50.

School connectedness

Table 60 shows that the majority of participants agreed (43.47%) or mostly agreed (42.21%) that school was a place where they were popular with other pupils. The majority of participants also agreed that school was a place where other pupils accept them as they are (57.40%).

8.4.3 Results

Logistic regression analyses tested if PCRQ at 9 years or school connectedness at 11 years predicted cannabis dependence at 17 years and whether school connectedness interacted with PCRQ to moderate associations between PCRQ at 9 years and experimental cannabis use at 17 years. Tables 61, 62 and 63 present the results of the analyses.

Table 61: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools with the odds of screening positive for cannabis dependency

	Imputed data set (n = 1165)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.99	1.00			0.99	1.00	0.99	1.00
	(0.97, 1.01)	(0.98, 1.03)			(0.97, 1.01)	(0.98, 1.02)	(0.96, 1.02)	(0.97, 1.03)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.60	0.54	0.58	0.54	0.84	0.70
			(0.38, 0.96)	(0.33, 0.87)	(0.36, 0.92)	(0.33, 0.87)	(0.06,11.59)	(0.05,10.54)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							0.99	0.99
							(0.93, 1.05)	(0.93, 1.06)

* Indicates reference group

Model 1: PCRQ and cannabis dependence.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 3: Popular in school and cannabis dependence.
Model 4: Popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 5: PCRQ, popular in school and cannabis dependence.
Model 6: PCRQ, popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 7: PCRQ, popular in school, PCRQ * popular in school and cannabis dependence.
Model 8: PCRQ, popular in school, PCRQ * popular in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.

Table 62: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are accepted in schools with cannabis dependence

	Imputed data set (n = 1165)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.99	1.00			0.99	1.00	1.00	1.01
	(0.97, 1.01)	(0.98, 1.03)			(0.97, 1.01)	(0.98, 1.03)	(0.96, 1.03)	(0.98, 1.04)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.86	0.81	0.84	0.82	1.32	1.40
			(0.65, 1.14)	(0.61, 1.09)	(0.64, 1.12)	(0.61, 1.09)	(0.15, 11.24)	(0.15, 13.34)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							0.99	0.99
							(0.94, 1.04)	(0.94, 1.04)

* Indicates reference group

Model 1: PCRQ and cannabis dependence.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 3: Accepted in school and cannabis dependence.
Model 4: Accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 5: PCRQ, accepted in school and cannabis dependence.
Model 6: PCRQ, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 7: PCRQ, accepted in school, PCRQ * accepted in school and cannabis dependence.
Model 8: PCRQ, accepted in school, PCRQ * accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.

Table 63: Odds ratios and 95% confidence intervals for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with cannabis dependency

	Imputed data set (n = 1165)							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
PCRQ	0.99	1.00			0.99	1.00	0.99	1.01
	(0.97, 1.01)	(0.98, 1.03)			(0.96, 1.01)	(0.97, 1.02)	(0.96, 1.03)	(0.97, 1.04)
Popular in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.62	0.56	0.59	0.56	0.69	0.53
			(0.38, 1.01)	(0.34, 0.93)	(0.36, 0.97)	(0.34, 0.92)	(0.04, 10.86)	(0.03, 9.84)
Accepted in school								
Agree*			1.00	1.00	1.00	1.00	1.00	1.00
Disagree			0.94	0.90	0.92	0.90	1.56	1.81
			(0.70, 1.27)	(0.67, 1.22)	(0.69, 1.24)	(0.66, 1.22)	(0.16, 14.95)	(0.16, 20.35)
PCRQ * popular in school								
Agree*							1.00	1.00
Disagree							1.00	1.00
							(0.93, 1.06)	(0.94, 1.07)
PCRQ * accepted in school								
Agree*							1.00	1.00
Disagree							0.99	0.98
							(0.94, 1.04)	(0.93, 1.04)

* Indicates reference group

Model 1: PCRQ and cannabis dependence.
Model 2: PCRQ, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 3: Popular in school, accepted in school and cannabis dependence.
Model 4: Popular in school, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 5: PCRQ, popular in school, accepted in school and cannabis dependence.
Model 6: PCRQ, popular in school, accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.
Model 7: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school and cannabis dependence.
Model 8: PCRQ, popular in school, accepted in school, PCRQ * popular in school, PCRQ * accepted in school, covariates (including gender, ethnicity, parental financial difficulties, maternal education, maternal social class, maternal cannabis use since child's 5th birthday, paternal cannabis use at 9 years) and cannabis dependence.

Do higher levels of PCRQ at 9 years of age reduce cannabis dependence at 17 years of age?

Table 61 shows there was no evidence of a beneficial association between a high PCRQ and cannabis dependence at 17 years of age in the unadjusted (OR = 0.99, 95% CI = 0.97, 1.01) or adjusted models (OR = 1.00, 95% CI = 0.98, 1.01).

Do increased levels of school connectedness at 11 years of age reduce the likelihood of cannabis dependence at 17 years of age?

Table 61 shows that young people who disagreed that school was a place where they were popular with other pupils were 40% less likely to be cannabis dependent at 17 years of age than those who agreed (OR = 0.60, 95% CI = 0.38, 0.96). Adjusting for covariates mildly increased the strength of the association (OR = 0.54, 95% CI = 0.33, 0.87). The addition of PCRQ, alongside the covariates, had no impact upon the association.

Table 62 shows the odds ratio for school being a place where they were accepted by other pupils was 0.86 (95% CI = 0.65, 1.14). Adjusting for covariates slightly increased the strength of the association (OR = 0.81, 95% CI = 0.61, 1.09). The addition of PCRQ, alongside the covariates, had no effect.

To what extent does school connetedness at 11 years moderate associations between PCRQ at 9 years and cannabis dependence at 17 years?

Table 61 shows there was little evidence of an interaction between PCRQ at 9 years of age and being popular in school at 11 years of age, in predicting the odds of being cannabis dependent at 17 years of age (OR = 0.99, 95% CI = 0.93, 1.05).

Table 62 shows there was little evidence of an interaction between PCRQ at 9 years of age and being accepted in school at 11 years of age, in predicting the odds of being cannabis dependent at 17 years of age (OR = 0.99, 95% CI = 0.94, 1.04).

Table 63 shows there was little evidence of an interaction between PCRQ at 9 years of age and being popular in school (OR = 1.00, 95% CI = 0.93, 1.06) and accepted in school (OR = 0.99, 95% CI = 0.94, 1.04) at 11 years of age in predicting the odds of cannabis dependence at 17 years of age. The addition of covariates to the model had little effect on these associations.

Covariates

Table 6, Appendix 19 shows that there were a number of strong associations observed within the fully adjusted models. Specifically, the odds of being cannabis dependent at 17 years of age was higher in young people whose mother's had used cannabis (OR = 1.83, 95% CI = 1.07, 3.12), or father's had used cannabis (OR = 1.62, 95% CI = 1.02, 2.58). Whilst, the odds of being cannabis dependent at 17 years of age was lower in young people who were female (OR = 0.48, 95% CI = 0.37, 0.63) or whose mother's highest educational qualification was an A-level at birth (OR = 0.59, 95% CI = 0.34, 0.99).

8.5 Summary and implications for this study

This chapter presented the study results for analyses of associations between PCRQ, school connectedness and cannabis outcomes of experimental cannabis use and cannabis dependence. There was no evidence of a beneficial association between PCRQ and experimental cannabis use, nor cannabis dependence. An association was found between lower levels of popularity at school at 11 years of age and a decreased likelihood of experimentally using cannabis and becoming

cannabis dependent at 17 years of age. However, no effect was found for being accepted in school upon both experimental cannabis use and cannabis dependence. Findings for an association between school connectedness and experimental cannabis and dependence were inconclusive. There was no evidence in support of school connectedness as a moderator for associations between PCRQ and experimental cannabis use and dependence. The next chapter presents a discussion of these results.

Chapter 9: Discussion of main results and conclusions

9.1 Chapter overview

The studies presented in this thesis have made important contributions to knowledge about the association between PCRQ, school connectedness and the use of alcohol, tobacco and cannabis in adolescence. To the authors' knowledge, this study is the first to examine whether school connectedness moderates the association between PCRQ in the prediction of both experimental and hazardous levels of alcohol, tobacco and cannabis.

Six research questions guided the thesis. In the existing literature:

1. Is the quality of parent child relationships associated with experimental and hazardous levels of alcohol, tobacco and cannabis consumption in adolescence?
2. Is school connectedness associated with experimental and hazardous levels of alcohol, tobacco and cannabis consumption in adolescence?
3. Does school connectedness moderate existing associations between parent-child relationship quality and adolescent alcohol, tobacco and cannabis use?

Three additional research questions were specific to the study of ALSPAC data:

4. Is PCRQ at 9 years of age associated with experimental and hazardous use of alcohol, tobacco and cannabis use at 17 years of age?
5. Is school connectedness at 11 years of age associated with experimental and hazardous use of alcohol, tobacco and cannabis use at 17 years of age?
6. To what extent does school connectedness at 11 years moderate associations between PCRQ at 9 years of age and experiemental

and hazardous use of alcohol, tobacco and cannabis at 17 years of age?

This chapter presents a discussion of the study results presented in this thesis, compares them to existing research, examines the strengths and limitations of the methods used, proposes avenues for future research, and presents the overarching implications and conclusions of this work.

9.2 Main results

This thesis presented methodological and empirical contributions to advance the understanding of the epidemiology surrounding PCRQ, school connectedness and adolescent use of alcohol, tobacco and cannabis.

9.2.1 Contribution to knowledge one: systematic reviews of literature examining whether PCRQ is associated with experimental and hazardous levels of alcohol, tobacco and cannabis consumption in adolescence

This thesis presented three distinct systematic reviews to identify and synthesise the evidence gathered in longitudinal studies on the association between:

1. PCRQ and adolescent alcohol use;
2. PCRQ and adolescent tobacco use; and
3. PCRQ and adolescent cannabis use.

Results from each review were used to inform the development of a plan to analyse data collected in the ALSPAC study of PCRQ at 9 years of age and adolescent use of alcohol, tobacco and cannabis at 17 years of age.

The first systematic review examined evidence from longitudinal studies reporting upon PCRQ and adolescent alcohol use. Across the eleven

included studies, there was mixed evidence for answering the question "Is the quality of parent child relationships associated with experimental and hazardous levels of alcohol consumption in adolescence?" Specifically, only two studies found a prospective association between PCRQ and later alcohol use for the whole group (Abar et al. 2014; Trucco et al. 2014) alongside four additional studies which found mixed evidence for certain groups. This was for boys (Weichold et al. 2014), in early school years (Cleveland et al. 2012), with maternal PCRQ only having an effect for girls in one study (Kelly et al. 2011) in comparison to paternal PCRQ only having an effect for girls in another (Ohanessian et al. 2016). Five studies reported no association between PCRQ and later alcohol use (White and Halliwell 2011; Visser et al. 2013; Minaie et al. 2015; Soloski et al. 2016; Wang et al. 2016), with findings inconclusive. A total of ten of the eleven included studies were of high methodological quality (Kelly et al. 2011a; White and Halliwell 2011; Visser et al. 2013; Abar et al. 2014; Trucco et al. 2014; Weichold et al. 2014; Minaie et al. 2015; Wang et al. 2015; Ohannessian et al. 2016; Soloski et al. 2016), with a diverse range of PCRQ and alcohol using outcomes assessed. It is possible that mixed support for the association between PCRQ and later alcohol use arose due to the heterogeneity in PCRQ and alcohol measures used across studies, or the differential ages for the assessment of PCRQ and alcohol consumption. Further, this review highlighted a lack of studies examining hazardous levels of alcohol use, with only one study assessing the quantity and frequency of such use using a validated measure (Ohanessian et al. 2016).

A previous review of longitudinal studies examining parent child relationships and alcohol use by Visser et al. (2012) presented similar findings whereby only weak evidence was found for a prospective association between PCRQ and adolescent alcohol use. They explained this lack of association as in some studies, the measurement of PCRQ was heterogeneous, some did not use validated questionnaires, and a few

studies using parent report which may be less valid than child report. In addition, some studies excluded participants who missed one of the repeated measurements. This may have led to selection bias due to the attrition of adolescents with high levels of alcohol use and even though some studies used imputation methods to reduce this bias (Sterne et al. 2009), only three of the twenty eight included studies used this approach (Visser et al. 2012; Weichold et al. 2014; Wang et al. 2015). This review suggested that more studies with better outcome measurements are needed. The analysis of ALSPAC data was used to address some of the weaknesses found in this review.

The second systematic review examined evidence from longitudinal studies reporting upon PCRQ and adolescent tobacco use. Across twenty five included studies, there was moderate evidence for answering the question "Is the quality of parent child relationships associated with experimental tobacco use and nicotine dependence in adolescence?" Ten studies reported a prospective association between PCRQ and adolescent smoking (Brook et al. 2004; Kandel et al. 2004; Hill et al. 2005; Wen et al. 2009; Brook et al. 2010; Ennett et al. 2010; Gutman et al. 2011; Tucker et al. 2012; White 2012; Mahabee-Gittens et al. 2013), six studies reported an association for specific groups (Tucker et al. 2002; Scal et al. 2003; Liu et al. 2004; van den Bree et al. 2004; Nowlin and Colder 2007; Mahabee-Gittens et al. 2011) and nine studies reported no association (Cohen et al. 1994; Simons-Morton and Haynie 2003; Kim et al. 2009; Skinner et al. 2009; Chang et al. 2011; White and Halliwell 2011; Chen et al. 2013; Lakon et al. 2015; Wang et al. 2016).

Of the six studies finding an association for specific groups, three studies reported associations across gender, but findings were inconsistent with mixed effects being reported for both girls and boys (Scal et al. 2003; Liu et al. 2004; van den Bree et al. 2004). Two studies reported associations

across ethnicity with one study finding associations between maternal and paternal PCRQ and adolescent smoking to be stronger for White adolescents than Black adolescents (Nowlin and Colder 2007) and the other finding that high PCRQ was only protective against smoking initiation for Hispanic youth and not African-American, Hispanic or Caucasian youth (Mahabee-Gittens et al. 2011). One study reported effects of PCRQ on smoking across baseline smoking status whereby effects of PCRQ were stronger for experimental smokers than non-smokers (Tucker et al. 2012). Of the twenty five studies included in the review, eighteen were of high methodological quality (Scal et al. 2003; Kandel et al. 2004; Liu 2004; van den Bree et al. 2004; Hill et al. 2005; Nowlin and Colder 2007; Kim et al. 2009; Wen et al. 2009; Ennett et al. 2010; Gutman et al. 2011; Mahabee-Gittens et al. 2011; White and Halliwell 2011; Tucker et al. 2012; White 2012; Mahabee-Gittens et al. 2013; Chen et al. 2014; Lakon et al. 2015; Wang et al. 2016), with the majority examining cigarette use in the past 30 days or past year.

This was the first full review of this area as prior reviews by Tyas and Pederson (1998) and Wellman et al. (2016) only examined PCRQ as a predictor of the onset of cigarette smoking, whilst the review presented in this thesis examined all levels of adolescent smoking behaviours including nicotine dependence. By widening the criteria surrounding cigarette using outcomes, a total of twenty-five studies were included in this review, in comparison to the three studies included in each of the prior reviews. Notably, the findings of this review differ to the reviews of Tyas and Pederson (1998) and Wellman et al. (2016). Tyas and Pederson (1998) found that maternal PCRQ was more important in associations with adolescent smoking than paternal PCRQ, with paternal PCRQ only influencing smoking behaviours for girls but not boys. Whilst Wellman et al. (2016) found that PCRQ was not a consistent factor reported within the literature. These differences in findings may be explained by the use of wider search terms for smoking outcomes alongside a closer inspection of

studies reporting on parental factors to identify those specifically reporting on associations between PCRQ and adolescent tobacco use.

The third systematic review synthesised evidence from longitudinal studies reporting upon PCRQ and adolescent cannabis use (Ellickson et al. 2004; Lac et al. 2011). Across two studies reporting on PCRQ and adolescent cannabis use, weak evidence was found for answering the question "Is the quality of parent child relationships associated with experimental cannabis use and cannabis dependence in adolescence?" Both studies reported inconsistent findings with one suggesting that higher levels of PCRQ reduced the likelihood of later cannabis use (Lac et al. 2011), whilst the other suggesting higher levels of PCRQ at 12 -13 years, reduced the likelihood of cannabis use at 13 – 14 years; but PCRQ at 13-14 years did not reduce the likelihood of cannabis use at 15-16 years (Ellickson et al. 2004). Thus, the effect of PCRQ on cannabis use may be dependent on age.

A review by Guxens et al. (2007) found evidence that low levels of PCRQ were associated with an increased likelihood of cannabis use onset in adolescence. However, only two studies were included in this review with different PCRQ measures used and the total sample size for the updated review comprising of 2,278 participants from the USA. Hence, findings needed to be interpreted with caution when generalising to UK adolescents' due to the differing cultural and legal norms surrounding cannabis use between the USA and UK.

Overall, the three reviews presented in this thesis contribute to the knowledge base by firstly updating established reviews and secondly, by examining different frequencies of adolescent alcohol, tobacco and cannabis use. This is important as frequency of use is associated with harms to health. The specific contributions made to existing knowledge were:

1. Updated and expanded an existing review which examined PCRQ and adolescent alcohol use (Visser et al. 2012) in addition to examining different levels of alcohol use.
2. A new review upon longitudinal studies reporting on PCRQ and adolescent smoking, alongside synthesising evidence examining smoking frequency and nicotine dependence.
3. Updated and expanded an existing review examining PCRQ and adolescent cannabis use (Guxens et al. 2007).

9.2.2 Contribution to knowledge two: systematic reviews of literature examining whether school connectedness is associated with experimental and hazardous levels of alcohol, tobacco and cannabis consumption in adolescence

This thesis presented three alternative systematic reviews which identified and synthesised existing evidence upon:

1. School connectedness and adolescent alcohol use;
2. School connectedness and adolescent tobacco use; and
3. School connectedness and adolescent cannabis use.

The first systematic review examined longitudinal studies reporting upon the association between school connectedness and adolescent alcohol use. Across eleven included studies there was moderate evidence for answering the question "Is the quality of school connectedness associated with experimental and hazardous levels of alcohol consumption in adolescence?" Five studies reported a negative association where low levels of school connectedness were associated to an increased likelihood of adolescent alcohol use (Crosnoe et al. 2006; Botticello 2009; Henry et al. 2009; Perra et al. 2012; Roebroek and Koning 2016), two studies reported an association but only for those in specific school years (Cleveland et al. 2012; Gianotta and Ozdemir 2013), and four studies reported no

association (Hawkins et al. 1997; Cocker and Borders 2001; Bryant et al. 2003; Hawkins et al. 1997; Mason et al. 2007). Results were inconclusive for answering the question "Does school connectedness moderate existing associations between PCRQ and adolescent alcohol use?" with no studies identified as reporting upon this area.

There were no existing systematic reviews of this area to compare findings. However, the results of the review were drawn from a strong evidence base where all seven studies reporting a prospective association between school connectedness and later alcohol use were of high methodological quality (Crosnoe et al. 2006; Botticello 2009; Henry et al. 2009; Cleveland et al. 2012; Perra et al. 2012; Gianotta and Ozdemir 2013; Roebroek and Koning 2016). Notably, findings of the review were stronger for associations between school connectedness and alcohol use onset than those between school connectedness and frequency/hazardous levels of alcohol use. This may have arisen as three studies examined alcohol use in the past year (Crosnoe 2006; Botticello 2009; Perra et al. 2012), four studies examined alcohol use in the last 30 days (Bryant et al. 2003; Henry 2009; Cleveland et al. 2012; Giannotta and Ozdemir 2013) and only one study assessed problematic drinking over the past two weeks (Cocker and Borders 2001). As such, little evidence was available for hazardous levels of adolescent alcohol use with the majority of studies focusing upon experimental alcohol use.

The second systematic review examined longitudinal studies reporting upon school connectedness and adolescent cigarette smoking. Across the thirteen studies included in the review, there was strong support for the question "Is school connectedness associated with experimental smoking and nicotine dependence in adolescence?" Six studies found school connectedness to be linked to the development of adolescent smoking

(Bond et al. 2007; Henderson et al. 2008; Xie et al. 2013; Chen et al. 2014; Andersson and Maralani 2015; Han et al. 2016) and two additional studies found low levels of school connectedness to be associated with an increased the risk of smoking behaviours in adolescence, but only for specific school years (Bryant et al. 2000) or levels of smoking (Hagger-Johnson et al. 2012). Five studies found no association between school connectedness and the development of adolescent smoking (van den Bree et al. 2004; Kim et al. 2009; Ennett et al. 2010; Perra et al. 2012; Staff et al. 2016). Only one study assessed nicotine dependence using a validated measure– the Fagerstrom Test for Nicotine Dependence (FTND: Heatherton et al. 1991) (Ennett et al. 2010), but this study was one of the five studies reporting no association. No evidence was found in terms of studies reporting on school connectedness as a moderator for associations between PCRQ and adolescent cigarette smoking. Therefore the question "Does school connectedness moderate associations between parent-child relationship quality and cigarette smoking in adolescence?" remained unanswered.

The findings of a prospective association between school connectedness and adolescent cigarette smoking support the conclusions drawn in an earlier review by Fletcher et al. (2008) which concluded that adolescents with low levels of school connectedness were more likely to smoke than those who were strongly connected to school. The findings of the review presented in this thesis extends the evidence base examining school connectedness and adolescent cigarette smoking, with six studies reporting associations, in contrast to the three studies originally identified in the review of Fletcher et al. All studies identified in this review were of high methodological quality and even though overall, the strength of the evidence was strong, differentiations were found across smoking outcomes whereby stronger associations were found for associations of school connectedness with progression to daily smoking than that presented for

the onset of smoking. This may have arose due to different measures of cigarette smoking being used across studies. These results informed the design of analysis of the ALSPAC study.

The third systematic review examined longitudinal studies reporting upon school connectedness and adolescent cannabis use. Across the five studies included in the review, there was moderate evidence for answering the question "Is the quality of school connectedness associated with experimental cannabis use and cannabis dependence in adolescence?" Four of the five included studies found a prospective association between school connectedness and adolescent cannabis use (Bond et al. 2007; Prado et al. 2009; Perra et al. 2012; Benner et al. 2015), with only one study finding no evidence of an association (Vogel et al. 2015). The methodological quality of all included studies were high, with all examining experimental cannabis using outcomes through assessing ever used cannabis or cannabis use in the past 30 days, 6 or 12 months. No studies assessed cannabis dependence. No evidence was found in terms of studies reporting on school connectedness as a moderator for associations between PCRQ and adolescent cannabis use. One study was identified which examined the mediational properties of school connectedness, but the hypothesis linking PCRQ and school connectedness was unclear. Hence the question "Does school connectedness moderate associations between parent-child relationship quality and cannabis use in adolescence?" remained unanswered.

The findings of a prospective association between school connectedness and adolescent cannabis use support the conclusions drawn in an earlier review by Fletcher et al. (2008) which concluded that disengagement from school and poor teacher–student relations were independently associated with adolescent cannabis use after adjustment for students' demographic

characteristics, socio-economic status and prior drug use. The findings of this review extend the evidence base examining school connectedness and adolescent cannabis use, identifying an additional five studies to add to the four identified in Fletcher et al's review.

Overall, the three reviews made the following contributions to knowledge:

1. Provided a new review of studies reporting on school connectedness and adolescent alcohol use, across both experimental and hazardous levels.
2. Updated and expanded an existing review which examined school connectedness and adolescent tobacco use (Fletcher et al. 2008), alongside synthesising evidence examining more frequent levels of smoking and nicotine dependence.
3. Updated and expanded an existing review examining school connectedness and adolescent cannabis use (Fletcher et al. 2007), alongside identifying a lack of evidence reporting on cannabis dependence.

9.2.3 Contribution to knowledge three: Is PCRQ at 9 years of age associated with experimental and hazardous alcohol, tobacco and cannabis use at 17 years of age?

This thesis presented an analysis of data gathered in the ALSPAC examining PCRQ at 9 years of age and adolescent alcohol, tobacco and cannabis use at 17 years of age. It was hypothesised that adolescents with increased PCRQ at 9 years of age would have lower levels of use of alcohol, tobacco and/or cannabis at 17 years of age. Specifically, findings from the ALSPAC study revealed that:

- there was no evidence of a beneficial association between PCRQ at 9 years of age and the odds of experimental or hazardous alcohol use at 17 years of age;

- there was no evidence of a beneficial association between PCRQ at 9 years of age and the odds of experimentally smoking, or nicotine dependence, at 17 years of age; and
- there was no evidence of a beneficial association between PCRQ at 9 years of age and the odds of experimental cannabis use, or cannabis dependence, at 17 years of age.

These findings were consistent across experimental alcohol, tobacco or cannabis use and hazardous alcohol consumption, nicotine and cannabis dependence.

The findings for experimental or hazardous alcohol use at 17 years of age were consistent with the conclusions drawn following a prior systematic review of this area, which found that the evidence base was null to very weak (Visser et al. 2012). Of the twenty eight longitudinal studies included in the review by Visser et al, only five studies reported poor PCRQ was associated with higher levels of adolescent alcohol use. Another seven studies only found this association for certain subgroups such as boys or girls, or for specific age groups. The remaining sixteen studies did not find any evidence of a beneficial association. The findings of no beneficial association between PCRQ at 9 years of age and experimental or hazardous alcohol use at 17 years of age were consistent with the conclusions drawn following a systematic review undertaken as part of this thesis. This review identified an additional eleven studies which presented inconclusive evidence for a prospective association between PCRQ and adolescent alcohol use. Of these eleven studies, only two studies reported a prospective association for the whole group, four studies reported an association for specific sub groups and five studies reported no association. Thus, evidence was stronger for a null association and the findings of the ALSPAC study align with these conclusions suggesting that PCRQ may not

be associated with these alcohol using outcomes. If these findings were included in the systematic review undertaken as part of this thesis, then findings of a null support for an association would be reinforced.

The lack of a beneficial association between PCRQ at 9 years of age and experimental smoking, or nicotine dependence, at 17 years of age were not consistent with the conclusions drawn following the systematic review which found moderate evidence in support of an association. Ten studies included in the review found an association for the whole group (Brook et al. 2004; Kandel et al. 2004; Hill et al. 2005; Wen et al. 2009; Brook et al. 2010; Ennett et al. 2010; Gutman et al. 2011; Tucker et al. 2012; White 2012; Mahabee-Gittens et al. 2013), with six additional studies reporting an association for specific sub groups (Tucker et al. 2002; Scal et al. 2003; Liu et al. 2004; van den Bree et al. 2004; Nowlin and Colder 2007; Mahabee-Gittens et al. 2011). This included three studies which found effects for specific genders but presented mixed evidence for both boys and girls (Scal et al. 2003, Liu et al. 2004, van den Bree et al. 2004). Two studies which presented mixed evidence for ethnicity whereby one study found stronger associations between maternal and paternal PCRQ and adolescent smoking for White adolescents than Black adolescents (Nowlin and Colder 2007), and the other found high PCRQ to be protective against smoking initiation for Hispanic youth but not African-American, Hispanic or Caucasian youth (Mahabee-Gittens et al. 2011). One study which found effects for smokers but not for non-smokers (Tucker et al. 2012).

The ALSPAC analysis presented in this thesis adjusts for a more comprehensive range of covariates than the studies included in the systematic review, which may explain why a null effect was observed. Despite such differences across studies, given the weight of the existing evidence base as synthesised within the systematic review, the ALSPAC study findings would not change the conclusions drawn. However, they do

add to the existing knowledge base in terms of PCRQ and smoking outcomes amongst UK adolescents.

The lack of a beneficial association between PCRQ at 9 years of age and the odds of experimentally using cannabis, or cannabis dependence, at 17 years of age in the ALSPAC analysis were not consistent with the conclusions drawn following the systematic review which found weak evidence of a positive association. However, only two studies were included in the review, with associations in one study only being found for boys but not girls (Lac et al. 2011) and the other finding associations for one PCRQ component and not another (Ellickson et al. 2004).

Given the consistency of findings across all substance use outcomes assessed, it is possible that the null effects observed may be because PCRQ does not have a causal effect on these substances. Methodological explanations for the null association included the 8 year difference between exposure and outcome measures, alongside attrition effects over this lengthy time period whereby those with weakened PCRQ may have been lost to follow up, and the measure of PCRQ not being validated. Alternatively, the measure of PCRQ used in the ALSPAC study encapsulated a range of measures to assess the quality of relationship between parent and child. For example, liking the parent, having fun together, finding the parent easy to talk to and wanting to bring their own child up like they have been bought up by their parents. In contrast, studies included in the reviews which found an effect of PCRQ on use of alcohol, tobacco and cannabis drew upon more established measures of PCRQ including parental closeness and/or attachment (Skinner et al. 2009; Gutman et al. 2011; Lac et al. 2011; Mahabee-Gittens et al. 2011; White and Halliwell 2011; Mahabee-Gittens et al. 2013; Visser et al. 2013; Abar et al. 2014; Trucco et al. 2014; Ohannessian et al. 2016; Soloski et al. 2016). Further,

PCRQ was examined as a continuous measure. This assumes the association between PCRQ and outcomes is linear. It may be that there is a threshold in the association such that only at high or low levels of PCRQ does the associations become protective.

These findings have theoretical implications in terms that they do not support the theoretical tenets of the SDM (Catalano and Hawkins 1986). The SDM perceives PCRQ to be an integral component of why adolescents use alcohol, tobacco and cannabis, outlining the importance of PCRQ in the early years for prospective associations in late adolescence. The findings of the ALSPAC study offered no support for this theoretical tenet, posing questions to the assertions of the SDM.

9.2.4 Contribution to knowledge four: Is school connectedness at 11 years of age associated with experimental and hazardous levels of adolescent alcohol, tobacco and cannabis use at 17 years of age?

This thesis presented empirical evidence from statistical analysis of ALSPAC data which examined school connectedness at 11 years of age and adolescent alcohol, tobacco and cannabis use at 17 years of age. School connectedness was measured by two questions which examined being popular in school and accepted in school.

Specifically, adolescents who disagreed that school was a place where they were popular with other pupils at 11 years of age:

- were 59% less likely to have ever drunk at 17 years of age than those who agreed that they were popular with other pupils;
- had total AUDIT scores 1.09 units lower at 17 years of age than those who agreed that they were popular with other pupils;

- were 28% less likely to smoked experimentally at 17 years of age than those who agreed that they were popular with other pupils;
- were 19% more likely to be nicotine dependent at 17 years of age than those who agreed that they were popular with other pupils;
- were 37% less likely to have used cannabis experimentally by 17 years of age than those who agreed that they were popular with other pupils; and
- were 40% less likely to be cannabis dependent at 17 years of age than those who agreed that they were popular with other pupils.

In contrast, adolescents who disagreed that school was a place where they were accepted by other pupils at 11 years of age:

- were 41% less likely to have ever drunk at 17 years of age than those who agreed that they were accepted in school;
- were no more likely to be hazardous drinkers at 17 years of age than those who agreed that they were accepted in school;
- were no more likely to have smoked experimentally or be nicotine dependent at 17 years at age than those who agreed that they were accepted in school;
- were only 7% less likely to have experimentally used cannabis at 17 years of age, than those who those who agreed that they were accepted in school; and
- were no more likely to be cannabis dependent at 17 years of age, than those who agreed that they were accepted in school.

Taking the two school connectedness measures combined, consistent associations were only found for experimental alcohol use whereby lower levels of school connectedness reduced the risk of use. This was in the opposite direction to that predicted whereby it was thought that adolescents with lower levels of school connectedness at 11 years of age

would have higher levels of alcohol use at 17 years of age but findings suggested that it was those with higher levels of school connectedness that were more liklely to use.

Findings from the ALSPAC study were not consistent with the conclusions of the first review. Specifically, the review found moderate evidence in support of a prospective association between lower levels of school connectedness and an increased likelihood of alcohol use. The analysis of ALSPAC data found school connectedness increased the likelihood of experimental alcohol use, but no association was found for hazardous levels of alcohol use. Findings that there was no beneficial association between school connectedness at 11 years of age and experimental smoking and nicotine dependence at 17 years of age were not consistent with the conclusions of the second review which found good evidence for a prospective association between school connectedness and adolescent smoking behaviours. Lower levels of school connectedness at 11 years of age were associated with a reduced odds of experimental cannabis use but not cannabis dependence at 17 years of age. This finding was not consistent with the conclusions of the third review which found moderate evidence for a prospective association between lower levels of school connectedness and increased adolescent cannabis using behaviours.

One possible explation for the findings in the ALSPAC analysis being in the opposite direction to that found in the reviews, is that within the ALPSPAC data, the school connectedness measure may be better characterised as a measure of popularity rather than connectedness as typically measured by the studies included in the systematic reviews. It is possible that questions used to assess school connectedness in ALSPAC, i.e. being, “popular in school” and “accepted in school”, were a proxy indicator of peer group influences, whereby being more connected to school meant having a

greater attachment to, or popularity with peers. This may have strengthened observed effects for overall school connectedness at 11 years of age and later alcohol, tobacco or cannabis use as a number of studies suggest that popularity in school might facilitate subsequent substance use in adolescence (Moody et al. 2011; Mundt 2011). Such influences were not assessed by this study, and exploration of how peer influences across childhood interact with school connectedness would be beneficial. Using alternative school connectedness measures or controlling for peer group influences may disentangle such effects. Notably, the SDM (Catalano and Hawkins 1986) describes the mechanisms by which family, school and peer attachment influence involvement in alcohol use (Henry et al. 2009). Even though describing them as three unique elements in the socialisation process, the SDM does postulate that peers have the propensity to moderate the relationship between family and school and subsequent alcohol use (Henry et al. 2009).

It is also possible that the lack of consistent associations between school connectedness and hazardous alcohol use, experimental smoking, nicotine dependence and cannabis dependence may also be an artifact of limitations in the two item measure of school connectedness used in ALSPAC. Specifically, being popular in school was consistently associated across all substance using outcomes, but accepted in school was only linked to experimental alcohol and cannabis use, alongside cannabis dependence. These items do not examine constructs that measures of school connectedness used in reviews of whether teachers and other pupils care about their learning and them; or how committed they are to learning or achievement. A wide range of measures of school 'connectedness', 'attachment', 'bonding' and 'engagement' have been operationalised to study adolescent's orientation to school (Libbey 2004), with no universally accepted measure. If these analyses of the ALSPAC data were included in the systematic reviews, they would not change the

conclusions made because the findings from the ALSPAC data may be better characterised as measures assessing popularity and acceptance, not school connectedness.

9.2.5 Contribution to knowledge five: To what extent school connectedness at 11 years of age moderate associations between PCRQ at 9 years of age and adolescent use of alcohol, tobacco and cannabis at 17 years of age?

It was hypothesised that: higher levels of school connectedness at 11 years of age would reduce the effects of low PCRQ at 9 years of age upon use of alcohol, tobacco and/or cannabis at 17 years of age. The findings were consistent. As no beneficial association was found between PCRQ and outcomes, no interaction was found between PCRQ and school connectedness in the prediction of alcohol, tobacco and cannabis use. To the best of the author's knowledge, there are no studies available to compare such findings. Even though there was little evidence to support the hypothesis that school connectedness moderated the association between parent child relationship quality and substance misuse, the study findings contribute to a paucity of research in this area and suggest that there is more consistent support for school popularity as a risk factor than PCRQ in the prediction of adolescent alcohol, tobacco and cannabis use.

9.3 Strengths and limitations of key results

9.3.1 Data considerations

A main strength of this research was the use of existing data from a large population based birth cohort in England (ALSPAC). The sample sizes used for analysis were large, with a wide range of potentially confounding factors, and validated measures of problematic alcohol (AUDIT: Babor et al. 2001), tobacco (FTND: Heatherton et al. 1991) and cannabis use at 17 years of age (CAST: Legleye et al. 2007).

One limitation is the likely measurement error due to the use of self-report methods for assessing adolescent use of alcohol, tobacco and cannabis. If some young people did not report use when they had used, or vice versa, this would have acted to reduce the strength of associations found. Having said this, biomarkers of cannabis use lack sensitivity even for heavy use when extending back only three months (Taylor et al. 2017), such that self-report measures may still represent the 'gold standard' in assessing lifetime use cannabis use. The same limitations is found in biological indicators of tobacco use with metabolites such as nicotine only assessing tobacco exposure over the past 72 hours (Dolcini et al. 2003; Harris et al. 2008), and liver cirrhosis being multifactorial in cause and rare in adolescence (McCambridge et al. 2011). For these reasons self-report may still represent the best measure of lifetime substance use.

9.3.2 Statistical methods

Characteristic of many cohort studies, missing data were common in the ALSPAC sample. The six studies presented in this thesis were strengthened by the use of multiple imputation methods to reduce selection bias and maximise sample size. However, the actual values of the missing data remain unknown and it is not possible to determine whether this method resulted in an accurate imputed dataset, or whether data were truly missing at random. Nevertheless, examination of both the observed and imputed values suggested those imputed were comparable.

There were also limitations surrounding the measurement of PCRQ and school connectedness. Firstly, the examination of PCRQ as a continuous variable presents caution as the distribution of PCRQ was not normal, and it may be that the associations with outcomes were not linear and may have been better modelled categorically to explore thresholds in these associations. Secondly, school connectedness was examined as two

separate variables, with one variable presenting stronger associations than the other. It could be argued that an overall measure of school connectedness should have been utilised, but the analytical approach was guided by prior research of school connectedness using ALSPAC data (Kidger et al. 2015). Although the analyses were grounded in causal inference, it is important to again note the limitations of observational data. The risk factor effect estimates (odds ratios) presented are based on measures of association, and will only resemble the true causal effect to the extent to which there is no unmeasured confounding. The assumption of no unmeasured confounding is unlikely to hold for most epidemiological investigations. Thus, the results presented represent an effort to obtain the most rigorous estimates, given the limitations of the data.

9.4 Implications and future research

9.4.1 Research gaps and extensions

There has been limited evidence on PCRQ, school connectedness and adolescent use of alcohol, tobacco and cannabis in the UK for both experimental and hazardous levels of use. There is also limited evidence which examines the inter-relationship of PCRQ and school connectedness in predicting adolescent use of alcohol, tobacco and cannabis. Of the limited evidence available, there is uncertainty and mixed messaging around both PCRQ and school connectedness as factors in adolescent use of alcohol, tobacco and cannabis (Fletcher et al. 2008; Visser et al. 2012). The reviews presented in this thesis suggest young people who feel connected to school are less likely to engage in experimental and hazardous levels of substance use. This may help explain the successes of whole school public health improvement interventions which attempt to increase school connectedness and have found positive effects on risk behaviours in adolescents. For example, the GATEHOUSE project found that increasing a student's connectedness to school was linked to a reduction in adolescent substance use behaviours (Bond et al. 2004).

Whilst the INCLUSIVE trial found that engaging students in school decision making and providing social and emotional skills education reduced adolescent smoking and drunkenness (Bonell et al. 2018). Similarly, the lack of an association between PCRQ and adolescent substance misuse, may help to explain why some interventions which aim to increase and improve the quality of parent and child relationships have been ineffective. For example, independent evaluations of the SFP 10-14 found that the family based prevention program was not effective in reducing adolescent substance using behaviours (Gorman 2017).

9.4.2 Suggestions for future research

While study findings suggest limited potential value of 'school connectedness' in the development of adolescent alcohol, tobacco and cannabis use, the lack of consistent association is well placed for future research. Using alternative measures of school connectedness would be beneficial as the Gatehouse Project (Bond et al., 2004; Patton et al., 2006), seeks to modify the school environment to enhance positive teacher–student relationships and school safety, and examination of these factors would be useful in conceptualising schools as complex 'risk environments' (Fletcher et al. 2008). Future longitudinal studies should aim to collect more detailed information about school connectedness and capture teacher–student relationships, school safety and wider connectedness factors including 'attachment', 'bonding' and 'engagement', in order to examine this relationship.

9.5 Conclusions

This thesis identified and addressed gaps in the evidence base on the association between the quality of relationships between parents and children, school connectedness and adolescents' use of alcohol, tobacco and cannabis. The studies presented in this thesis make important

contributions to knowledge on the association between parent and child relationship quality, school connectedness and substance use in adolescence. In the relation to the research questions presented above, there was little evidence that PCRQ was associated with use of alcohol, tobacco and cannabis in adolescence. There was some support for a beneficial association between school connectedness in reducing the risk of substance misuse in adolescence in the published peer reviewed literature. There was little evidence to support the hypothesis that school connectedness moderated the association between parent child relationship quality and substance misuse. These findings have important implications for theory and practise.

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Appendix 1: PRISMA Statement

Adapted From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

Appendix 1, Table 1: PRISMA criterion for PCRQ and adolescent alcohol use

Section/topic	#	Checklist item	Reported on page #
TITLE: PCRQ AND ADOLESCENT ALCOHOL USE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	57
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	iv, v
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	95
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	95
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address), and, if available, provide	N/A

		registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility, giving rationale.	57, 58, 96
Information sources	7	Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	57, 96
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 3
Study selection	9	State the process for selecting studies (i.e. screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	58
Data collection process	10	Describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	58
Data items	11	List and define all variables for which data were sought (e.g. PICOS, funding sources) and any assumptions and simplifications made.	97
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	58
Summary measures	13	State the principal summary measures (e.g. risk ratio, difference in means).	58
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of	58

		consistency (e.g. I^2) for each meta-analysis.	
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies).	58, 59
Additional Analyses	16	Describe methods of additional analyses (e.g. sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	98
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g. study size, PICOS, follow-up period) and provide the citations.	101-107
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	109
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	100, 108, 109, 111
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	109
Additional analysis	23	Give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			

Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. healthcare providers, users, and policy makers).	110
Limitations	25	Discuss limitations at study and outcome level (e.g. risk of bias), and at review-level (e.g. incomplete retrieval of identified research, reporting bias).	111
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	112
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g. supply of data); role of funders for the systematic review.	N/A

Appendix 1, Table 2: PRISMA criterion for PCRQ and adolescent smoking

Section/topic	#	Checklist item	Reported on page #
TITLE: PCRQ AND ADOLESCENT SMOKING			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	57
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	iv, v
INTRODUCTION			

Rationale	3	Describe the rationale for the review in the context of what is already known.	112, 113
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	112
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility, giving rationale.	57, 58, 114
Information sources	7	Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	57, 114
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 3
Study selection	9	State the process for selecting studies (i.e. screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	58
Data collection process	10	Describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	58
Data items	11	List and define all variables for which data were sought (e.g. PICOS, funding	114

		sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	58
Summary measures	13	State the principal summary measures (e.g. risk ratio, difference in means).	58
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g. I^2) for each meta-analysis.	58
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies).	58, 59
Additional Analyses	16	Describe methods of additional analyses (e.g. sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	117
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g. study size, PICOS, follow-up period) and provide the citations.	119-132
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	135-136

Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	117, 118, 133, 134, 137
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	135-136
Additional analysis	23	Give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. healthcare providers, users, and policy makers).	137
Limitations	25	Discuss limitations at study and outcome level (e.g. risk of bias), and at review-level (e.g. incomplete retrieval of identified research, reporting bias).	138
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	139
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g. supply of data); role of funders for the systematic review.	N/A

Appendix 1, Table 3: PRISMA criterion for PCRQ and adolescent cannabis use

Section/topic	#	Checklist item	Reported on page #
TITLE: PCRQ AND ADOLESCENT CANNABIS USE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	57
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	iv, v
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	139-140
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	139
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility, giving rationale.	57, 58, 141
Information sources	7	Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	57, 140

Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 3
Study selection	9	State the process for selecting studies (i.e. screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	58
Data collection process	10	Describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	58
Data items	11	List and define all variables for which data were sought (e.g. PICOS, funding sources) and any assumptions and simplifications made.	141
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	58
Summary measures	13	State the principal summary measures (e.g. risk ratio, difference in means).	58
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g. I^2) for each meta-analysis.	58
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies).	58, 59
Additional Analyses	16	Describe methods of additional analyses (e.g. sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			

Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	143
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g. study size, PICOS, follow-up period) and provide the citations.	141-142
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	146
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	143-144
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	146
Additional analysis	23	Give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. healthcare providers, users, and policy makers).	144
Limitations	25	Discuss limitations at study and outcome level (e.g. risk of bias), and at review-level (e.g. incomplete retrieval of identified research, reporting bias).	144
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	147

FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g. supply of data); role of funders for the systematic review.	N/A

Appendix 1, Table 4: PRISMA criterion for school connectedness and adolescent alcohol use

Section/topic	#	Checklist item	Reported on page #
TITLE: SCHOOL CONNECTEDNESS AND ADOLESCENT ALCOHOL USE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	57
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	iv
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	148-149
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	148
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility, giving rationale.	57, 58, 149, 150

Information sources	7	Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	57, 149
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 3
Study selection	9	State the process for selecting studies (i.e. screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	58
Data collection process	10	Describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	58
Data items	11	List and define all variables for which data were sought (e.g. PICOS, funding sources) and any assumptions and simplifications made.	150
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	58
Summary measures	13	State the principal summary measures (e.g. risk ratio, difference in means).	58
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g. I^2) for each meta-analysis.	58
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies).	58, 59
Additional Analyses	16	Describe methods of additional analyses (e.g. sensitivity or subgroup	N/A

		analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	151
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g. study size, PICOS, follow-up period) and provide the citations.	154-160
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	161
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	152, 153, 162, 163, 164
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	161
Additional analysis	23	Give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. healthcare providers, users, and policy makers).	162-164
Limitations	25	Discuss limitations at study and outcome level (e.g. risk of bias), and at review-level (e.g. incomplete retrieval of identified research, reporting bias).	165

Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	166
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g. supply of data); role of funders for the systematic review.	N/A

Appendix 1, Table 5: PRISMA criterion for school connectedness and adolescent smoking

Section/topic	#	Checklist item	Reported on page #
TITLE: SCHOOL CONNECTEDNESS AND ADOLESCENT SMOKING			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	57
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Iv
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	167
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	167
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility, giving rationale.	57, 58, 168

Information sources	7	Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	57, 168
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 3
Study selection	9	State the process for selecting studies (i.e. screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	58
Data collection process	10	Describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	58
Data items	11	List and define all variables for which data were sought (e.g. PICOS, funding sources) and any assumptions and simplifications made.	169
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	58
Summary measures	13	State the principal summary measures (e.g. risk ratio, difference in means).	58
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g. I^2) for each meta-analysis.	58
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies).	58, 59
Additional Analyses	16	Describe methods of additional analyses (e.g. sensitivity or subgroup	N/A

		analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	170
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g. study size, PICOS, follow-up period) and provide the citations.	172-179
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	181
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	171, 180, 181, 183, 184
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	182
Additional analysis	23	Give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. healthcare providers, users, and policy makers).	184
Limitations	25	Discuss limitations at study and outcome level (e.g. risk of bias), and at review-level (e.g. incomplete retrieval of identified research, reporting bias).	185

Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	186
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g. supply of data); role of funders for the systematic review.	N/A

Appendix 1, Table 6: PRISMA criterion for school connectedness and adolescent cannabis use

Section/topic	#	Checklist item	Reported on page #
TITLE: SCHOOL CONNECTEDNESS AND ADOLESCENT CANNABIS USE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	57
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Iv
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	187
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	187
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility, giving rationale.	57, 58, 188, 189

Information sources	7	Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	57, 188
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 3
Study selection	9	State the process for selecting studies (i.e. screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	58
Data collection process	10	Describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	58
Data items	11	List and define all variables for which data were sought (e.g. PICOS, funding sources) and any assumptions and simplifications made.	188
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	58
Summary measures	13	State the principal summary measures (e.g. risk ratio, difference in means).	58
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g. I^2) for each meta-analysis.	58
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies).	58, 59
Additional Analyses	16	Describe methods of additional analyses (e.g. sensitivity or subgroup	N/A

		analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	190
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g. study size, PICOS, follow-up period) and provide the citations.	192-194
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	197
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	191, 195, 196
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	197
Additional analysis	23	Give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. healthcare providers, users, and policy makers).	198
Limitations	25	Discuss limitations at study and outcome level (e.g. risk of bias), and at review-level (e.g. incomplete retrieval of identified research, reporting bias).	198

Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	199
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g. supply of data); role of funders for the systematic review.	N/A

Appendix 2: Examples of specific search terms used in the systematic reviews

Search for PCRQ and adolescent alcohol use (Scopus)

TITLE-ABS-KEY (**"parent"** OR **"family"** OR **"child rearing"**) AND TITLE (**"alcohol"** OR **"drink"**) AND TITLE-ABS-KEY (**"longitudinal"** OR **"cohort"** OR **"prospective"** OR **"follow up"**) AND (LIMIT-TO (PUBYEAR , **2017**) OR LIMIT-TO (PUBYEAR , **2016**) OR LIMIT-TO (PUBYEAR , **2015**) OR LIMIT-TO (PUBYEAR , **2014**) OR LIMIT-TO (PUBYEAR , **2013**) OR LIMIT-TO (PUBYEAR , **2012**) OR LIMIT-TO (PUBYEAR , **2011**)) AND (LIMIT-TO (LANGUAGE , **"English"**)) AND (LIMIT-TO (DOCTYPE , **"ar"**) OR LIMIT-TO (DOCTYPE , **"ip"**))

Search for PCRQ and adolescent tobacco use (Scopus)

TITLE-ABS-KEY (**"parent"** OR **"family"** OR **"child rearing"**) AND TITLE (**"smok*"** OR **"cigarette"** OR "tobacco") AND TITLE-ABS-KEY (**"longitudinal"** OR **"cohort"** OR **"prospective"** OR **"follow up"**) AND (LIMIT-TO (LANGUAGE , **"English"**)) AND (LIMIT-TO (DOCTYPE , **"ar"**) OR LIMIT-TO (DOCTYPE , **"ip"**))

Search for PCRQ and adolescent cannabis use (Scopus)

TITLE-ABS-KEY (**"parent"** OR **"family"** OR **"child rearing"**) AND TITLE (**"cannabis"** OR **"marihuana"** OR **"marijuana"**) AND TITLE-ABS-KEY (**"longitudinal"** OR **"cohort"** OR **"prospective"** OR **"follow up"**) AND (EXCLUDE (DOCTYPE , **"ar OR LIMIT-TO DOCTYPE "**)) AND (LIMIT-TO (LANGUAGE , **"English"**)) AND (LIMIT-TO (PUBYEAR , **2016**) OR LIMIT-TO (PUBYEAR , **2015**) OR LIMIT-TO (PUBYEAR , **2014**) OR LIMIT-TO (PUBYEAR , **2013**) OR LIMIT-TO (PUBYEAR , **2012**) OR LIMIT-TO (PUBYEAR , **2011**) OR LIMIT-TO (PUBYEAR , **2010**) OR LIMIT-TO (PUBYEAR , **2009**) OR LIMIT-TO (PUBYEAR , **2008**) OR LIMIT-TO (PUBYEAR , **2007**) OR LIMIT-TO (PUBYEAR , **2006**) OR LIMIT-TO (PUBYEAR , **2005**) OR LIMIT-TO (PUBYEAR , **2004**))

Search for school connectedness and adolescent alcohol use (Web of Science)

TITLE-ABS-KEY("school" OR "education" OR "teacher") AND TITLE("alcohol" OR "drink*") AND TITLE-ABS-KEY("longitudinal" OR "cohort" OR "prospective" OR "follow up") AND TITLE-ABS-KEY("child" OR "adolescent" OR "youth") AND (LIMIT-TO(LANGUAGE,"English"))

Search for school connectedness and adolescent tobacco use (Web of Science)

TITLE-ABS-KEY("school" OR "education" OR "teacher") AND TITLE("smok*" OR "tobacco" OR “cigarette” OR “substance”) AND TITLE-ABS-KEY("longitudinal" OR "cohort" OR "prospective" OR "follow up") AND TITLE-ABS-KEY("child" OR "adolescent" OR "youth") AND (LIMIT-TO(LANGUAGE,"English"))

Search for school connectedness and adolescent cannabis use (OvidMedline)

TS=(school OR education OR teacher) AND TI=(cannabis OR marijuana OR marihuana OR substance OR hash*) AND TS= (longitudinal OR cohort OR prospective OR follow up) AND TS= (child* OR adolescent OR youth)

Limits English and Article

("school" OR "education" OR "teacher") AND ti(("cannabis" OR "marijuana" OR "marihuana" OR "hash*" OR "substance")) AND ("longitudinal" OR "cohort" OR "prospective" OR "follow up") AND ("youth" OR "adolescen*" OR "child*")

Appendix 3: NEWCASTLE-OTTAWA QUALITY ASSESSMENT SCALE: COHORT STUDIES

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability.

Selection

1) Representativeness of the exposed cohort

a) truly representative of the average _____ (describe) in the community ☐

b) somewhat representative of the average _____ in the community ☐

c) selected group of users eg nurses, volunteers

d) no description of the derivation of the cohort

2) Selection of the non exposed cohort

a) drawn from the same community as the exposed cohort ☐

b) drawn from a different source

c) no description of the derivation of the non exposed cohort

3) Ascertainment of exposure

a) secure record (eg surgical records) ☐

b) structured interview ☐

c) written self report

d) no description

4) Demonstration that outcome of interest was not present at start of study

a) yes ☐

b) no

Comparability

1) Comparability of cohorts on the basis of the design or analysis

a) study controls for _____ (select the most important factor) ☐

b) study controls for any additional factor ☐ (This criteria could be modified to indicate specific control for a second important factor.)

Outcome

1) Assessment of outcome

a) independent blind assessment ☐

b) record linkage ☐

c) self report

d) no description

2) Was follow-up long enough for outcomes to occur

a) yes (select an adequate follow up period for outcome of interest) ☐

b) no

3) Adequacy of follow up of cohorts

a) complete follow up - all subjects accounted for ☐

b) subjects lost to follow up unlikely to introduce bias - small number lost - > ____ % (select an adequate %) follow up, or description provided of those lost) ☐

c) follow up rate < ____% (select an adequate %) and no description of those lost

d) no statement

From: Wells, G. A, Shea, B., O'Connel, D. et al. The Newcastle-Ottawa scale (NOS) for assessing the quailty of nonrandomised

Appendix 4: Data source screening criteria

	Yes	No	Description
Drinking			
Is alcohol use measured?			
Are you able to assess levels of alcohol use?			
Smoking			
Does the data set measure smoking?			
Are you able to assess nicotine dependence?			
Cannabis use			
Is cannabis use measured?			
Are you able to assess levels of cannabis use?			
Family			
Is data available for:			
Parental conversations/communication			
Parental relationship quality			
Parent child arguments			
Any other measure of relationship quality			
School			
Is data available for:			
School connectedness			
School bonding/attachment			
Relationships with teachers			
Any other measure of school connectedness			
FINAL DECISION & JUSTIFICATION:			

Appendix 5: ALSPAC and Cardiff University project approvals

To: Rhiannon Yapp <YappR@cardiff.ac.uk>
From: Alspac Exec Mailbox
Sent by: fdbcj@bristol.ac.uk
Date: 05/28/2013 10:43AM
Cc: Kate Northstone <Kate.Northstone@bristol.ac.uk>, Jacqueline Slack <Jacqueline.Slack@bristol.ac.uk>
Subject: Re: Data Request

Dear Rhiannon,

The Executive Committee met last Friday and are pleased to approve your proposal. The reference number is B2018 (please quote this on all correspondence).

Please note that due to the Wellcome Trust's open access policy, you will be responsible for making any publications open access. For further clarification, please visit the below link:-

<http://www.wellcome.ac.uk/About-us/Policy/Spotlight-issues/Open-access/index.htm>

I have copied in Kate Northstone who will be in touch to assign a data buddy to help with the data. This proposal will incur a Data Buddy Fee, which is a set amount of £896.00. Please could you provide me with a name and address to send the invoice to?

Please also note that I will be monitoring the proposals process and I would therefore appreciate any updates regarding the project.

The approved project will be listed on ALSPAC's website.

Best wishes

Barb.

Miss Barbara Johnstone

Research Secretary

ALSPAC (Children of the 90s)

University of Bristol

Oakfield House, Oakfield Grove

Bristol BS8 2BN

Tel: +44 (0)117 3310167 http://www.bristol.ac.uk/alspac

Your Application ref: SREC/1110

Rhiannon Yapp

PhD Programme, SOCSI

Dear Rhiannon

You will shortly receive a letter from the Chair of the School Research Ethics Committee, Professor Tom Horlick-Jones, confirming the following:

Your project entitled "*Peer mediating and moderating effects upon parent-child relationships, school connectedness and adolescent substance use*" has now been approved by the School of Social Sciences Research Ethics Committee of Cardiff University and you can now commence the project.

If you make any substantial changes with ethical implications to the project as it progresses you need to inform the SREC about the nature of these changes. Such changes could be: 1) changes in the type of participants recruited (e.g. inclusion of a group of potentially vulnerable participants), 2) changes to questionnaires, interview guides etc. (e.g. including new questions on sensitive issues), 3) changes to the way data are handled (e.g. sharing of non-anonymised data with other researchers).

In addition, if anything occurs in your project from which you think the SREC might usefully learn, then please do share this information with us.

All ongoing projects will be monitored every 12 months and it is a condition of continued approval that you complete the monitoring form.

Please inform the SREC when the project has ended. Please use the SREC's project reference number above in any future correspondence.

Regards

Deborah Watkins
Research & Graduate Studies Administrator
Cardiff School of Social Sciences (SOCSI)
Glamorgan Building
King Edward VII Avenue
Cardiff CF10 3WT
Tel: +44 (0)29 2087 9051
Fax: +44 (0)29 2087 4175
http://www.cardiff.ac.uk/socsi

Appendix 6: Specific ALSPAC variables requested

Concept	Person	Source	Time Points	Specific Variables[17]
Outcome				
Alcohol, tobacco and cannabis use	Child	Clinic	TF4	Experimental use: FJAL050 FJSM050 FJDR050 AUDIT ITEMS: FJAL1000 FJAL1050 FJAL1100 FJAL1150 FJAL1350 FJAL1400 FJAL1450 FJAL1550 FJAL1900 FJAL1950 FAGERSTROM ITEMS: FJSM550 FJSM600 FJSM650 FJSM700 FJSM750 FJSM400 CAST ITEMS: FJDR1000 FJDR1050 FJDR1100 FJDR1150 FJDR1200 FJDR1250

[17] Variable names are case sensitive.

Exposure/ moderator				
School connectedness	Child	Questionnaire	CCJ School life and me 134m (11y2m)	ccj100 ccj101 ccj104 ccj105 ccj107 ccj112 ccj115 ccj122 ccj131 ccj133 ccj144 ccj145 ccj151 ccj160 ccj162
Exposure				
Parent child relationship quality (PCRQ)	Child	Questionnaire	CCF My Hands, My Feet and Me (9y6m)	ccf104 ccf106 ccf111 ccf118 ccf125 ccf120 ccf122 ccf127 ccf133 ccf141 ccf138 ccf143 ccf146 ccf149 ccf154 ccf157 ccf160 ccf165 ccf168
Covariates				
Sex	N/A	Not specified	Birth	Kz021
Ethnicity	Mother	Questionnaire	C Your Pregnancy 32wks Gest	c800 c801 c804 [d]
Maternal social class	Mother	Questionnaire	C Your Pregnancy 32wks Gest	Maternal c755 [d]

Maternal education	Mother	Questionnaire	C Your Pregnancy 32wks Gest	Maternal c645[d] c645A [d]
Behavioural Difficulties	Mother	Questionnaire	J Mother's New Questionnaire 47 months	j555F [d] j556F [d]
Parental drinking at child age 1yr 9m	Mother	Questionnaire	G Caring for a Toddler 21 months	Maternal pe410 Paternal g750
Parental alcohol consumption at child aged 9 years	Mother	Questionnaire	P/PM Mother/Father of a 9yr old 110m	Maternal pm3190 pm3191 Paternal p3190 C16a p3191 C16b
Parental smoking	Mother	Questionnaire	G Caring for a Toddler 21 months	Maternal g820 Paternal g649
Parental cannabis use	Mother	Questionnaire	L Mother's Lifestyle 73 months	Maternal l3042 Paternal pm1052

[d] = derived variable

*Also measures for peers auxiliary

** Social Class, Parental Education and Employment Status are derived variables and later measures have been found, but not derived.

Appendix 7: Linear regression test assumptions

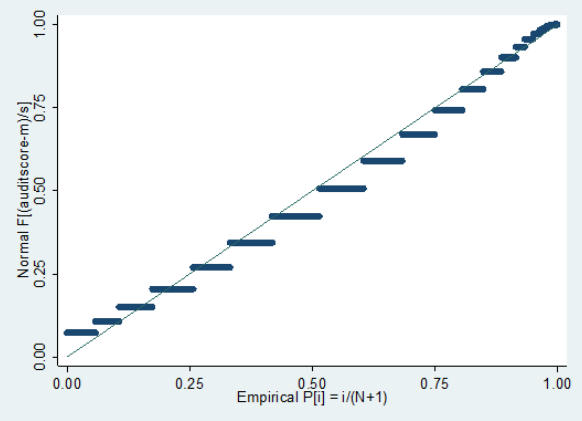
Four key assumptions for linear regression analyses were tested:

1. Linear relationship

This assumption was assessed by a scatter plot between PCRQ and total AUDIT scores. Linearity was observed with a positive relationship between PCRQ and total AUDIT scores. Hence, when PCRQ increased, total AUDIT scores also increased. Outliers were observed, but were deemed not to be extreme.

2. Multivariate normality

This assumption was tested with a histogram, as presented within the main thesis (see page 79). The histogram presents an approximate normal distribution. It was further tested by a Q-Q plot distribution:



3. Multicollinearity

Multicollinearity between the independent variables was tested for with a correlation matrix of PCRQ and school connectedness. Spearman's Rho correlation coefficients were all below -0.2 (see Table A7.1), satisfying this test assumption.

Table A7.1: Spearman's Rho correlation coefficients

Variables	Correlation Coefficient
PCRQ x popular in school	-0.1832
PCRQ x accepted in school	-0.0681

4. Homoscedasticity

This assumption was assessed through observing the residuals of the scatterplot between PCRQ and total AUDIT scores. Data was seen to not have homoscedastic variance, satisfying this assumption.

Appendix 8: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with experimental alcohol use, analysis 1 through 3, complete case data

Appendix 8, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental alcohol use, models 1 through 4, complete case data[18]

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.02	0.99	1.06	1.00	0.94	1.06						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.40**	**0.28**	**0.57**	0.55	0.28	1.07
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.31	0.76	2.25				1.17	0.70	1.93
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.98	0.22	4.42				0.92	0.20	4.09

[18] For all odds ratios and 95% Cis presented in this table and all subsequent tables in this thesis, **bold** denotes significant findings at $p<0.05$.

Behavioural Difficulties	0.97	0.91	1.03	0.99	0.93	1.05
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.27	0.20	8.18	1.27	0.20	8.04
O level	0.72	0.20	2.59	0.65	0.18	2.29
A level	0.67	0.18	2.48	0.58	0.16	2.09
Degree	0.45	0.11	1.78	0.47	0.12	1.79
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.78	0.41	1.48	0.87	0.48	1.58
IV & V	1.27	0.27	5.98	1.70	0.37	7.87
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.53	0.18	1.50	0.56	0.21	1.49
Occasionally	0.57	0.18	1.82	0.63	0.22	1.85
1-2 glasses a day	0.46	0.09	2.29	0.54	0.12	2.49
3-9 glasses a day	0.09	0.01	1.23	0.10	0.01	1.30
Maternal alcohol consumption at child aged 9 years						

Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.36	0.47	3.97	1.52	0.56	4.16
>= Once a week	2.17	0.69	6.77	2.59	0.90	7.47
Daily	5.55	1.36	22.68	**5.92**	**1.61**	**21.82**
Paternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.91	0.53	6.86	1.54	0.44	5.39
Occasionally	1.65	0.42	6.43	1.54	0.41	5.79
1-2 glasses a day	2.31	0.46	11.62	2.23	0.47	10.59
3-9 glasses a day	1.46	0.22	9.87	2.72	0.35	21.23
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.40	0.08	2.10	0.40	0.08	2.09
>= Once a week	0.70	0.12	3.98	0.52	0.09	2.83
Daily	0.60	0.10	3.65	0.43	0.07	2.51

Appendix 8, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental alcohol use, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.01	0.97	1.05	1.00	0.94	1.06	0.98	0.93	1.03	0.97	0.90	1.04
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.40**	**0.26**	**0.61**	0.68	0.32	1.46	**0.01**	**0.00**	**0.35**	**0.00**	**0.00**	**0.54**
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**1.08**	**1.00**	**1.16**	**1.16**	**1.00**	**1.34**
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.30	0.75	2.26				1.32	0.76	2.30
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.01	0.22	4.62				0.97	0.21	4.46
Behavioural Difficulties				0.97	0.91	1.04				0.97	0.91	1.04
Maternal Education												

CSE	1.00	(reference)		1.00	(reference)	
Vocational	2.50	0.24	25.51	2.53	0.25	25.79
O level	0.73	0.20	2.60	0.75	0.21	2.70
A level	0.71	0.19	2.65	0.74	0.20	2.77
Degree	0.44	0.11	1.75	0.46	0.11	1.81
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.80	0.42	1.54	0.82	0.43	1.57
IV & V	1.25	0.26	5.98	1.19	0.25	5.74
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.53	0.18	1.52	0.49	0.17	1.45
Occasionally	0.57	0.18	1.83	0.54	0.16	1.76
1-2 glasses a day	0.59	0.11	3.23	0.64	0.11	3.60
3-9 glasses a day	0.08	0.01	1.06	0.07	0.01	1.03
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.38	0.47	4.06	1.42	0.47	4.24
>= Once a week	2.34	0.74	7.41	2.36	0.73	7.62

Daily	**6.69**	**1.57**	**28.42**	**6.97**	**1.63**	**29.85**
Paternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.86	0.51	6.76	2.02	0.55	7.46
Occasionally	1.53	0.39	6.07	1.66	0.42	6.67
1-2 glasses a day	2.02	0.40	10.30	2.14	0.42	10.93
3-9 glasses a day	2.09	0.26	17.01	2.41	0.29	19.90
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.42	0.08	2.27	0.41	0.08	2.21
>= Once a week	0.70	0.12	4.01	0.67	0.12	3.92
Daily	0.58	0.09	3.63	0.56	0.09	3.52

Appendix 8, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental alcohol use, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.02	0.99	1.06	1.00	0.94	1.06						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.60**	**0.44**	**0.81**	**0.60**	**0.36**	**1.00**
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.31	0.76	2.25				1.09	0.66	1.79
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.98	0.22	4.42				0.81	0.18	3.61
Behavioural				0.97	0.91	1.03				0.97	0.92	1.03
Difficulties												
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	1.27	0.20	8.18	0.83	0.16	4.39
O level	0.72	0.20	2.59	0.66	0.19	2.34
A level	0.67	0.18	2.48	0.57	0.16	2.07
Degree	0.45	0.11	1.78	0.48	0.13	1.84
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.78	0.41	1.48	0.88	0.49	1.59
IV & V	1.27	0.27	5.98	1.85	0.40	8.52
Maternal drinking at child age 1yr 9 m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.53	0.18	1.50	0.57	0.22	1.51
Occasionally	0.57	0.18	1.82	0.61	0.21	1.79
1-2 glasses a day	0.46	0.09	2.29	0.42	0.10	1.83
3-9 glasses a day	0.09	0.01	1.23	0.09	0.01	1.17
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.36	0.47	3.97	1.49	0.55	4.05
>= Once a week	2.17	0.69	6.77	2.61	0.91	7.51
Daily	5.55	1.36	22.68	**5.54**	**1.54**	**19.97**
Paternal drinking at child age 1yr 9m						

Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.91	0.53	6.86	1.68	0.49	5.81
Occasionally	1.65	0.42	6.43	1.74	0.47	6.46
1-2 glasses a day	2.31	0.46	11.62	2.69	0.57	12.65
3-9 glasses a day	1.46	0.22	9.87	1.99	0.31	12.87
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.40	0.08	2.10	0.42	0.08	2.15
>= Once a week	0.70	0.12	3.98	0.54	0.10	2.93
Daily	0.60	0.10	3.65	0.42	0.07	2.44

Appendix 8, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental alcohol use, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.01	0.98	1.05	0.99	0.94	1.06	0.98	0.92	1.05	0.98	0.89	1.08
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.57**	**0.41**	**0.80**	**0.57**	**0.33**	**0.99**	0.06	0.00	2.33	0.21	0.00	66.24
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.05	0.97	1.14	1.02	0.90	1.16
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.29	0.74	2.24				1.29	0.75	2.24
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.90	0.19	4.14				0.89	0.19	4.13
Behavioural Difficulties				0.97	0.91	1.03				0.97	0.91	1.03
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	2.41	0.24	24.62	2.42	0.24	24.69
O level	0.72	0.20	2.58	0.73	0.20	2.63
A level	0.68	0.18	2.57	0.69	0.18	2.59
Degree	0.45	0.11	1.78	0.45	0.11	1.79
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.85	0.44	1.63	0.85	0.44	1.63
IV & V	1.37	0.28	6.59	1.37	0.29	6.62
Maternal drinking at child age 1yr 9 m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.54	0.19	1.53	0.54	0.19	1.53
Occasionally	0.58	0.18	1.85	0.58	0.18	1.84
1-2 glasses a day	0.45	0.09	2.24	0.46	0.09	2.25
3-9 glasses a day	**0.07**	**0.01**	**0.94**	**0.07**	**0.01**	**0.95**
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.36	0.47	3.96	1.38	0.47	4.03
>= Once a week	2.36	0.75	7.42	2.39	0.76	7.54
Daily	**5.77**	**1.41**	**23.56**	**5.85**	**1.43**	**23.89**
Paternal drinking at child age 1yr 9m						

Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.89	0.52	6.79	1.90	0.53	6.86
Occasionally	1.69	0.43	6.62	1.70	0.43	6.69
1-2 glasses a day	2.34	0.46	11.87	2.38	0.47	12.12
3-9 glasses a day	1.49	0.22	10.14	1.52	0.22	10.34
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.46	0.09	2.40	0.46	0.09	2.42
>= Once a week	0.77	0.14	4.37	0.77	0.13	4.38
Daily	0.59	0.10	3.58	0.58	0.10	3.58

Appendix 8, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental alcohol use, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.02	0.99	1.06	1.00	0.94	1.06						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.45**	**0.30**	**0.66**	0.68	0.33	1.38
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.72**	**0.52**	**0.99**	0.62	0.36	1.06
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.31	0.76	2.25				1.20	0.72	1.99

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.98	0.22	4.42	0.85	0.19	3.82
Behavioural Difficulties	0.97	0.91	1.03	0.99	0.93	1.05
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.27	0.20	8.18	1.26	0.20	8.00
O level	0.72	0.20	2.59	0.65	0.18	2.31
A level	0.67	0.18	2.48	0.59	0.16	2.15
Degree	0.45	0.11	1.78	0.47	0.12	1.80
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.78	0.41	1.48	0.90	0.49	1.63
IV & V	1.27	0.27	5.98	1.75	0.37	8.17
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.53	0.18	1.50	0.56	0.21	1.48
Occasionally	0.57	0.18	1.82	0.64	0.22	1.88
1-2 glasses a day	0.46	0.09	2.29	0.52	0.11	2.41
3-9 glasses a day	0.09	0.01	1.23	0.08	0.01	1.02

Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.36	0.47	3.97	1.51	0.55	4.15
>= Once a week	2.17	0.69	6.77	2.62	0.90	7.60
Daily	**5.55**	**1.36**	**22.68**	**5.85**	**1.58**	**21.65**
Paternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.91	0.53	6.86	1.54	0.44	5.35
Occasionally	1.65	0.42	6.43	1.64	0.44	6.16
1-2 glasses a day	2.31	0.46	11.62	2.35	0.50	11.16
3-9 glasses a day	1.46	0.22	9.87	2.84	0.37	22.03
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.40	0.08	2.10	0.41	0.08	2.13
>= Once a week	0.70	0.12	3.98	0.54	0.10	2.94
Daily	0.60	0.10	3.65	0.41	0.07	2.40

Appendix 8, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental alcohol use, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.01	0.97	1.04	1.00	0.94	1.06	0.97	0.90	1.04	0.98	0.89	1.09
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.46**	**0.29**	**0.72**	0.85	0.38	1.88	**0.01**	**0.00**	**0.61**	**0.00**	**0.00**	**0.59**
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.67**	**0.47**	**0.96**	0.57	0.32	1.03	0.38	0.01	22.30	5.19	0.01	4010.36
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.08	0.99	1.17	1.18	1.01	1.39
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.93	1.10	0.95	0.83	1.10
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.35	0.77	2.36				1.37	0.78	2.41

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.92	0.20	4.32	0.88	0.19	4.17
Behavioural Difficulties	0.97	0.91	1.04	0.97	0.91	1.04
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	2.47	0.24	25.24	2.48	0.24	25.33
O level	0.71	0.20	2.58	0.72	0.20	2.62
A level	0.72	0.19	2.72	0.75	0.20	2.84
Degree	0.44	0.11	1.75	0.45	0.11	1.80
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.84	0.43	1.63	0.87	0.45	1.68
IV & V	1.30	0.27	6.33	1.25	0.26	6.04
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.53	0.18	1.52	0.50	0.17	1.46
Occasionally	0.58	0.18	1.87	0.55	0.17	1.83
1-2 glasses a day	0.57	0.10	3.11	0.61	0.11	3.46
3-9 glasses a day	**0.06**	**0.00**	**0.79**	**0.05**	**0.00**	**0.74**

Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.39	0.47	4.10	1.40	0.47	4.22
>= Once a week	2.36	0.74	7.54	2.34	0.72	7.61
Daily	**6.54**	**1.53**	**27.86**	**6.75**	**1.57**	**29.03**
Paternal drinking at child age 1yr 9 months						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.82	0.50	6.63	1.95	0.53	7.15
Occasionally	1.62	0.41	6.42	1.73	0.43	6.95
1-2 glasses a day	2.08	0.41	10.66	2.10	0.41	10.83
3-9 glasses a day	2.12	0.26	17.23	2.40	0.29	19.82
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.45	0.08	2.42	0.42	0.08	2.30
>= Once a week	0.77	0.13	4.41	0.73	0.12	4.25
Daily	0.59	0.09	3.66	0.56	0.09	3.53

Appendix 9: Odds ratios and 95% CIs for the association of PCRQ, popular in school and accepted in school with experimental alcohol use, analysis 1 through 3, imputed data

Appendix 9, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental alcohol use, models 1 through 4, imputed data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.01	0.98	1.04	0.99	0.96	1.03						
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree							**0.41**	**0.29**	**0.58**	**0.45**	**0.31**	**0.65**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.95	0.71	1.26				0.93	0.70	1.25
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.74	0.99	3.07				**1.85**	**1.04**	**3.30**
Behavioural Difficulties				**0.96**	**0.92**	**0.99**				0.97	0.93	1.00
Maternal Education												

CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.63	0.80	3.33	1.63	0.80	3.33
O level	1.37	0.85	2.20	1.36	0.84	2.19
A level	1.33	0.77	2.28	1.34	0.78	2.30
Degree	0.86	0.47	1.59	0.88	0.48	1.62
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.94	0.65	1.36	0.94	0.65	1.37
IV & V	1.35	0.67	2.69	1.37	0.69	2.71
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.10	0.60	2.00	1.14	0.63	2.08
Occasionally	1.01	0.53	1.92	1.09	0.57	2.07
1-2 glasses a day	0.68	0.28	1.63	0.74	0.30	1.81
3-9 glasses a day	0.58	0.07	5.00	0.64	0.07	5.54
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.53	0.87	2.68	1.46	0.82	2.58
>= Once a week	**2.47**	**1.31**	**4.65**	**2.25**	**1.20**	**4.22**

Daily	**4.10**	**1.90**	**8.85**	**3.63**	**1.66**	**7.91**
Paternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.83	0.95	3.53	1.78	0.91	3.45
Occasionally	**2.16**	**1.07**	**4.38**	**2.08**	**1.01**	**4.27**
1-2 glasses a day	2.22	0.92	5.36	2.14	0.87	5.26
3-9 glasses a day	2.66	0.92	7.74	2.58	0.88	7.57
>10 glasses per day	0.59	0.10	3.60	0.53	0.09	3.19
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.91	0.45	1.87	0.92	0.45	1.90
>= Once a week	0.89	0.43	1.88	0.90	0.43	1.92
Daily	0.98	0.44	2.16	0.99	0.45	2.20

Appendix 9, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental alcohol use, models 5 through 8, imputed data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.99	0.96	1.02	0.98	0.95	1.02	0.98	0.94	1.02	0.97	0.93	1.01
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.40**	**0.28**	**0.58**	**0.43**	**0.30**	**0.63**	0.11	0.01	1.53	0.10	0.01	1.59
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.03	0.97	1.09	1.03	0.97	1.10
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.95	0.71	1.27				0.95	0.71	1.27
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				**1.88**	**1.05**	**3.36**				**1.86**	**1.04**	**3.33**
Behavioural Difficulties				0.97	0.93	1.00				0.97	0.93	1.00
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	1.63	0.80	3.34	1.64	0.80	3.34
O level	1.36	0.84	2.20	1.36	0.84	2.20
A level	1.33	0.77	2.29	1.33	0.77	2.30
Degree	0.87	0.47	1.61	0.87	0.47	1.60
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.94	0.65	1.36	0.95	0.65	1.37
IV & V	1.37	0.69	2.72	1.36	0.69	2.71
Maternal drinking at child age 1yr 9 months						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.14	0.63	2.08	1.14	0.63	2.07
Occasionally	1.09	0.57	2.08	1.08	0.56	2.08
1-2 glasses a day	0.74	0.30	1.80	0.74	0.30	1.81
3-9 glasses a day	0.63	0.07	5.47	0.64	0.07	5.53
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.47	0.83	2.60	1.47	0.83	2.60
>= Once a week	**2.27**	**1.21**	**4.28**	**2.28**	**1.21**	**4.30**
Daily	**3.67**	**1.68**	**8.00**	**3.69**	**1.69**	**8.09**

Paternal drinking at child age 1yr 9 months						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.76	0.91	3.43	1.75	0.90	3.41
Occasionally	2.06	1.00	4.24	2.05	0.99	4.23
1-2 glasses a day	2.12	0.86	5.23	2.10	0.85	5.21
3-9 glasses a day	2.54	0.87	7.43	2.53	0.86	7.45
>10 glasses per day	0.52	0.09	3.15	0.52	0.08	3.16
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.91	0.44	1.89	0.93	0.45	1.92
>= Once a week	0.90	0.42	1.92	0.91	0.43	1.94
Daily	0.99	0.44	2.20	1.00	0.45	2.23

Appendix 9, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental alcohol use, models 1 through 4, imputed data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.01	0.98	1.04	0.99	0.96	1.03						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.59**	**0.44**	**0.80**	**0.61**	**0.45**	**0.84**
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.95	0.71	1.26				0.92	0.69	1.23
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.74	0.99	3.07				**1.77**	**1.01**	**3.11**
Behavioural Difficulties				**0.96**	**0.92**	**0.99**				**0.96**	**0.93**	**1.00**
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	1.63	0.80	3.33	1.69	0.83	3.46
O level	1.37	0.85	2.20	1.36	0.85	2.19
A level	1.33	0.77	2.28	1.37	0.80	2.34
Degree	0.86	0.47	1.59	0.88	0.48	1.61
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.94	0.65	1.36	0.94	0.65	1.37
IV & V	1.35	0.67	2.69	1.36	0.68	2.71
Maternal drinking at child age 1yr 9 m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.10	0.60	2.00	1.10	0.61	2.01
Occasionally	1.01	0.53	1.92	1.01	0.54	1.91
1-2 glasses a day	0.68	0.28	1.63	0.68	0.28	1.65
3-9 glasses a day	0.58	0.07	5.00	0.55	0.06	4.72
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.53	0.87	2.68	1.52	0.87	2.67
>= Once a week	**2.47**	**1.31**	**4.65**	**2.44**	**1.30**	**4.56**
Daily	**4.10**	**1.90**	**8.85**	**4.00**	**1.85**	**8.62**
Paternal drinking at child age 1yr 9m						

Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.83	0.95	3.53	1.81	0.94	3.50
Occasionally	**2.16**	**1.07**	**4.38**	**2.18**	**1.07**	**4.44**
1-2 glasses a day	2.22	0.92	5.36	2.21	0.91	5.36
3-9 glasses a day	2.66	0.92	7.74	2.75	0.94	8.03
>10 glasses per day	0.59	0.10	3.60	0.63	0.10	3.86
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.91	0.45	1.87	0.91	0.44	1.86
>= Once a week	0.89	0.43	1.88	0.90	0.43	1.90
Daily	0.98	s	2.16	0.97	0.44	2.14

Appendix 9, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental alcohol use, models 5 through 8, imputed data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.97	1.03	0.99	0.95	1.02	0.98	0.93	1.03	0.97	0.92	1.03
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.59**	**0.43**	**0.80**	**0.60**	**0.43**	**0.82**	0.23	0.01	5.20	0.25	0.01	6.49
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.02	0.95	1.09	1.02	0.95	1.09
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.93	0.70	1.25				0.93	0.70	1.25
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				**1.79**	**1.02**	**3.15**				**1.78**	**1.01**	**3.14**
Behavioural Difficulties				**0.96**	**0.93**	**1.00**				**0.96**	**0.93**	**1.00**

Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.70	0.83	3.48	1.71	0.84	3.49
O level	1.36	0.85	2.19	1.37	0.85	2.20
A level	1.36	0.79	2.34	1.37	0.80	2.35
Degree	0.87	0.48	1.60	0.87	0.48	1.60
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.94	0.65	1.37	0.94	0.65	1.37
IV & V	1.36	0.68	2.73	1.36	0.68	2.72
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.10	0.60	2.00	1.10	0.61	2.00
Occasionally	1.01	0.53	1.91	1.01	0.53	1.91
1-2 glasses a day	0.68	0.28	1.63	0.68	0.28	1.64
3-9 glasses a day	0.54	0.06	4.66	0.54	0.06	4.65
Maternal alcohol consumption at child aged 9 years						

Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.54	0.88	2.69	1.53	0.87	2.69
>= Once a week	**2.47**	**1.32**	**4.63**	**2.47**	**1.31**	**4.63**
Daily	**4.06**	**1.88**	**8.75**	**4.06**	**1.88**	**8.76**
Paternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.80	0.93	3.48	1.80	0.93	3.48
Occasionally	**2.16**	**1.06**	**4.41**	**2.16**	**1.06**	**4.42**
1-2 glasses a day	2.19	0.90	5.33	2.19	0.90	5.33
3-9 glasses a day	2.71	0.93	7.94	2.71	0.92	7.95
>10 glasses per day	0.63	0.10	3.86	0.62	0.10	3.85
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.90	0.44	1.86	0.91	0.44	1.87
>= Once a week	0.90	0.43	1.90	0.90	0.43	1.91
Daily	0.97	0.44	2.14	0.97	0.44	2.15

Appendix 9, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental alcohol use, models 1 through 4, imputed data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.01	0.98	1.04	0.99	0.96	1.03						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.47**	**0.33**	**0.69**	**0.52**	**0.35**	**0.76**
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.71**	**0.51**	**0.97**	0.72	0.51	1.00
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.95	0.71	1.26				0.92	0.69	1.23

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	1.74	0.99	3.07	**1.86**	**1.04**	**3.30**
Behavioural Difficulties	**0.96**	**0.92**	**0.99**	0.97	0.94	1.00
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.63	0.80	3.33	1.67	0.82	3.42
O level	1.37	0.85	2.20	1.36	0.84	2.19
A level	1.33	0.77	2.28	1.36	0.79	2.34
Degree	0.86	0.47	1.59	0.89	0.48	1.63
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.94	0.65	1.36	0.95	0.65	1.37
IV & V	1.35	0.67	2.69	1.37	0.69	2.72
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.10	0.60	2.00	1.14	0.63	2.07
Occasionally	1.01	0.53	1.92	1.08	0.56	2.05
1-2 glasses a day	0.68	0.28	1.63	0.74	0.30	1.79
3-9 glasses a day	0.58	0.07	5.00	0.60	0.07	5.21

Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.53	0.87	2.68	1.46	0.83	2.59
>= Once a week	**2.47**	**1.31**	**4.65**	**2.26**	**1.21**	**4.25**
Daily	**4.10**	**1.90**	**8.85**	**3.64**	**1.67**	**7.93**
Paternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.83	0.95	3.53	1.77	0.91	3.44
Occasionally	**2.16**	**1.07**	**4.38**	**2.10**	**1.02**	**4.32**
1-2 glasses a day	2.22	0.92	5.36	2.15	0.87	5.27
3-9 glasses a day	2.66	0.92	7.74	2.64	0.90	7.74
>10 glasses per day	0.59	0.10	3.60	0.56	0.09	3.40
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.91	0.45	1.87	0.92	0.44	1.89
>= Once a week	0.89	0.43	1.88	0.91	0.43	1.93
Daily	0.98	0.44	2.16	0.98	0.44	2.18

Appendix 9, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental alcohol use, models 5 through 8, imputed data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.99	0.96	1.02	0.97	0.91	1.02	0.97	0.92	1.02	0.97	0.91	1.02
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.46**	**0.32**	**0.67**	**0.50**	**0.33**	**0.74**	0.11	0.01	1.97	0.10	0.01	2.05
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.70**	**0.50**	**0.96**	**0.70**	**0.50**	**0.98**	0.54	0.02	15.81	0.67	0.02	24.00
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.03	0.97	1.10	1.04	0.97	1.11

Interaction:									
PCRQ * accepted in school									
Agree				1.00	(reference)		1.00	(reference)	
Disagree				1.01	0.93	1.08	1.00	0.93	1.08
Covariates									
Gender									
Male	1.00	(reference)					1.00	(reference)	
Female	0.94	0.70	1.26				0.94	0.70	1.26
Ethnicity									
White	1.00	(reference)					1.00	(reference)	
Non-white	**1.89**	**1.06**	**3.37**				**1.87**	**1.05**	**3.34**
Behavioural	0.97	0.93	1.00				0.97	0.93	1.00
Difficulties									
Maternal									
Education									
CSE	1.00	(reference)					1.00	(reference)	
Vocational	1.69	0.82	3.45				1.69	0.83	3.46
O level	1.36	0.84	2.20				1.36	0.84	2.20
A level	1.36	0.79	2.34				1.36	0.79	2.34
Degree	0.88	0.48	1.62				0.88	0.48	1.61
Maternal Social									
Class									
I & II	1.00	(reference)					1.00	(reference)	
III	0.94	0.65	1.37				0.95	0.65	1.38

IV & V	1.37	0.69	2.74	1.37	0.68	2.73
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	1.14	0.62	2.07	1.14	0.63	2.07
Occasionally	1.07	0.56	2.06	1.07	0.56	2.05
1-2 glasses a day	0.73	0.30	1.78	0.73	0.30	1.79
3-9 glasses a day	0.59	0.07	5.11	0.59	0.07	5.16
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	1.48	0.83	2.63	1.48	0.84	2.63
>= Once a week	**2.29**	**1.22**	**4.32**	**2.31**	**1.23**	**4.35**
Daily	**3.69**	**1.69**	**8.03**	**3.72**	**1.70**	**8.14**
Paternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	

Very occasionally	1.75	0.90	3.41	1.74	0.89	3.40
	2.08	**1.01**	**4.28**	2.06	1.00	4.28
Occasionally						
1-2 glasses a day	2.12	0.86	5.24	2.10	0.84	5.21
3-9 glasses a day	2.58	0.88	7.58	2.58	0.87	7.62
>10 glasses per day	0.55	0.09	3.36	0.55	0.09	3.39
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	0.91	0.44	1.88	0.92	0.44	1.92
>= Once a week	0.91	0.43	1.93	0.92	0.43	1.95
Daily	0.98	0.44	2.19	0.99	0.45	2.21

Appendix 10: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with hazardous alcohol use, analysis 1 through 3, complete case data

Appendix 10, Table 1: β coefficient and 95% CIs for the association of PCRQ, whether participants are popular in schools with hazardous alcohol use, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	0.00	-0.04	0.04	0.01	-0.05	0.07						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**-1.38**	**-1.92**	**-0.85**	**-1.66**	**-2.50**	**-0.81**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				-0.45	-0.99	0.09				-0.37	-0.88	0.14
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.01	-0.62	2.65				1.10	-0.49	2.69
Behavioural Difficulties				-0.04	-0.11	0.02				-0.03	-0.09	0.03

Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.46	-1.16	2.07	0.44	-1.07	1.96
O level	-0.41	-1.58	0.75	-0.15	-1.28	0.97
A level	-0.87	-2.07	0.34	-0.54	-1.70	0.62
Degree	**-1.50**	**-2.77**	**-0.24**	-0.94	-2.16	0.28
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.40	-1.05	0.25	-0.36	-0.97	0.25
IV & V	-0.58	-1.89	0.74	0.04	-1.20	1.29
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.09	-1.03	1.21	0.53	-0.52	1.58
Occasionally	0.02	-1.18	1.21	0.62	-0.50	1.73
1-2 glasses a day	-0.43	-1.92	1.06	0.05	-1.36	1.46
3-9 glasses a day	2.67	-1.08	6.42	2.08	-1.40	5.56
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	-0.12	-1.43	1.20	-0.63	-1.92	0.66

>= Once a week				0.48	-0.88	1.84				-0.36	-1.68	0.96
Daily				0.65	-0.81	2.11				0.02	-1.40	1.43
Paternal drinking at child age 1yr 9m												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
Very occasionally				0.85	-0.83	2.54				0.85	-0.73	2.44
Occasionally				1.41	-0.32	3.15				1.51	-0.12	3.13
1-2 glasses a day				**2.20**	**0.33**	**4.07**				**2.36**	**0.60**	**4.12**
3-9 glasses a day				1.29	-0.91	3.50				1.78	-0.31	3.87
>10 glasses per day				-5.22	-14.05	3.61						
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.42	-2.20	1.37				-0.12	-1.79	1.54
>= Once a week				-0.13	-1.93	1.66				0.00	-1.68	1.67
Daily				0.55	-1.30	2.41				0.53	-1.20	2.26
CONSTANT	**7.88**	**6.07**	**9.70**	**5.70**	**1.61**	**9.78**	**8.06**	**7.89**	**8.23**	**5.78**	**3.15**	**8.40**

Appendix 10, Table 2: β coefficient and 95% CIs for the association of PCRQ, whether participants are popular in schools with hazardous alcohol use, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	-0.03	-0.07	0.01	-0.01	-0.07	0.06	-0.02	-0.07	0.03	-0.01	-0.08	0.06
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**-1.51**	**-2.11**	**-0.92**	**-1.74**	**-2.68**	**-0.80**	0.42	-4.59	5.43	-1.40	-10.23	7.44
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							-0.04	-0.15	0.07	-0.01	-0.20	0.19
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				-0.46	-1.02	0.09				-0.46	-1.02	0.09
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.10	-0.59	2.79				1.10	-0.59	2.79
Behavioural Difficulties				-0.03	-0.09	0.04				-0.03	-0.09	0.04
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.22	-1.44	1.89	0.22	-1.45	1.89
O level	-0.28	-1.48	0.92	-0.28	-1.49	0.92
A level	-0.73	-1.98	0.51	-0.74	-1.98	0.51
Degree	-1.26	-2.57	0.05	-1.26	-2.57	0.05
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.39	-1.05	0.28	-0.39	-1.05	0.28
IV & V	-0.03	-1.40	1.35	-0.03	-1.40	1.35
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.25	-0.89	1.40	0.25	-0.89	1.40
Occasionally	0.28	-0.94	1.50	0.28	-0.94	1.50
1-2 glasses a day	-0.23	-1.75	1.29	-0.23	-1.75	1.29
3-9 glasses a day	2.71	-1.05	6.46	2.71	-1.05	6.47
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	-0.36	-1.71	1.00	-0.36	-1.72	1.00
>= Once a week	0.03	-1.37	1.43	0.03	-1.37	1.43
Daily	0.21	-1.29	1.71	0.20	-1.30	1.71
Paternal drinking at child age 1yr 9 m						

Never drinks alcohol				1.00	(reference)					1.00	(reference)	
Very occasionally				0.68	-1.02	2.38				0.68	-1.03	2.38
Occasionally				1.18	-0.57	2.93				1.18	-0.58	2.93
1-2 glasses a day				2.16	0.27	4.05				**2.16**	**0.26**	**4.05**
3-9 glasses a day				1.22	-1.02	3.46				1.22	-1.02	3.46
>10 glasses per day												
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.22	-2.05	1.61				-0.22	-2.05	1.61
>= Once a week				0.02	-1.81	1.86				0.02	-1.81	1.86
Daily				0.74	-1.16	2.64				0.74	-1.16	2.64
CONSTANT	**9.31**	**7.35**	**11.27**	**6.60**	**2.37**	**10.83**	**8.97**	**6.82**	**11.11**	**6.56**	**2.20**	**10.91**

Appendix 10, Table 3: β coefficient and 95% CIs for the association of PCRQ, whether participants are accepted in schools with hazardous alcohol use, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	0.00	-0.04	0.04	0.01	-0.05	0.07						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							-0.15	-0.49	0.20	-0.18	-0.71	0.35
Interaction: PCRQ * accepted in school												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				-0.45	-0.99	0.09				-0.36	-0.88	0.15
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.01	-0.62	2.65				1.03	-0.54	2.60
Behavioural Difficulties				-0.04	-0.11	0.02				-0.04	-0.10	0.02
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	
Vocational				0.46	-1.16	2.07				0.51	-1.00	2.02
O level				-0.41	-1.58	0.75				-0.03	-1.14	1.09

A level	-0.87	-2.07	0.34	-0.47	-1.62	0.68
Degree	**-1.50**	**-2.77**	**-0.24**	-0.95	-2.15	0.26
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.40	-1.05	0.25	-0.33	-0.94	0.28
IV & V	-0.58	-1.89	0.74	-0.23	-1.44	0.98
Maternal drinking at child age 1yr 9 m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.09	-1.03	1.21	0.46	-0.58	1.51
Occasionally	0.02	-1.18	1.21	0.54	-0.57	1.65
1-2 glasses a day	-0.43	-1.92	1.06	-0.04	-1.45	1.38
3-9 glasses a day	2.67	-1.08	6.42	2.04	-1.67	5.76
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	-0.12	-1.43	1.20	-0.50	-1.78	0.77
>= Once a week	0.48	-0.88	1.84	-0.08	-1.39	1.22
Daily	0.65	-0.81	2.11	0.27	-1.14	1.67
Paternal drinking at child age 1yr 9 m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.85	-0.83	2.54	0.98	-0.61	2.57

Occasionally				1.41	-0.32	3.15				1.61	-0.02	3.25
1-2 glasses a day				**2.20**	**0.33**	**4.07**				**2.34**	**0.57**	**4.11**
3-9 glasses a day				1.29	-0.91	3.50				1.84	-0.29	3.96
>10 glasses per day				-5.22	-14.05	3.61				-4.52	-13.28	4.24
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.42	-2.20	1.37				-0.14	-1.82	1.53
>= Once a week				-0.13	-1.93	1.66				0.00	-1.69	1.68
Daily				0.55	-1.30	2.41				0.55	-1.20	2.30
CONSTANT	**7.88**	**6.07**	**9.70**	**5.70**	**1.61**	**9.78**	**7.95**	**7.74**	**8.15**	**5.51**	**2.88**	**8.13**

Appendix 10, Table 4: β coefficient and 95% CIs for the association of PCRQ, whether participants are accepted in schools with hazardous alcohol use, models 5 through 8, complete case data

	Model 5			Model 6			Model 7			Model 8		
	β	(95% CI)		β	(95% CI)		β	(95% CI)		β	(95% CI)	
Main variables												
PCRQ	-0.01	-0.05	0.03	0.01	-0.06	0.07	-0.02	-0.08	0.04	0.03	-0.06	0.12
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	-0.24	-0.61	0.14	-0.09	-0.67	0.49	-1.46	-5.41	2.49	2.14	-3.79	8.07
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.03	-0.06	0.11	-0.05	-0.18	0.08
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				-0.48	-1.03	0.08				-0.47	-1.03	0.08
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.05	-0.61	2.71				1.07	-0.59	2.74
Behavioural Difficulties				-0.04	-0.10	0.03				-0.04	-0.10	0.03

Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.31	-1.35	1.97	0.29	-1.37	1.96
O level	-0.17	-1.36	1.03	-0.21	-1.41	0.99
A level	-0.66	-1.90	0.57	-0.68	-1.92	0.55
Degree	-1.26	-2.56	0.03	-1.28	-2.58	0.02
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.37	-1.03	0.30	-0.36	-1.02	0.30
IV & V	-0.35	-1.70	1.00	-0.34	-1.69	1.00
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.12	-1.01	1.26	0.13	-1.01	1.27
Occasionally	0.14	-1.07	1.35	0.15	-1.07	1.36
1-2 glasses a day	-0.43	-1.95	1.09	-0.44	-1.96	1.08
3-9 glasses a day	2.70	-1.35	6.76	2.70	-1.36	6.76
Maternal alcohol consumption at child aged 9 years						

Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.25	-1.59	1.09				-0.30	-1.64	1.05
>= Once a week				0.38	-1.00	1.76				0.35	-1.03	1.73
Daily				0.51	-0.97	2.00				0.49	-1.00	1.97
Paternal drinking at child age 1yr9m												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
Very occasionally				0.83	-0.88	2.54				0.81	-0.90	2.52
Occasionally				1.33	-0.43	3.09				1.30	-0.46	3.07
1-2 glasses a day				2.17	0.27	4.07				**2.13**	**0.23**	**4.04**
3-9 glasses a day				1.33	-0.94	3.61				1.30	-0.98	3.58
>10 glasses per day				-4.93	-13.78	3.92				-4.93	-13.78	3.92
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.28	-2.13	1.56				-0.28	-2.13	1.57
>= Once a week				-0.07	-1.92	1.79				-0.05	-1.91	1.80
Daily				0.70	-1.22	2.62				0.71	-1.21	2.62
COVARIATES	**8.44**	**6.43**	**10.46**	**5.60**	**1.34**	**9.85**	**9.06**	**6.24**	**11.87**	4.53	-0.57	9.63

Appendix 10, Table 5: β coefficient and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with hazardous alcohol use, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	0.00	-0.04	0.04	0.01	-0.05	0.07						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**-1.49**	**-2.04**	**-0.93**	**-1.74**	**-2.63**	**-0.84**
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.14	-0.22	0.49	0.18	-0.38	0.74
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				-0.45	-0.99	0.09				-0.39	-0.91	0.12

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	1.01	-0.62	2.65	1.11	-0.48	2.70
Behavioural Difficulties	-0.04	-0.11	0.02	-0.03	-0.09	0.03
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.46	-1.16	2.07	0.42	-1.09	1.94
O level	-0.41	-1.58	0.75	-0.07	-1.19	1.06
A level	-0.87	-2.07	0.34	-0.53	-1.69	0.63
Degree	**-1.50**	**-2.77**	**-0.24**	-0.91	-2.13	0.31
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.40	-1.05	0.25	-0.29	-0.90	0.33
IV & V	-0.58	-1.89	0.74	0.05	-1.19	1.30
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.09	-1.03	1.21	0.57	-0.48	1.62
Occasionally	0.02	-1.18	1.21	0.66	-0.46	1.78
1-2 glasses a day	-0.43	-1.92	1.06	0.04	-1.38	1.46
3-9 glasses a day	2.67	-1.08	6.42	2.10	-1.60	5.81

Maternal alcohol consumption at child aged 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.12	-1.43	1.20				-0.60	-1.89	0.69
>= Once a week				0.48	-0.88	1.84				-0.33	-1.65	0.98
Daily				0.65	-0.81	2.11				0.02	-1.39	1.44
Paternal drinking at child age 1yr 9m												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
Very occasionally				0.85	-0.83	2.54				0.83	-0.76	2.42
Occasionally				1.41	-0.32	3.15				1.45	-0.19	3.08
1-2 glasses a day				**2.20**	**0.33**	**4.07**				**2.25**	**0.48**	**4.03**
3-9 glasses a day				1.29	-0.91	3.50				1.74	-0.38	3.85
>10 glasses per day				-5.22	-14.05	3.61						
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.42	-2.20	1.37				-0.16	-1.83	1.51
>= Once a week				-0.13	-1.93	1.66				-0.04	-1.72	1.64
Daily				0.55	-1.30	2.41				0.53	-1.21	2.27
CONSTANT	**7.88**	**6.07**	**9.70**	**5.70**	**1.61**	**9.78**	**8.02**	**7.81**	**8.22**	**5.71**	**3.07**	**8.35**

Appendix 10, Table 6: β coefficient and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with hazardous alcohol use, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	-0.02	-0.07	0.02	0.00	-0.07	0.06	-0.03	-0.09	0.03	0.02	-0.07	0.11
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**-1.60**	**-2.23**	**-0.98**	**-1.82**	**-2.81**	**-0.83**	-1.03	-6.43	4.38	-2.63	-11.74	6.49
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.05	-0.34	0.44	0.24	-0.36	0.85	-1.02	-5.17	3.12	2.78	-3.33	8.89
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							-0.01	-0.13	0.11	0.02	-0.19	0.22
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.02	-0.07	0.11	-0.06	-0.19	0.08

Covariates						
Gender						
Male	1.00	(reference)		1.00	(reference)	
Female	-0.49	-1.04	0.07	-0.48	-1.04	0.07
Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	1.09	-0.59	2.78	1.12	-0.57	2.81
Behavioural Difficulties	-0.03	-0.10	0.03	-0.03	-0.10	0.03
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.19	-1.47	1.85	0.17	-1.49	1.84
O level	-0.19	-1.39	1.02	-0.24	-1.45	0.97
A level	-0.73	-1.97	0.52	-0.75	-1.99	0.50
Degree	-1.24	-2.55	0.07	-1.25	-2.56	0.06
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.32	-0.98	0.35	-0.30	-0.97	0.37
IV & V	-0.01	-1.39	1.36	-0.01	-1.38	1.37
Maternal drinking at child age 1yr 9m						

Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.28	-0.87	1.42	0.28	-0.86	1.43
Occasionally	0.31	-0.91	1.53	0.31	-0.91	1.53
1-2 glasses a day	-0.26	-1.79	1.27	-0.27	-1.80	1.26
3-9 glasses a day	2.82	-1.22	6.87	2.81	-1.24	6.86
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	-0.34	-1.70	1.01	-0.38	-1.74	0.98
>= Once a week	0.08	-1.31	1.48	0.06	-1.35	1.46
Daily	0.22	-1.28	1.73	0.21	-1.30	1.72
Paternal drinking at child age 1yr9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.65	-1.06	2.36	0.62	-1.09	2.33
Occasionally	1.13	-0.62	2.89	1.11	-0.65	2.86
1-2 glasses a day	**2.07**	**0.17**	**3.97**	**2.03**	**0.12**	**3.93**
3-9 glasses a day	1.19	-1.07	3.46	1.16	-1.11	3.44
>10 glasses per day						

Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.28	-2.12	1.56				-0.28	-2.12	1.56
>= Once a week				-0.07	-1.92	1.77				-0.06	-1.91	1.79
Daily				0.70	-1.21	2.60				0.70	-1.21	2.61
CONSTANT	**9.16**	**7.13**	**11.19**	**6.41**	**2.13**	**10.70**	**9.59**	**6.75**	**12.44**	**5.29**	**0.13**	**10.45**

Appendix 11: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with hazardous alcohol use, analysis 1 through 3, imputed data

Appendix 11, Table 1: β coefficient and 95% CIs for the association of PCRQ, whether participants are popular in schools with hazardous alcohol use, models 1 through 4, imputed data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	β	**(95% CI)**		β	**(95% CI)**		β	**(95% CI)**		β	**(95% CI)**	
Main variables												
PCRQ	-0.02	-0.06	0.01	-0.02	-0.05	0.02						
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree							**-1.09**	**-1.56**	**-0.61**	**-1.14**	**-1.62**	**-0.66**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**-0.38**	**-0.69**	**-0.08**				**-0.41**	**-0.71**	**-0.11**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.15	-0.68	0.98				0.18	-0.64	1.01
Behavioural Difficulties				0.03	-0.01	0.07				**0.04**	**0.00**	**0.08**

Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.01	-0.77	0.78	0.00	-0.77	0.77
O level	-0.26	-0.83	0.30	-0.27	-0.83	0.30
A level	**-0.67**	**-1.30**	**-0.04**	**-0.66**	**-1.29**	**-0.03**
Degree	**-0.94**	**-1.64**	**-0.24**	**-0.92**	**-1.61**	**-0.22**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.23	-0.65	0.18	-0.23	-0.64	0.18
IV & V	-0.05	-0.78	0.68	-0.04	-0.76	0.68
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.12	-0.64	0.88	0.17	-0.59	0.93
Occasionally	0.23	-0.63	1.09	0.31	-0.55	1.16
1-2 glasses a day	0.22	-0.95	1.39	0.29	-0.89	1.47
3-9 glasses a day	2.46	-0.92	5.84	2.48	-0.86	5.82
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	-0.22	-1.20	0.75	-0.28	-1.25	0.69

>= Once a week				0.07	-0.92	1.06				-0.03	-1.02	0.96
Daily				0.38	-0.88	1.64				0.27	-0.99	1.54
Paternal drinking at child age 1yr 9m												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
Very occasionally				-0.12	-1.11	0.86				-0.15	-1.15	0.85
Occasionally				0.36	-0.65	1.36				0.34	-0.68	1.37
1-2 glasses a day				0.72	-0.43	1.86				0.71	-0.45	1.87
3-9 glasses a day				0.65	-0.63	1.94				0.69	-0.60	1.97
>10 glasses per day				0.33	-3.06	3.73				0.29	-3.11	3.69
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				0.33	-0.62	1.27				0.32	-0.62	1.26
>= Once a week				0.20	-0.72	1.12				0.17	-0.74	1.08
Daily				0.59	-0.46	1.64				0.57	-0.47	1.60
CONSTANT	**9.03**	**7.47**	**10.60**	**8.17**	**6.06**	**10.27**	**8.06**	**7.90**	**8.22**	**7.53**	**6.06**	**9.00**

Appendix 11, Table 2: β coefficient and 95% CIs for the association of PCRQ, whether participants are popular in schools with hazardous alcohol use, models 5 through 8, imputed data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	**-0.04**	**-0.07**	**0.00**	-0.03	-0.06	0.01	-0.03	-0.07	0.01	-0.02	-0.06	0.02
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**-1.19**	**-1.67**	**-0.70**	**-1.21**	**-1.70**	**-0.72**	0.35	-4.01	4.71	0.16	-4.22	4.55
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							-0.04	-0.13	0.06	-0.03	-0.13	0.07
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**-0.38**	**-0.68**	**-0.07**				**-0.38**	**-0.69**	**-0.07**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.21	-0.63	1.04				0.21	-0.62	1.04
Behavioural Difficulties				0.03	0.00	0.07				0.03	0.00	0.07
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.01	-0.75	0.78	0.01	-0.76	0.78
O level	-0.26	-0.83	0.31	-0.26	-0.83	0.30
A level	**-0.66**	**-1.29**	**-0.03**	**-0.66**	**-1.29**	**-0.04**
Degree	**-0.92**	**-1.62**	**-0.22**	**-0.92**	**-1.62**	**-0.22**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.23	-0.64	0.18	-0.24	-0.64	0.17
IV & V	-0.05	-0.77	0.67	-0.06	-0.78	0.67
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.17	-0.59	0.92	0.17	-0.58	0.92
Occasionally	0.30	-0.54	1.15	0.31	-0.53	1.15
1-2 glasses a day	0.28	-0.89	1.45	0.28	-0.88	1.45
3-9 glasses a day	2.48	-0.87	5.83	2.48	-0.87	5.83
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	-0.26	-1.23	0.70	-0.27	-1.23	0.70
>= Once a week	-0.02	-1.00	0.97	-0.02	-1.00	0.96
Daily	0.29	-0.96	1.55	0.29	-0.97	1.54
Paternal drinking at child age 1yr 9 m						

Never drinks alcohol				1.00	(reference)					1.00	(reference)	
Very occasionally				-0.16	-1.16	0.84				-0.16	-1.15	0.84
Occasionally				0.33	-0.69	1.35				0.33	-0.69	1.35
1-2 glasses a day				0.69	-0.46	1.85				0.69	-0.46	1.84
3-9 glasses a day				0.65	-0.64	1.94				0.65	-0.64	1.94
>10 glasses per day				0.25	-3.16	3.66				0.24	-3.17	3.64
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				0.32	-0.62	1.26				0.32	-0.62	1.26
>= Once a week				0.18	-0.73	1.10				0.18	-0.73	1.09
Daily				0.58	-0.45	1.62				0.58	-0.45	1.62
CONSTANT	**9.73**	**8.14**	**11.33**	**8.76**	**6.64**	**10.88**	**9.43**	**7.79**	**11.06**	**8.49**	**6.33**	**10.66**

Appendix 11, Table 3: β coefficient and 95% CIs for the association of PCRQ, whether participants are accepted in schools with hazardous alcohol use, models 1 through 4, imputed data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	-0.02	-0.06	0.01	-0.02	-0.05	0.02						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							-0.05	-0.39	0.30	-0.07	-0.42	0.28
Interaction: PCRQ * accepted in school												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**-0.38**	**-0.69**	**-0.08**				**-0.40**	**-0.70**	**-0.10**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.15	-0.68	0.98				0.14	-0.68	0.96
Behavioural Difficulties				0.03	-0.01	0.07				0.03	-0.01	0.07
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	
Vocational				0.01	-0.77	0.78				0.00	-0.77	0.77
O level				-0.26	-0.83	0.30				-0.27	-0.83	0.30

A level	**-0.67**	**-1.30**	**-0.04**	**-0.67**	**-1.30**	**-0.03**
Degree	**-0.94**	**-1.64**	**-0.24**	**-0.94**	**-1.64**	**-0.24**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.23	-0.65	0.18	-0.23	-0.64	0.18
IV & V	-0.05	-0.78	0.68	-0.04	-0.77	0.68
Maternal drinking at child age 1yr 9 m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.12	-0.64	0.88	0.12	-0.64	0.89
Occasionally	0.23	-0.63	1.09	0.24	-0.62	1.10
1-2 glasses a day	0.22	-0.95	1.39	0.23	-0.95	1.41
3-9 glasses a day	2.46	-0.92	5.84	2.45	-0.92	5.83
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	-0.22	-1.20	0.75	-0.24	-1.21	0.74
>= Once a week	0.07	-0.92	1.06	0.05	-0.94	1.04
Daily	0.38	-0.88	1.64	0.37	-0.89	1.63
Paternal drinking at child age 1yr 9 m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	-0.12	-1.11	0.86	-0.13	-1.12	0.87

Occasionally				0.36	-0.65	1.36				0.36	-0.65	1.37
1-2 glasses a day				0.72	-0.43	1.86				0.72	-0.42	1.86
3-9 glasses a day				0.65	-0.63	1.94				0.68	-0.61	1.96
>10 glasses per day				0.33	-3.06	3.73				0.35	-3.04	3.75
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				0.33	-0.62	1.27				0.32	-0.62	1.27
>= Once a week				0.20	-0.72	1.12				0.19	-0.73	1.11
Daily				0.59	-0.46	1.64				0.58	-0.47	1.62
CONSTANT	**9.03**	**7.47**	**10.60**	**8.17**	**6.06**	**10.27**	**7.94**	**7.74**	**8.14**	**7.49**	**6.00**	**8.97**

Appendix 11, Table 4: β coefficient and 95% CIs for the association of PCRQ, whether participants are accepted in schools with hazardous alcohol use, models 5 through 8, imputed data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	-0.03	-0.06	0.01	-0.02	-0.05	0.02	-0.02	-0.07	0.03	-0.01	-0.06	0.03
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	-0.10	-0.45	0.25	-0.10	-0.45	0.25	0.36	-2.47	3.19	0.30	-2.58	3.19
Interaction: PCRQ * accepted in school							-0.01	-0.07	0.05	-0.01	-0.07	0.05
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**-0.38**	**-0.69**	**-0.08**				-0.38	-0.69	-0.08
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.15	-0.68	0.98				0.15	-0.68	0.98
Behavioural Difficulties				0.03	-0.01	0.07				0.03	-0.01	0.07
Maternal Education												

CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.01	-0.76	0.78	0.01	-0.77	0.78
O level	-0.27	-0.83	0.30	-0.27	-0.84	0.30
A level	**-0.67**	**-1.30**	**-0.03**	**-0.67**	**-1.30**	**-0.03**
Degree	**-0.94**	**-1.64**	**-0.24**	**-0.94**	**-1.65**	**-0.24**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.23	-0.65	0.18	-0.23	-0.65	0.18
IV & V	-0.05	-0.78	0.68	-0.05	-0.78	0.68
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.12	-0.64	0.88	0.12	-0.64	0.88
Occasionally	0.23	-0.62	1.09	0.23	-0.62	1.09
1-2 glasses a day	0.22	-0.95	1.39	0.22	-0.95	1.39
3-9 glasses a day	2.45	-0.93	5.83	2.45	-0.93	5.84
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	

< Once a week				-0.23	-1.20	0.75				-0.23	-1.20	0.75
>= Once a week				0.06	-0.92	1.05				0.06	-0.93	1.05
Daily				0.38	-0.88	1.64				0.38	-0.88	1.63
Paternal drinking at child age 1yr9m												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
Very occasionally				-0.13	-1.12	0.86				-0.13	-1.12	0.86
Occasionally				0.36	-0.65	1.36				0.36	-0.65	1.36
1-2 glasses a day				0.71	-0.43	1.85				0.71	-0.43	1.85
3-9 glasses a day				0.66	-0.63	1.94				0.66	-0.63	1.94
>10 glasses per day				0.33	-3.07	3.73				0.33	-3.06	3.73
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				0.32	-0.62	1.27				0.33	-0.62	1.27
>= Once a week				0.20	-0.72	1.12				0.20	-0.72	1.12
Daily				0.59	-0.46	1.63				0.59	-0.46	1.64
COVARIATES	**9.14**	**7.53**	**10.75**	**8.27**	**6.13**	**10.42**	**8.90**	**6.75**	**11.05**	**8.07**	**5.44**	**10.69**

Appendix 11, Table 5: β coefficient and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with hazardous alcohol use, models 1 through 4, imputed data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	β	**(95% CI)**		β	**(95% CI)**		β	**(95% CI)**		β	**(95% CI)**	
Main variables												
PCRQ	-0.02	-0.06	0.01	-0.02	-0.05	0.02						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**-1.17**	**-1.67**	**-0.66**	**-1.21**	**-1.72**	**-0.71**
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.19	-0.18	0.55	0.17	-0.20	0.54
Interaction: PCRQ * popular in school												
Interaction: PCRQ * accepted in school												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**-0.38**	**-0.69**	**-0.08**				**-0.40**	**-0.71**	**-0.10**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.15	-0.68	0.98				0.19	-0.64	1.01

Behavioural Difficulties	0.03	-0.01	0.07	**0.04**	**0.00**	**0.08**
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.01	-0.77	0.78	0.00	-0.77	0.76
O level	-0.26	-0.83	0.30	-0.26	-0.83	0.30
A level	**-0.67**	**-1.30**	**-0.04**	**-0.66**	**-1.30**	**-0.03**
Degree	**-0.94**	**-1.64**	**-0.24**	**-0.92**	**-1.61**	**-0.22**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.23	-0.65	0.18	-0.23	-0.64	0.18
IV & V	-0.05	-0.78	0.68	-0.04	-0.76	0.69
PE410: Maternal drinking at child age 1yr 9 months (Father completed)						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.12	-0.64	0.88	0.17	-0.59	0.93
Occasionally	0.23	-0.63	1.09	0.31	-0.55	1.17
1-2 glasses a day	0.22	-0.95	1.39	0.30	-0.89	1.48
3-9 glasses a day	2.46	-0.92	5.84	2.50	-0.84	5.85

Maternal alcohol consumption at child aged 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				-0.22	-1.20	0.75				-0.28	-1.25	0.69
>= Once a week				0.07	-0.92	1.06				-0.03	-1.02	0.96
Daily				0.38	-0.88	1.64				0.27	-0.99	1.53
Paternal drinking at child age 1yr 9m												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
Very occasionally				-0.12	-1.11	0.86				-0.14	-1.14	0.86
Occasionally				0.36	-0.65	1.36				0.34	-0.68	1.37
1-2 glasses a day				0.72	-0.43	1.86				0.71	-0.44	1.87
3-9 glasses a day				0.65	-0.63	1.94				0.68	-0.61	1.97
>10 glasses per day				0.33	-3.06	3.73				0.28	-3.12	3.68
Paternal drinking at child age 9 years												
Never drinks alcohol				1.00	(reference)					1.00	(reference)	
< Once a week				0.33	-0.62	1.27				0.32	-0.62	1.26
>= Once a week				0.20	-0.72	1.12				0.17	-0.74	1.08
Daily				0.59	-0.46	1.64				0.57	-0.46	1.61
CONSTANT	**9.03**	**7.47**	**10.60**	**8.17**	**6.06**	**10.27**	**8.00**	**7.80**	**8.20**	**7.47**	**5.99**	**8.96**

Appendix 11, Table 6: β coefficient and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with hazardous alcohol use, models 5 through 8, imputed data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	β	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**		**β**	**(95% CI)**	
Main variables												
PCRQ	**-0.03**	**-0.07**	**0.00**	-0.03	-0.06	0.01	-0.02	-0.07	0.02	-0.02	-0.06	0.03
Popular in school												
Agree	1.00	(reference)					1.00	(reference)		1.00	(reference)	
Disagree	**-1.24**	**-1.75**	**-0.73**	**-1.26**	**-1.77**	**-0.75**	0.17	-4.47	4.81	-0.01	-4.69	4.66
Accepted in school												
Agree	1.00	(reference)					1.00	(reference)		1.00	(reference)	
Disagree	0.13	-0.23	0.50	0.13	-0.24	0.50	0.59	-2.45	3.62	0.58	-2.53	3.68
Interaction: PCRQ * popular in school							-0.03	-0.14	0.07	-0.03	-0.14	0.08
Interaction: PCRQ * accepted in school							-0.01	-0.08	0.06	-0.01	-0.08	0.06
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**-0.38**	**-0.68**	**-0.07**				-0.38	-0.68	-0.07

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.21	-0.63	1.04	0.21	-0.62	1.04
Behavioural Difficulties	0.03	0.00	0.07	0.03	0.00	0.07
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.01	-0.76	0.78	0.00	-0.77	0.77
O level	-0.26	-0.82	0.31	-0.27	-0.83	0.30
A level	**-0.67**	**-1.30**	**-0.03**	**-0.67**	**-1.30**	**-0.04**
Degree	**-0.92**	**-1.62**	**-0.22**	**-0.92**	**-1.62**	**-0.22**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	-0.23	-0.64	0.18	-0.24	-0.64	0.17
IV & V	-0.05	-0.77	0.67	-0.05	-0.78	0.67
Maternal drinking at child age 1yr 9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	0.17	-0.59	0.92	0.17	-0.58	0.92
Occasionally	0.31	-0.54	1.15	0.31	-0.53	1.15
1-2 glasses a day	0.29	-0.89	1.46	0.29	-0.88	1.46

3-9 glasses a day	2.50	-0.86	5.86	2.50	-0.86	5.86
Maternal alcohol consumption at child aged 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
< Once a week	-0.27	-1.23	0.70	-0.27	-1.23	0.70
>= Once a week	-0.02	-1.00	0.97	-0.02	-1.00	0.96
Daily	0.29	-0.96	1.54	0.28	-0.97	1.54
Paternal drinking at child age 1yr9m						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	
Very occasionally	-0.15	-1.15	0.85	-0.15	-1.15	0.85
Occasionally	0.33	-0.69	1.35	0.33	-0.69	1.35
1-2 glasses a day	0.70	-0.46	1.85	0.69	-0.46	1.84
3-9 glasses a day	0.65	-0.64	1.94	0.65	-0.64	1.93
>10 glasses per day	0.25	-3.16	3.65	0.23	-3.17	3.63
Paternal drinking at child age 9 years						
Never drinks alcohol	1.00	(reference)		1.00	(reference)	

< Once a week				0.32	-0.62	1.27				0.32	-0.62	1.27
>= Once a week				0.18	-0.73	1.10				0.18	-0.73	1.10
Daily				0.59	-0.45	1.63				0.59	-0.45	1.63
CONSTANT	**9.62**	**8.01**	**11.23**	**8.65**	**6.51**	**10.79**	**9.11**	**6.99**	**11.23**	**8.18**	**5.59**	**10.78**

Appendix 12: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with experimental smoking, analysis 1 through 3, complete case data

Appendix 12, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental smoking, models 1 through 4, complete case data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.98	1.01	0.99	0.97	1.01						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.70**	**0.56**	**0.86**	**0.59**	**0.45**	**0.77**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.32**	**1.11**	**1.56**				**1.35**	**1.15**	**1.59**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.94	0.59	1.49				1.02	0.64	1.61
Behavioural Difficulties				0.99	0.97	1.01				1.00	0.98	1.02
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.88	0.56	1.41	1.06	0.68	1.67
O level	0.73	0.51	1.03	0.86	0.61	1.20
A level	**0.64**	**0.44**	**0.93**	0.79	0.56	1.13
Degree	**0.52**	**0.35**	**0.77**	0.70	0.48	1.02
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	1.00	0.82	1.23	1.06	0.87	1.29
IV & V	0.81	0.56	1.15	0.99	0.70	1.40
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.52	0.92	2.50	1.47	0.91	2.36
5-9	1.22	0.73	2.04	1.42	0.86	2.35
10-14	**1.79**	**1.03**	**3.14**	**1.90**	**1.10**	**3.28**
15-19	1.73	0.91	3.28	1.75	0.97	3.13
20-24	1.20	0.56	2.60	1.47	0.69	3.15
25-29	2.52	0.50	12.69	2.75	0.54	13.88
>30	1.00			0.38	0.03	4.28
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.22	0.84	1.77	1.41	0.97	2.05
10-19	**1.80**	**1.25**	**2.60**	**1.62**	**1.15**	**2.28**

20+				1.42	0.98	2.06	1.36	0.95	1.95

Appendix 12, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental smoking, models 5 through 8, complete case data.

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.98	1.01	0.98	0.96	1.00	0.99	0.97	1.01	**0.97**	**0.95**	**0.99**
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.70**	**0.55**	**0.89**	**0.59**	**0.44**	**0.78**	0.18	0.02	1.32	**0.04**	**0.00**	**0.52**
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.03	0.99	1.08	**1.06**	**1.00**	**1.13**
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.29**	**1.08**	**1.54**				**1.29**	**1.08**	**1.54**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.04	0.63	1.70				1.01	0.61	1.66
Behavioural Difficulties				0.99	0.97	1.01				0.99	0.97	1.01
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.92	0.56	1.49	0.91	0.56	1.49
O level	0.77	0.54	1.12	0.77	0.53	1.11
A level	**0.67**	**0.45**	**0.99**	**0.67**	**0.45**	**0.99**
Degree	**0.57**	**0.37**	**0.86**	**0.56**	**0.37**	**0.85**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	1.02	0.82	1.26	1.03	0.83	1.27
IV & V	0.86	0.58	1.27	0.85	0.58	1.26
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.60	0.95	2.67	1.60	0.96	2.68
5-9	1.20	0.70	2.07	1.18	0.69	2.03
10-14	**2.03**	**1.12**	**3.70**	**2.05**	**1.12**	**3.73**
15-19	1.78	0.91	3.48	1.75	0.90	3.42
20-24	1.73	0.74	4.04	1.75	0.75	4.11
25-29	2.78	0.55	14.07	2.85	0.56	14.42
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.34	0.90	1.99	1.34	0.90	2.00
10-19	**1.94**	**1.32**	**2.87**	**1.96**	**1.33**	**2.90**
20+	1.34	0.90	2.00	1.33	0.89	1.98

Appendix 12, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental smoking, models 1 through 4, complete case data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.98	1.01	0.99	0.97	1.01						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.94	0.82	1.08	0.91	0.77	1.07
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.32**	**1.11**	**1.56**				**1.33**	**1.13**	**1.56**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.94	0.59	1.49				0.99	0.63	1.55
Behavioural Difficulties				0.99	0.97	1.01				0.99	0.98	1.01
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.88	0.56	1.41	1.05	0.67	1.63
O level	0.73	0.51	1.03	0.88	0.63	1.22
A level	**0.64**	**0.44**	**0.93**	0.80	0.56	1.13
Degree	**0.52**	**0.35**	**0.77**	0.69	0.48	1.01
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	1.00	0.82	1.23	1.07	0.88	1.30
IV & V	0.81	0.56	1.15	1.03	0.73	1.45
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.52	0.92	2.50	1.41	0.88	2.26
5-9	1.22	0.73	2.04	1.51	0.91	2.51
10-14	**1.79**	**1.03**	**3.14**	**1.90**	**1.11**	**3.28**
15-19	1.73	0.91	3.28	1.70	0.95	3.04
20-24	1.20	0.56	2.60	1.35	0.65	2.83
25-29	2.52	0.50	12.69	2.49	0.50	12.54
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.22	0.84	1.77	1.42	0.98	2.06
10-19	**1.80**	**1.25**	**2.60**	**1.57**	**1.12**	**2.20**
20+	1.42	0.98	2.06	1.29	0.90	1.84

Appendix 12, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental smoking, models 5 through 8, complete case data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.98	1.02	0.98	0.96	1.00	0.99	0.97	1.01	0.98	0.95	1.01
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.92	0.79	1.07	0.84	0.70	1.01	0.38	0.08	1.86	0.62	0.09	4.11
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.02	0.99	1.06	1.01	0.97	1.05
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.28**	**1.07**	**1.53**				**1.28**	**1.07**	**1.53**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.02	0.62	1.66				1.01	0.62	1.65
Behavioural Difficulties				0.99	0.97	1.01				0.99	0.97	1.01
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.92	0.57	1.50	0.92	0.57	1.50
O level	0.79	0.55	1.14	0.80	0.55	1.15
A level	0.69	0.47	1.01	0.69	0.47	1.01
Degree	**0.57**	**0.38**	**0.86**	**0.57**	**0.38**	**0.86**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	1.04	0.84	1.29	1.04	0.84	1.29
IV & V	0.89	0.61	1.30	0.89	0.61	1.30
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.49	0.89	2.49	1.49	0.89	2.49
5-9	1.31	0.76	2.25	1.31	0.76	2.25
10-14	**1.92**	**1.07**	**3.46**	**1.92**	**1.06**	**3.45**
15-19	1.78	0.91	3.46	1.78	0.91	3.46
20-24	1.53	0.68	3.46	1.53	0.67	3.45
25-29	2.49	0.49	12.56	2.48	0.49	12.54
Paternal smoking at child aged 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
<10	1.36	0.91	2.03	1.36	0.91	2.03
10-19	**1.95**	**1.33**	**2.86**	**1.95**	**1.33**	**2.86**
20+	1.27	0.86	1.89	1.27	0.85	1.89

Appendix 12, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental smoking, models 1 through 4, complete case data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.98	1.01	0.99	0.97	1.01						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.70**	**0.56**	**0.87**	**0.60**	**0.46**	**0.79**
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.87	1.17	1.00	0.84	1.19
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.32**	**1.11**	**1.56**				**1.35**	**1.14**	**1.59**

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.94	0.59	1.49	1.02	0.64	1.60
Behavioural Difficulties	0.99	0.97	1.01	1.00	0.98	1.02
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.88	0.56	1.41	1.04	0.66	1.62
O level	0.73	0.51	1.03	0.86	0.61	1.21
A level	**0.64**	**0.44**	**0.93**	0.80	0.56	1.14
Degree	**0.52**	**0.35**	**0.77**	0.69	0.47	1.02
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	1.00	0.82	1.23	1.08	0.88	1.31
IV & V	0.81	0.56	1.15	1.02	0.72	1.45
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.52	0.92	2.50	1.41	0.87	2.28
5-9	1.22	0.73	2.04	1.44	0.86	2.40
10-14	**1.79**	**1.03**	**3.14**	**2.00**	**1.15**	**3.48**
15-19	1.73	0.91	3.28	1.75	0.98	3.14
20-24	1.20	0.56	2.60	1.48	0.69	3.16
25-29	2.52	0.50	12.69	2.74	0.54	13.85

Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.22	0.84	1.77	1.43	0.98	2.08
10-19	**1.80**	**1.25**	**2.60**	**1.59**	**1.13**	**2.25**
20+	1.42	0.98	2.06	1.32	0.92	1.90

Appendix 12, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental smoking, models 5 through 8, complete case data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.98	1.01	0.98	0.96	1.00	0.98	0.96	1.01	0.97	0.94	1.00
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.71**	**0.55**	**0.92**	**0.63**	**0.46**	**0.85**	0.13	0.01	1.12	**0.02**	**0.00**	**0.38**
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.98	0.84	1.15	0.92	0.76	1.12	0.56	0.10	3.05	1.43	0.18	11.13
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.04	0.99	1.09	**1.08**	**1.01**	**1.15**
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.98	1.05	0.99	0.95	1.04
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.29**	**1.08**	**1.54**				**1.30**	**1.08**	**1.55**

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	1.03	0.63	1.70	1.00	0.60	1.65
Behavioural Difficulties	0.99	0.97	1.01	0.99	0.97	1.01
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.89	0.55	1.45	0.88	0.54	1.44
O level	0.77	0.53	1.12	0.76	0.52	1.10
A level	0.68	0.46	1.01	0.68	0.46	1.00
Degree	**0.56**	**0.37**	**0.85**	**0.56**	**0.37**	**0.84**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	1.05	0.85	1.30	1.06	0.85	1.32
IV & V	0.90	0.61	1.33	0.89	0.60	1.32
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.53	0.91	2.58	1.54	0.91	2.59
5-9	1.25	0.72	2.15	1.22	0.71	2.11
10-14	**2.05**	**1.12**	**3.73**	**2.07**	**1.14**	**3.78**
15-19	1.78	0.91	3.48	1.74	0.89	3.41
20-24	1.72	0.74	4.02	1.75	0.74	4.10
25-29	2.69	0.53	13.60	2.77	0.55	14.02

Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.35	0.90	2.03	1.36	0.90	2.03
10-19	**1.93**	**1.31**	**2.85**	**1.95**	**1.32**	**2.88**
20+	1.31	0.87	1.96	1.30	0.87	1.94

Appendix 13: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with experimental smoking, analysis 1 through 3, imputed data

Appendix 13, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental smoking, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.99	0.98	1.01	0.99	0.98	1.01						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.72**	**0.58**	**0.90**	**0.70**	**0.55**	**0.87**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.36**	**1.20**	**1.54**				**1.34**	**1.18**	**1.52**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.19	0.86	1.65				1.20	0.87	1.67
Behavioural				1.00	0.98	1.02				1.00	0.99	1.02
Difficulties												
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.81	0.60	1.11	0.81	0.59	1.10
O level	0.83	0.66	1.04	0.83	0.66	1.04
A level	**0.76**	**0.59**	**0.99**	**0.77**	**0.59**	**0.99**
Degree	**0.60**	**0.45**	**0.79**	**0.60**	**0.46**	**0.80**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.99	0.84	1.17	0.99	0.84	1.17
IV & V	0.98	0.74	1.30	0.99	0.75	1.31
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	**1.68**	**1.15**	**2.45**	**1.65**	**1.13**	**2.41**
5-9	**1.55**	**1.02**	**2.35**	**1.55**	**1.02**	**2.35**
10-14	**1.75**	**1.19**	**2.57**	**1.77**	**1.20**	**2.61**
15-19	1.47	0.95	2.26	1.50	0.98	2.31
20-24	1.28	0.76	2.14	1.34	0.80	2.25
25-29	**3.32**	**1.09**	**10.06**	**3.39**	**1.11**	**10.33**
>30	0.84	0.14	5.05	0.84	0.14	5.10
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.25	0.93	1.67	1.26	0.94	1.69
10-19	**1.34**	**1.01**	**1.77**	**1.34**	**1.01**	**1.78**

20+			1.55	1.14	2.10		**1.57**	**1.16**	**2.13**

Appendix 13, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental smoking, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.99	0.97	1.00	0.99	0.97	1.00	0.99	0.97	1.00	0.98	0.97	1.00
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.70**	**0.56**	**0.87**	**0.67**	**0.54**	**0.85**	0.40	0.08	1.96	0.39	0.07	1.99
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.98	1.05	1.01	0.98	1.05
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.36**	**1.20**	**1.54**				**1.36**	**1.20**	**1.54**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.21	0.88	1.68				1.21	0.87	1.68

Behavioural Difficulties	1.00	0.98	1.02	1.00	0.98	1.02
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.81	0.59	1.11	0.81	0.59	1.11
O level	0.83	0.66	1.04	0.83	0.66	1.04
A level	**0.77**	**0.59**	**0.99**	**0.77**	**0.59**	**0.99**
Degree	**0.60**	**0.45**	**0.80**	**0.60**	**0.45**	**0.80**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.99	0.84	1.17	0.99	0.84	1.17
IV & V	0.98	0.74	1.30	0.98	0.74	1.30
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	**1.66**	**1.14**	**2.43**	**1.66**	**1.14**	**2.43**
5-9	**1.54**	**1.01**	**2.34**	**1.53**	**1.01**	**2.33**
10-14	**1.76**	**1.19**	**2.60**	**1.76**	**1.19**	**2.59**
15-19	1.49	0.97	2.29	1.49	0.97	2.29
20-24	1.30	0.77	2.19	1.30	0.77	2.19
25-29	**3.44**	**1.13**	**10.50**	**3.42**	**1.12**	**10.43**
>30	0.82	0.13	4.97	0.82	0.13	4.97

Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.26	0.94	1.70	1.26	0.94	1.70
10-19	**1.34**	**1.01**	**1.78**	**1.34**	**1.01**	**1.78**
20+	**1.56**	**1.15**	**2.12**	**1.56**	**1.15**	**2.12**

Appendix 13, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental smoking, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.99	0.98	1.01	0.99	0.98	1.01						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.95	0.83	1.09	0.95	0.83	1.09
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)		1.00			1.00	(reference)	
Female				**1.36**	**1.20**	**1.54**				**1.34**	**1.18**	**1.52**
Ethnicity												
White				1.00	(reference)		1.00			1.00	(reference)	
Non-white				1.19	0.86	1.65				1.19	0.86	1.64
Behavioural				1.00	0.98	1.02				1.00	0.98	1.02
Difficulties												
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.81	0.60	1.11	0.81	0.60	1.11
O level	0.83	0.66	1.04	0.83	0.66	1.04
A level	**0.76**	**0.59**	**0.99**	**0.77**	**0.59**	**0.99**
Degree	**0.60**	**0.45**	**0.79**	**0.60**	**0.45**	**0.80**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.99	0.84	1.17	0.99	0.84	1.17
IV & V	0.98	0.74	1.30	0.98	0.74	1.30
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	**1.68**	**1.15**	**2.45**	**1.67**	**1.15**	**2.44**
5-9	**1.55**	**1.02**	**2.35**	**1.56**	**1.03**	**2.36**
10-14	**1.75**	**1.19**	**2.57**	**1.76**	**1.19**	**2.59**
15-19	1.47	0.95	2.26	1.48	0.96	2.28
20-24	1.28	0.76	2.14	1.31	0.78	2.19
25-29	**3.32**	**1.09**	**10.06**	**3.28**	**1.09**	**9.92**
>30	0.84	0.14	5.05	0.86	0.14	5.18
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.25	0.93	1.67	1.25	0.93	1.68
10-19	**1.34**	**1.01**	**1.77**	**1.34**	**1.01**	**1.77**

20+			1.55	1.14	2.10		**1.56**	**1.15**	**2.12**

Appendix 13, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental smoking, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.99	0.98	1.00	0.99	0.98	1.00	0.99	0.97	1.01	0.99	0.97	1.01
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.94	0.81	1.07	0.94	0.81	1.08	0.68	0.19	2.48	0.75	0.21	2.72
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.98	1.04	1.00	0.98	1.03
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.35**	**1.19**	**1.54**				**1.35**	**1.19**	**1.54**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.20	0.87	1.66				1.20	0.86	1.66
Behavioural				1.00	0.98	1.02				1.00	0.98	1.02
Difficulties												
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.82	0.60	1.11	0.82	0.60	1.11
O level	0.83	0.66	1.04	0.83	0.66	1.04
A level	**0.77**	**0.59**	**0.99**	**0.77**	**0.59**	**0.99**
Degree	**0.60**	**0.45**	**0.79**	**0.60**	**0.45**	**0.79**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.99	0.84	1.17	0.99	0.84	1.17
IV & V	0.98	0.74	1.29	0.98	0.74	1.29
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	**1.68**	**1.15**	**2.46**	**1.68**	**1.15**	**2.46**
5-9	**1.55**	**1.02**	**2.35**	**1.55**	**1.02**	**2.35**
10-14	**1.75**	**1.19**	**2.59**	**1.75**	**1.19**	**2.58**
15-19	1.46	0.95	2.26	1.46	0.95	2.26
20-24	1.27	0.76	2.13	1.27	0.76	2.13
25-29	**3.31**	**1.09**	**10.01**	**3.30**	**1.09**	**10.00**
>30	0.85	0.14	5.09	0.85	0.14	5.11
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.25	0.93	1.68	1.25	0.93	1.68
10-19	**1.33**	**1.01**	**1.76**	**1.33**	**1.01**	**1.77**

20+				**1.55**	**1.15**	**2.10**		**1.55**	**1.14**	**2.10**

Appendix 13, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental smoking, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.99	0.98	1.01	0.99	0.98	1.01						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.72**	**0.57**	**0.90**	**0.69**	**0.54**	**0.87**
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.88	1.17	1.02	0.88	1.18
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.36**	**1.20**	**1.54**				**1.34**	**1.18**	**1.52**

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	1.19	0.86	1.65	1.20	0.87	1.67
Behavioural	1.00	0.98	1.02	1.00	0.99	1.02
Difficulties						
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.81	0.60	1.11	0.81	0.59	1.10
O level	0.83	0.66	1.04	0.83	0.66	1.04
A level	**0.76**	**0.59**	**0.99**	**0.77**	**0.59**	**0.99**
Degree	**0.60**	**0.45**	**0.79**	**0.60**	**0.46**	**0.80**
Maternal Social						
Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.99	0.84	1.17	0.99	0.84	1.17
IV & V	0.98	0.74	1.30	0.99	0.75	1.31
Maternal smoking						
at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	**1.68**	**1.15**	**2.45**	**1.65**	**1.13**	**2.41**
5-9	**1.55**	**1.02**	**2.35**	**1.55**	**1.02**	**2.35**
10-14	**1.75**	**1.19**	**2.57**	**1.76**	**1.20**	**2.61**
15-19	1.47	0.95	2.26	1.50	0.98	2.31
20-24	1.28	0.76	2.14	1.34	0.80	2.25
25-29	**3.32**	**1.09**	**10.06**	**3.40**	**1.12**	**10.35**

>30	0.84	0.14	5.05	0.83	0.14	5.08
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.25	0.93	1.67	1.26	0.94	1.69
10-19	**1.34**	**1.01**	**1.77**	**1.34**	**1.02**	**1.78**
20+	1.55	1.14	2.10	**1.57**	**1.16**	**2.13**

Appendix 13, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental smoking, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.99	0.97	1.00	0.99	0.97	1.00	0.98	0.96	1.01	0.98	0.96	1.01
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.70**	**0.56**	**0.88**	**0.67**	**0.53**	**0.85**	0.42	0.08	2.24	0.38	0.07	2.16
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	1.00	0.86	1.15	1.00	0.87	1.16	0.92	0.24	3.54	1.05	0.27	4.05
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.97	1.05	1.01	0.97	1.05
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.00	0.97	1.03	1.00	0.97	1.03
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**1.36**	**1.20**	**1.54**				**1.36**	**1.20**	**1.54**

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	1.21	0.88	1.68	1.21	0.87	1.68
Behavioural Difficulties	1.00	0.98	1.02	1.00	0.98	1.02
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.81	0.59	1.11	0.81	0.59	1.11
O level	0.83	0.66	1.04	0.83	0.66	1.04
A level	**0.77**	**0.59**	**0.99**	**0.77**	**0.59**	**0.99**
Degree	**0.60**	**0.45**	**0.80**	**0.60**	**0.45**	**0.80**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.99	0.84	1.17	0.99	0.84	1.17
IV & V	0.98	0.74	1.30	0.99	0.74	1.30
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	**1.66**	**1.14**	**2.43**	**1.66**	**1.14**	**2.43**
5-9	**1.54**	**1.01**	**2.34**	**1.53**	**1.01**	**2.33**
10-14	**1.76**	**1.19**	**2.60**	**1.76**	**1.19**	**2.60**
15-19	1.49	0.97	2.29	1.49	0.97	2.29
20-24	1.30	0.77	2.19	1.30	0.77	2.19
25-29	**3.44**	**1.13**	**10.49**	**3.42**	**1.12**	**10.43**

>30	0.82	0.13	4.97	0.82	0.13	4.97
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.26	0.94	1.70	1.26	0.94	1.70
10-19	**1.34**	**1.01**	**1.78**	**1.34**	**1.01**	**1.78**
20+	**1.56**	**1.15**	**2.12**	**1.56**	**1.15**	**2.12**

Appendix 14: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with nicotine dependence, analysis 1 through 3, complete case data

Appendix 14, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in school with nicotine dependence, models 1 through 4, complete case data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.97	0.93	1.03	0.99	0.91	1.07						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.96	0.60	1.54	0.91	0.44	1.91
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.59	0.74	3.42				1.96	0.89	4.29
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.45	0.10	2.14				0.22	0.04	1.13
Behavioural Difficulties				1.05	0.97	1.12				1.04	0.97	1.12
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	2.81	0.40	19.71	1.33	0.16	11.10
O level	**4.70**	**1.04**	**21.25**	**7.62**	**1.78**	**32.64**
A level	2.26	0.44	11.68	2.50	0.51	12.14
Degree	4.11	0.69	24.39	**7.57**	**1.35**	**42.40**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.83	0.33	2.07	0.88	0.36	2.18
IV & V	1.91	0.53	6.94	1.38	0.41	4.65
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.84	0.14	5.03	0.79	0.13	4.82
5-9	1.39	0.30	6.52	**3.75**	**1.06**	**13.33**
10-14	0.58	0.10	3.25	1.49	0.34	6.64
15-19	1.93	0.55	6.75	**4.45**	**1.43**	**13.81**
20-24	5.44	0.80	37.22	**7.59**	**1.16**	**49.41**
25-29	1.00			1.00		
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	2.51	0.63	9.97	1.50	0.33	6.75
10-19	2.61	0.99	6.90	2.06	0.78	5.45
20+	1.54	0.53	4.47	0.87	0.29	2.67

Appendix 14, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in school with nicotine dependence, models 5 through 8, complete case data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.98	0.92	1.04	0.98	0.89	1.09	0.95	0.86	1.04	0.91	0.78	1.07
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.84	0.48	1.46	0.70	0.30	1.62	0.09	0.00	27.33	0.00	0.00	26.02
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.05	0.93	1.19	1.12	0.93	1.36
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.91	0.80	4.56				1.92	0.80	4.61
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.17	0.03	1.01				0.17	0.03	1.00
Behavioural Difficulties				1.03	0.95	1.12				1.03	0.95	1.12
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	3.77	0.33	42.53	4.36	0.39	49.16
O level	**11.54**	**1.77**	**75.39**	13.50	2.03	89.58
A level	3.32	0.45	24.47	3.50	0.47	25.91
Degree	**10.76**	**1.32**	**87.72**	12.99	1.54	109.77
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.64	0.23	1.78	0.64	0.23	1.77
IV & V	1.55	0.37	6.61	1.63	0.38	6.97
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.12	0.17	7.58	1.17	0.17	7.93
5-9	2.22	0.41	12.02	2.18	0.40	11.77
10-14	0.99	0.17	5.82	1.04	0.18	6.14
15-19	2.91	0.77	10.97	2.93	0.77	11.16
20-24	**15.74**	**1.71**	**144.83**	**16.19**	**1.74**	**150.38**
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.97	0.38	10.21	2.02	0.39	10.55
10-19	2.09	0.70	6.24	2.14	0.72	6.39
20+	1.17	0.33	4.12	1.15	0.32	4.11

Appendix 14, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with nicotine dependence, models 1 through 4, complete case data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.97	0.93	1.03	0.99	0.91	1.07						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.03	0.63	1.68	1.05	0.50	2.19
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.59	0.74	3.42				2.00	0.92	4.35
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.45	0.10	2.14				0.21	0.04	1.07
Behavioural Difficulties				1.05	0.97	1.12				1.04	0.97	1.12
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	2.81	0.40	19.71	1.31	0.16	10.63
O level	**4.70**	**1.04**	**21.25**	**7.21**	**1.69**	**30.76**
A level	2.26	0.44	11.68	2.40	0.49	11.71
Degree	4.11	0.69	24.39	**6.83**	**1.23**	**37.92**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.83	0.33	2.07	0.77	0.31	1.89
IV & V	1.91	0.53	6.94	1.26	0.38	4.15
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.84	0.14	5.03	0.76	0.13	4.57
5-9	1.39	0.30	6.52	2.78	0.74	10.41
10-14	0.58	0.10	3.25	1.43	0.32	6.31
15-19	1.93	0.55	6.75	**4.18**	**1.35**	**12.92**
20-24	5.44	0.80	37.22	**6.79**	**1.05**	**44.03**
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	2.51	0.63	9.97	1.47	0.32	6.64
10-19	2.61	0.99	6.90	2.22	0.85	5.80
20+	1.54	0.53	4.47	0.93	0.31	2.84

Appendix 14, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with nicotine dependence, models 5 through 8, complete case data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.94	1.06	1.00	0.91	1.10	1.02	0.93	1.11	0.96	0.86	1.07
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	1.08	0.62	1.88	1.19	0.52	2.73	10.20	0.03	3590.76	0.01	0.00	60.39
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.95	0.84	1.08	1.11	0.92	1.34
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.94	0.82	4.58				1.93	0.81	4.58
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.18	0.03	1.04				**0.16**	**0.03**	**0.98**
Behavioural Difficulties				1.04	0.95	1.13				1.04	0.96	1.13
Maternal Education												

CSE	1.00	(reference)		1.00	(reference)	
Vocational	3.64	0.31	42.08	4.01	0.34	47.28
O level	**10.76**	**1.61**	**72.02**	**11.81**	**1.77**	**78.92**
A level	4.13	0.58	29.49	4.47	0.63	31.81
Degree	**10.07**	**1.22**	**83.09**	**11.21**	**1.35**	**93.12**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.60	0.22	1.66	0.61	0.22	1.69
IV & V	1.49	0.36	6.10	1.63	0.39	6.80
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.07	0.16	7.19	1.13	0.17	7.70
5-9	1.87	0.35	10.07	1.75	0.31	9.83
10-14	0.93	0.16	5.36	0.84	0.14	4.90
15-19	2.80	0.74	10.57	3.03	0.79	11.61
20-24	**12.93**	**1.41**	**118.42**	**12.97**	**1.41**	**119.47**
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.80	0.36	9.11	1.76	0.34	9.03
10-19	2.61	0.91	7.54	2.80	0.96	8.21
20+	1.28	0.36	4.50	1.29	0.36	4.56

Appendix 14, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with nicotine dependence, models 1 through 4, complete case data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.97	0.93	1.03	0.99	0.91	1.07						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.88	0.53	1.46	0.85	0.39	1.85
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.06	0.63	1.79	1.14	0.53	2.48
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.59	0.74	3.42				1.89	0.86	4.17

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.45	0.10	2.14	0.20	0.04	1.01
Behavioural Difficulties	1.05	0.97	1.12	1.04	0.97	1.12
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	2.81	0.40	19.71	1.28	0.16	10.47
O level	**4.70**	**1.04**	**21.25**	**7.15**	**1.66**	**30.74**
A level	2.26	0.44	11.68	2.01	0.39	10.24
Degree	4.11	0.69	24.39	**6.92**	**1.23**	**38.78**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.83	0.33	2.07	0.81	0.33	2.03
IV & V	1.91	0.53	6.94	1.38	0.41	4.70
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.84	0.14	5.03	0.83	0.14	5.15
5-9	1.39	0.30	6.52	3.00	0.78	11.46
10-14	0.58	0.10	3.25	1.47	0.33	6.55
15-19	1.93	0.55	6.75	**4.46**	**1.43**	**13.88**
20-24	5.44	0.80	37.22	**7.15**	**1.10**	**46.49**

Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	2.51	0.63	9.97	1.46	0.32	6.69
10-19	2.61	0.99	6.90	1.84	0.67	5.00
20+	1.54	0.53	4.47	0.89	0.29	2.71

Appendix 14, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with nicotine dependence, models 5 through 8, complete case data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	1.00	0.93	1.06	0.98	0.89	1.09	0.97	0.87	1.08	0.89	0.76	1.05
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.79	0.44	1.41	0.64	0.27	1.52	0.01	0.00	6.31	0.00	0.00	47.47
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	1.15	0.63	2.08	1.42	0.59	3.40	17.67	0.03	9710.06	0.09	0.00	1120.66
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.09	0.96	1.25	1.12	0.91	1.36
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.94	0.82	1.08	1.06	0.87	1.30
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.86	0.77	4.48				1.86	0.77	4.51

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	**0.16**	**0.03**	**0.98**	**0.15**	**0.02**	**0.93**
Behavioural Difficulties	1.03	0.94	1.12	1.03	0.94	1.12
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	3.47	0.30	39.84	4.18	0.36	48.52
O level	**10.39**	**1.57**	**68.61**	**12.77**	**1.90**	**86.06**
A level	3.04	0.41	22.63	3.36	0.45	25.20
Degree	**9.82**	**1.20**	**80.49**	**12.63**	**1.47**	**108.16**
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.61	0.22	1.72	0.61	0.21	1.72
IV & V	1.58	0.37	6.73	1.77	0.41	7.68
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	1.25	0.18	8.64	1.37	0.19	9.62
5-9	2.15	0.39	11.95	2.01	0.35	11.42
10-14	0.94	0.16	5.44	0.93	0.16	5.47
15-19	2.85	0.75	10.81	2.99	0.77	11.63
20-24	**14.86**	**1.60**	**137.72**	**15.08**	**1.60**	**142.32**

Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.89	0.36	9.85	1.88	0.35	10.02
10-19	2.14	0.71	6.46	2.29	0.75	6.98
20+	1.20	0.34	4.24	1.19	0.33	4.28

Appendix 15: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with nicotine dependence, analysis 1 through 3, imputed data

Appendix 15, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in school with nicotine dependence, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.98	0.95	1.01	0.99	0.95	1.02						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.19	0.64	2.21	1.06	0.54	2.07
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.40	0.87	2.24				1.39	0.87	2.23
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.44	0.15	1.30				0.45	0.15	1.30
Behavioural Difficulties				1.04	1.00	1.09				1.05	1.00	1.09
Maternal Education												

CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.16	0.45	2.98	1.16	0.45	2.99
O level	1.57	0.80	3.08	1.58	0.80	3.10
A level	0.72	0.30	1.72	0.74	0.31	1.74
Degree	1.10	0.37	3.27	1.11	0.37	3.30
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.79	0.40	1.56	0.80	0.41	1.58
IV & V	1.00	0.40	2.50	1.01	0.40	2.53
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.66	0.16	2.66	0.65	0.16	2.63
5-9	1.23	0.44	3.45	1.23	0.44	3.44
10-14	0.81	0.32	2.09	0.81	0.32	2.07
15-19	1.66	0.72	3.81	1.69	0.74	3.86
20-24	1.99	0.57	6.92	1.98	0.57	6.83
25-29	0.80	0.09	7.40	0.82	0.09	7.59
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.27	0.40	4.07	1.25	0.39	3.97
10-19	1.83	0.90	3.74	1.85	0.91	3.76

20+				1.23	0.57	2.63	1.24	0.58	2.65

Appendix 15, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in school with nicotine dependence, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.98	0.95	1.01	0.99	0.95	1.02	0.97	0.93	1.01	0.97	0.93	1.01
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	1.10	0.58	2.09	1.00	0.50	2.01	0.18	0.00	7.75	0.12	0.00	6.30
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.05	0.96	1.14	1.05	0.96	1.15
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.40	0.87	2.25				1.40	0.87	2.25
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.44	0.15	1.29				0.44	0.15	1.30
Behavioural Difficulties				1.04	1.00	1.09				1.05	1.00	1.09
Maternal Education												

CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.16	0.45	2.98	1.19	0.46	3.08
O level	1.57	0.80	3.09	1.61	0.81	3.22
A level	0.72	0.30	1.72	0.74	0.31	1.79
Degree	1.10	0.37	3.27	1.13	0.37	3.40
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.79	0.40	1.56	0.80	0.41	1.60
IV & V	1.00	0.40	2.50	1.02	0.40	2.59
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.66	0.16	2.66	0.65	0.16	2.64
5-9	1.23	0.44	3.45	1.18	0.42	3.32
10-14	0.81	0.32	2.10	0.81	0.31	2.10
15-19	1.66	0.72	3.83	1.66	0.71	3.87
20-24	1.99	0.57	6.95	1.91	0.54	6.81
25-29	0.79	0.08	7.40	0.79	0.08	7.46
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.27	0.40	4.07	1.24	0.38	4.03
10-19	1.83	0.90	3.74	1.84	0.90	3.76

20+			1.22	0.57	2.61		1.21	0.56	2.61

Appendix 15, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with nicotine dependence, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.98	0.95	1.01	0.99	0.95	1.02						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.02	0.63	1.64	0.99	0.59	1.65
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.40	0.87	2.24				1.39	0.87	2.22
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.44	0.15	1.30				0.45	0.15	1.31
Behavioural Difficulties				1.04	1.00	1.09				1.05	1.00	1.09
Maternal Education												

CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.57	0.80	3.08	1.17	0.45	3.01
O level	0.72	0.30	1.72	1.58	0.80	3.10
A level	1.10	0.37	3.27	0.74	0.31	1.74
Degree	1.57	0.80	3.08	1.11	0.37	3.30
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.79	0.40	1.56	0.80	0.41	1.58
IV & V	1.00	0.40	2.50	1.01	0.40	2.52
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.66	0.16	2.66	0.65	0.16	2.64
5-9	1.23	0.44	3.45	1.23	0.44	3.45
10-14	0.81	0.32	2.09	0.81	0.31	2.07
15-19	1.66	0.72	3.81	1.70	0.75	3.86
20-24	1.99	0.57	6.92	1.99	0.58	6.84
25-29	0.80	0.09	7.40	0.82	0.09	7.59
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.27	0.40	4.07	1.25	0.39	4.00
10-19	1.83	0.90	3.74	1.85	0.91	3.78

20+			1.23	0.57	2.63		1.24	0.58	2.66

Appendix 15, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with nicotine dependence, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.98	0.94	1.01	0.99	0.95	1.02	0.97	0.93	1.02	0.98	0.93	1.03
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.98	0.61	1.59	0.97	0.58	1.62	0.52	0.02	15.58	0.45	0.01	15.38
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.94	1.10	1.02	0.94	1.10
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				1.40	0.87	2.25				1.39	0.86	2.23
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.44	0.15	1.30				0.44	0.15	1.32
Behavioural Difficulties				1.04	1.00	1.09				1.04	1.00	1.09
Maternal Education												

CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.16	0.45	2.99	1.18	0.46	3.04
O level	1.57	0.80	3.10	1.59	0.81	3.13
A level	0.72	0.30	1.72	0.73	0.31	1.75
Degree	1.10	0.37	3.27	1.11	0.37	3.29
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.79	0.40	1.57	0.79	0.40	1.57
IV & V	1.00	0.40	2.50	1.00	0.40	2.53
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.66	0.16	2.66	0.67	0.17	2.71
5-9	1.24	0.44	3.46	1.24	0.44	3.48
10-14	0.81	0.31	2.10	0.80	0.31	2.09
15-19	1.66	0.72	3.82	1.67	0.72	3.86
20-24	1.99	0.57	6.93	1.96	0.56	6.88
25-29	0.79	0.09	7.39	0.79	0.08	7.45
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.27	0.40	4.08	1.26	0.39	4.07
10-19	1.83	0.89	3.75	1.84	0.89	3.77

20+			1.22	0.57	2.61		1.22	0.57	2.61

Appendix 15, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with nicotine dependence, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.98	0.95	1.01	0.99	0.95	1.02						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.20	0.63	2.27	1.06	0.53	2.14
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.98	0.60	1.60	0.97	0.57	1.65
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	

Female	1.40	0.87	2.24	1.39	0.87	2.23
Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.44	0.15	1.30	0.45	0.15	1.31
Behavioural	1.04	1.00	1.09	1.05	1.00	1.09
Difficulties						
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.16	0.45	2.98	1.17	0.45	3.00
O level	1.57	0.80	3.08	1.58	0.80	3.11
A level	0.72	0.30	1.72	0.74	0.31	1.74
Degree	1.10	0.37	3.27	1.11	0.37	3.30
Maternal Social						
Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.79	0.40	1.56	0.80	0.41	1.58
IV & V	1.00	0.40	2.50	1.01	0.40	2.53
Maternal smoking						
at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.66	0.16	2.66	0.65	0.16	2.63
5-9	1.23	0.44	3.45	1.23	0.44	3.45
10-14	0.81	0.32	2.09	0.81	0.31	2.07
15-19	1.66	0.72	3.81	1.69	0.74	3.86
20-24	1.99	0.57	6.92	1.98	0.57	6.84

25-29	0.80	0.09	7.40	0.81	0.09	7.59
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.27	0.40	4.07	1.25	0.39	3.96
10-19	1.83	0.90	3.74	1.85	0.91	3.77
20+	1.23	0.57	2.63	1.24	0.58	2.64

Appendix 15, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with nicotine dependence, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main variables												
PCRQ	0.98	0.95	1.01	0.99	0.95	1.02	0.97	0.92	1.02	0.97	0.92	1.03
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	1.11	0.57	2.16	1.02	0.50	2.07	0.18	0.00	11.11	0.13	0.00	8.87
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.96	0.58	1.58	0.96	0.57	1.63	0.88	0.02	38.74	0.83	0.02	38.78
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.05	0.95	1.15	1.05	0.95	1.16
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.00	0.92	1.09	1.00	0.92	1.09
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	

Female	1.40	0.87	2.25	1.40	0.87	2.26
Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.44	0.15	1.30	0.44	0.15	1.31
Behavioural Difficulties	1.04	1.00	1.09	1.05	1.00	1.10
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.16	0.45	2.99	1.20	0.46	3.10
O level	1.57	0.80	3.10	1.63	0.81	3.25
A level	0.72	0.30	1.72	0.75	0.31	1.80
Degree	1.10	0.37	3.27	1.13	0.37	3.40
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.79	0.40	1.57	0.81	0.41	1.60
IV & V	1.00	0.40	2.50	1.01	0.40	2.58
Maternal smoking at child age 1yr 9m						
None	1.00	(reference)		1.00	(reference)	
1-4	0.66	0.16	2.65	0.65	0.16	2.65
5-9	1.23	0.44	3.46	1.19	0.42	3.35
10-14	0.81	0.31	2.10	0.80	0.31	2.11
15-19	1.66	0.72	3.84	1.67	0.71	3.88
20-24	1.99	0.57	6.96	1.91	0.53	6.82

25-29	0.79	0.08	7.39	0.79	0.08	7.46
Paternal smoking at child aged 1yr 9 m						
None	1.00	(reference)		1.00	(reference)	
<10	1.27	0.40	4.06	1.24	0.38	4.02
10-19	1.83	0.90	3.74	1.83	0.89	3.76
20+	1.22	0.57	2.60	1.21	0.56	2.60

Appendix 16: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with experimental cannabis use, analysis 1 through 3, complete case data

Appendix 16, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental cannabis use, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.97**	**1.00**	**0.96**	**0.94**	**0.99**						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.79**	**0.64**	**0.99**	**0.58**	**0.39**	**0.84**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.92	0.73	1.16				0.89	0.71	1.11
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.62	0.31	1.24				0.68	0.34	1.35
Behavioural Difficulties				0.98	0.95	1.00				0.99	0.96	1.01
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.94	0.47	1.86	0.94	0.49	1.81
O level	1.06	0.64	1.76	0.94	0.58	1.54
A level	0.98	0.58	1.66	0.91	0.55	1.50
Degree	1.02	0.59	1.77	1.04	0.61	1.76
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.87	0.66	1.16	0.93	0.71	1.22
IV & V	1.09	0.64	1.86	1.19	0.72	1.98
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.11**	**1.25**	**7.75**	**4.22**	**1.64**	**10.88**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.06**	**1.78**	**5.24**	**2.85**	**1.67**	**4.88**

Appendix 16, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental cannabis use, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.96**	**1.00**	**0.96**	**0.93**	**0.98**	**0.97**	**0.96**	**0.99**	**0.95**	**0.93**	**0.98**
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.75**	**0.58**	**0.96**	**0.49**	**0.31**	**0.75**	0.20	0.03	1.51	0.22	0.00	10.16
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.03	0.98	1.08	1.02	0.93	1.11
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.96	0.75	1.22				0.96	0.75	1.22
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.72	0.35	1.48				0.72	0.35	1.48
Behavioural Difficulties				0.98	0.95	1.01				0.98	0.95	1.01
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.92	0.45	1.89	0.92	0.45	1.89
O level	1.04	0.62	1.76	1.04	0.62	1.77
A level	0.91	0.53	1.56	0.91	0.53	1.57
Degree	1.00	0.57	1.76	1.00	0.57	1.77
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.86	0.64	1.14	0.86	0.64	1.15
IV & V	1.28	0.73	2.23	1.28	0.73	2.23
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.51**	**1.33**	**9.27**	**3.50**	**1.32**	**9.24**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.18**	**1.81**	**5.61**	**3.21**	**1.82**	**5.67**

Appendix 16, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental cannabis use, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.97**	**1.00**	**0.96**	**0.94**	**0.99**						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.00	0.87	1.15	0.98	0.78	1.24
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.92	0.73	1.16				0.88	0.70	1.09
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.62	0.31	1.24				0.61	0.31	1.19
Behavioural Difficulties				0.98	0.95	1.00				0.98	0.95	1.01
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.94	0.47	1.86	0.95	0.50	1.82
O level	1.06	0.64	1.76	1.00	0.62	1.63
A level	0.98	0.58	1.66	0.97	0.59	1.60
Degree	1.02	0.59	1.77	1.07	0.63	1.80
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.87	0.66	1.16	0.96	0.73	1.25
IV & V	1.09	0.64	1.86	1.22	0.74	2.00
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.11**	**1.25**	**7.75**	**3.63**	**1.49**	**8.89**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.06**	**1.78**	**5.24**	**2.85**	**1.67**	**4.84**

Appendix 16, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental cannabis use, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.96**	**1.00**	**0.96**	**0.93**	**0.99**	**0.96**	**0.94**	**0.99**	**0.95**	**0.92**	**0.99**
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.91	0.78	1.06	0.89	0.69	1.15	0.22	0.04	1.11	0.40	0.03	4.86
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.03	1.00	1.07	1.02	0.96	1.07
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.95	0.75	1.20				0.95	0.75	1.20
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.63	0.31	1.28				0.63	0.31	1.27
Behavioural Difficulties				0.98	0.95	1.01				0.98	0.95	1.01
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.95	0.47	1.93	0.95	0.47	1.94
O level	1.08	0.65	1.82	1.10	0.65	1.85
A level	0.98	0.57	1.67	0.98	0.57	1.69
Degree	1.02	0.58	1.78	1.02	0.58	1.80
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.89	0.67	1.19	0.89	0.66	1.18
IV & V	1.25	0.72	2.17	1.25	0.72	2.17
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.02**	**1.20**	**7.58**	**2.99**	**1.19**	**7.52**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.18**	**1.81**	**5.59**	**3.19**	**1.81**	**5.60**

Appendix 16, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental cannabis use, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.97**	**1.00**	**0.96**	**0.94**	**0.99**						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.78**	**0.62**	**0.99**	**0.56**	**0.38**	**0.84**
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.06	0.91	1.23	1.12	0.87	1.43
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.92	0.73	1.16				0.89	0.71	1.12

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.62	0.31	1.24	0.68	0.34	1.35
Behavioural Difficulties	0.98	0.95	1.00	0.98	0.96	1.01
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.94	0.47	1.86	0.94	0.49	1.80
O level	1.06	0.64	1.76	0.96	0.59	1.56
A level	0.98	0.58	1.66	0.91	0.55	1.51
Degree	1.02	0.59	1.77	1.00	0.59	1.70
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.87	0.66	1.16	0.95	0.73	1.25
IV & V	1.09	0.64	1.86	1.20	0.72	1.99
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.11**	**1.25**	**7.75**	**4.13**	**1.60**	**10.66**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.06**	**1.78**	**5.24**	**2.82**	**1.65**	**4.82**

Appendix 16, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental cannabis use, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.96**	**1.00**	**0.96**	**0.93**	**0.98**	**0.96**	**0.94**	**0.99**	**0.95**	**0.91**	**0.99**
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.76**	**0.59**	**0.99**	**0.50**	**0.32**	**0.78**	0.18	0.02	1.60	0.20	0.00	10.56
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.97	0.82	1.14	1.02	0.79	1.33	0.34	0.06	1.91	0.74	0.05	10.44
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.03	0.98	1.09	1.02	0.93	1.12
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.02	0.99	1.06	1.01	0.95	1.07
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.97	0.76	1.23				0.97	0.76	1.23

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.71	0.35	1.46	0.71	0.35	1.46
Behavioural Difficulties	0.98	0.95	1.01	0.98	0.95	1.01
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.92	0.45	1.89	0.92	0.45	1.89
O level	1.06	0.62	1.79	1.07	0.63	1.81
A level	0.92	0.53	1.58	0.92	0.54	1.60
Degree	0.97	0.55	1.71	0.97	0.55	1.72
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.88	0.66	1.18	0.88	0.66	1.18
IV & V	1.29	0.74	2.26	1.29	0.74	2.26
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.42**	**1.29**	**9.07**	**3.40**	**1.28**	**9.02**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**3.16**	**1.79**	**5.57**	**3.20**	**1.81**	**5.64**

Appendix 17: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with experimental cannabis use, analysis 1 through 3, imputed data

Appendix 17, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental cannabis use, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.96**	**0.99**	**0.96**	**0.94**	**0.98**						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.83	0.67	1.02	**0.71**	**0.51**	**0.99**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.90	0.74	1.10				0.87	0.72	1.06
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.84	0.46	1.51				0.84	0.46	1.51
Behavioural				0.98	0.95	1.00				0.99	0.96	1.01
Difficulties												
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	1.06	0.60	1.88	1.03	0.58	1.81
O level	1.31	0.87	1.97	1.28	0.85	1.92
A level	1.24	0.81	1.90	1.24	0.81	1.90
Degree	1.35	0.86	2.12	1.37	0.87	2.15
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.98	0.76	1.25	0.99	0.77	1.26
IV & V	1.07	0.68	1.69	1.11	0.71	1.73
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.58**	**1.26**	**5.31**	**2.52**	**1.23**	**5.16**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.61**	**1.69**	**4.02**	**2.69**	**1.75**	**4.14**

Appendix 17, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with experimental cannabis use, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.96**	**0.99**	**0.96**	**0.93**	**0.98**	**0.97**	**0.96**	**0.99**	**0.96**	**0.93**	**0.98**
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.77**	**0.62**	**0.96**	**0.63**	**0.45**	**0.88**	0.59	0.12	2.93	0.61	0.04	8.95
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.97	1.04	1.00	0.94	1.06
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.90	0.74	1.10				0.90	0.74	1.10
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.86	0.48	1.56				0.86	0.48	1.56

Behavioural Difficulties	0.98	0.95	1.00	0.98	0.95	1.00
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.05	0.59	1.86	1.05	0.59	1.86
O level	1.29	0.86	1.94	1.29	0.86	1.94
A level	1.22	0.79	1.88	1.22	0.79	1.88
Degree	1.35	0.86	2.12	1.35	0.86	2.12
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.99	0.77	1.27	0.99	0.77	1.27
IV & V	1.09	0.69	1.70	1.09	0.69	1.71
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.52**	**1.22**	**5.17**	**2.52**	**1.22**	**5.18**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.68**	**1.74**	**4.13**	**2.68**	**1.74**	**4.13**

Appendix 17, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental cannabis use, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.96**	**0.99**	**0.96**	**0.94**	**0.98**						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.88	1.16	1.00	0.81	1.23
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.90	0.74	1.10				0.88	0.72	1.06
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.84	0.46	1.51				0.82	0.45	1.47
Behavioural				0.98	0.95	1.00				0.98	0.96	1.01
Difficulties												
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	1.06	0.60	1.88	1.04	0.59	1.83
O level	1.31	0.87	1.97	1.30	0.87	1.94
A level	1.24	0.81	1.90	1.25	0.82	1.92
Degree	1.35	0.86	2.12	1.37	0.87	2.15
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.98	0.76	1.25	0.98	0.77	1.25
IV & V	1.07	0.68	1.69	1.10	0.70	1.72
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.58**	**1.26**	**5.31**	**2.57**	**1.25**	**5.27**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.61**	**1.69**	**4.02**	**2.64**	**1.71**	**4.05**

Appendix 17, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with experimental cannabis use, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.96**	**0.99**	**0.96**	**0.94**	**0.98**	**0.97**	**0.95**	**0.99**	**0.96**	**0.93**	**0.99**
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.97	0.84	1.11	0.93	0.75	1.14	0.62	0.17	2.32	0.80	0.11	5.93
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.98	1.04	1.00	0.96	1.05
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.90	0.74	1.10				0.90	0.74	1.10
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.84	0.46	1.51				0.84	0.46	1.51
Behavioural Difficulties				0.98	0.95	1.00				0.98	0.95	1.00
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	1.06	0.60	1.88	1.07	0.60	1.89
O level	1.31	0.87	1.97	1.31	0.87	1.97
A level	1.24	0.81	1.90	1.24	0.81	1.91
Degree	1.35	0.86	2.13	1.36	0.86	2.13
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.98	0.77	1.25	0.98	0.77	1.25
IV & V	1.08	0.69	1.69	1.08	0.69	1.69
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.58**	**1.26**	**5.31**	**2.58**	**1.25**	**5.31**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.62**	**1.70**	**4.04**	**2.62**	**1.70**	**4.04**

Appendix 17, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental cannabis use, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	**0.98**	**0.96**	**0.99**	**0.96**	**0.94**	**0.98**						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.81	0.65	1.02	**0.69**	**0.49**	**0.97**
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.05	0.91	1.21	1.07	0.86	1.33
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.90	0.74	1.10				0.87	0.72	1.06

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.84	0.46	1.51	0.84	0.46	1.51
Behavioural	0.98	0.95	1.00	0.99	0.96	1.01
Difficulties						
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.06	0.60	1.88	1.03	0.58	1.81
O level	1.31	0.87	1.97	1.28	0.85	1.92
A level	1.24	0.81	1.90	1.23	0.80	1.90
Degree	1.35	0.86	2.12	1.36	0.87	2.14
Maternal Social						
Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.98	0.76	1.25	0.99	0.77	1.26
IV & V	1.07	0.68	1.69	1.11	0.71	1.73
Maternal cannabis						
use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.58**	**1.26**	**5.31**	**2.51**	**1.23**	**5.15**
Paternal cannabis						
use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.61**	**1.69**	**4.02**	**2.69**	**1.75**	**4.14**

Appendix 17, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with experimental cannabis use, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables	**0.98**	**0.96**	**0.99**	**0.96**	**0.93**	**0.98**	**0.97**	**0.95**	**0.99**	**0.96**	**0.93**	**0.99**
PCRQ												
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.77**	**0.62**	**0.96**	**0.63**	**0.44**	**0.89**	0.67	0.12	3.73	0.61	0.03	10.69
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	1.01	0.88	1.17	1.01	0.81	1.26	0.72	0.18	2.95	1.02	0.12	8.77
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.00	0.97	1.04	1.00	0.94	1.07
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.01	0.98	1.04	1.00	0.95	1.05
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.90	0.74	1.10				0.90	0.74	1.10

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.86	0.48	1.56	0.86	0.48	1.56
Behavioural	0.98	0.95	1.00	0.98	0.95	1.00
Difficulties						
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	1.05	0.59	1.86	1.05	0.59	1.86
O level	1.29	0.86	1.94	1.29	0.86	1.94
A level	1.22	0.79	1.88	1.22	0.79	1.88
Degree	1.35	0.86	2.12	1.35	0.86	2.12
Maternal Social						
Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.99	0.77	1.27	0.99	0.77	1.27
IV & V	1.09	0.69	1.70	1.08	0.69	1.71
Maternal cannabis						
use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.52**	**1.22**	**5.17**	**2.52**	**1.22**	**5.18**
Paternal cannabis						
use						
No	1.00	(reference)		1.00	(reference)	
Yes	**2.68**	**1.74**	**4.13**	**2.68**	**1.74**	**4.14**

Appendix 18: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with cannabis dependence, analysis 1 through 3, complete case data

Appendix 18, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with cannabis dependence, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	1.01	0.98	1.04	1.05	0.99	1.11						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.46**	**0.28**	**0.77**	**0.26**	**0.07**	**0.89**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.52	0.31	0.87				**0.51**	**0.31**	**0.83**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.40	0.27	7.23				1.08	0.20	5.96
Behavioural Difficulties				1.01	0.95	1.08				1.01	0.95	1.07
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.91	0.17	4.75	1.44	0.31	6.57
O level	1.86	0.59	5.83	1.91	0.62	5.84
A level	0.97	0.28	3.38	1.06	0.32	3.51
Degree	0.93	0.26	3.35	0.89	0.26	3.04
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.57	0.27	1.17	0.67	0.35	1.29
IV & V	1.27	0.38	4.29	1.14	0.35	3.70
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	1.10	0.34	3.51	0.78	0.25	2.42
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	5.00	2.03	12.30	**5.68**	**2.29**	**14.05**

Appendix 18, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with cannabis dependence, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	1.01	0.98	1.05	1.05	0.99	1.11	1.01	0.98	1.05	1.04	0.98	1.10
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.54**	**0.31**	**0.94**	0.45	0.13	1.61	0.49	0.01	43.42	0.00	0.00	1462.84
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.00	0.91	1.11	1.11	0.84	1.48
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.47**	**0.28**	**0.79**				**0.47**	**0.28**	**0.80**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.75	0.12	4.50				0.72	0.11	4.47

Behavioural Difficulties	1.01	0.95	1.08	1.01	0.95	1.08
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.93	0.17	5.05	0.97	0.18	5.29
O level	1.75	0.54	5.62	1.82	0.56	5.89
A level	0.87	0.24	3.10	0.90	0.25	3.21
Degree	0.87	0.24	3.19	0.91	0.25	3.35
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.65	0.31	1.37	0.66	0.31	1.38
IV & V	1.33	0.39	4.57	1.34	0.39	4.61
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	1.10	0.33	3.63	1.09	0.33	3.62
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**4.55**	**1.78**	**11.65**	**4.70**	**1.81**	**12.21**

Appendix 18, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with cannabis dependence, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	1.01	0.98	1.04	1.05	0.99	1.11						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.86	0.65	1.14	0.61	0.36	1.03
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.52	0.31	0.87				**0.51**	**0.31**	**0.83**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				1.40	0.27	7.23				1.20	0.24	6.09
Behavioural Difficulties				1.01	0.95	1.08				1.01	0.95	1.06
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.91	0.17	4.75	1.41	0.32	6.21
O level	1.86	0.59	5.83	2.04	0.68	6.14
A level	0.97	0.28	3.38	1.10	0.34	3.62
Degree	0.93	0.26	3.35	0.91	0.27	3.05
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.57	0.27	1.17	0.65	0.34	1.24
IV & V	1.27	0.38	4.29	1.48	0.48	4.55
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	1.10	0.34	3.51	0.72	0.23	2.24
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	5.00	2.03	12.30	**6.26**	**2.54**	**15.45**

Appendix 18, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with cannabis dependence, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	1.02	0.98	1.05	1.05	0.99	1.12	1.00	0.96	1.05	1.03	0.95	1.11
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.87	0.64	1.19	0.60	0.33	1.08	0.21	0.01	5.55	0.04	0.00	16.86
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.03	0.96	1.11	1.06	0.93	1.21
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.48**	**0.28**	**0.82**				**0.48**	**0.28**	**0.83**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.87	0.16	4.73				0.85	0.15	4.76
Behavioural Difficulties				1.02	0.95	1.08				1.02	0.95	1.08
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.88	0.16	4.78	0.92	0.17	4.99
O level	1.73	0.54	5.50	1.88	0.58	6.06
A level	0.81	0.23	2.89	0.86	0.24	3.07
Degree	0.80	0.22	2.93	0.83	0.23	3.08
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.62	0.30	1.30	0.62	0.29	1.30
IV & V	1.42	0.41	4.89	1.44	0.42	4.95
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	0.98	0.29	3.30	0.99	0.29	3.34
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**5.05**	**1.96**	**13.00**	**5.03**	**1.95**	**12.99**

Appendix 18, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with cannabis dependence, models 1 through 4, complete case data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	1.01	0.98	1.04	1.05	0.99	1.11						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.46**	**0.27**	**0.78**	0.32	0.09	1.13
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.93	0.69	1.24	0.67	0.39	1.15
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				0.52	0.31	0.87				**0.52**	**0.31**	**0.85**

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	1.40	0.27	7.23	0.99	0.18	5.50
Behavioural Difficulties	1.01	0.95	1.08	1.01	0.96	1.07
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.91	0.17	4.75	1.40	0.31	6.36
O level	1.86	0.59	5.83	1.91	0.63	5.83
A level	0.97	0.28	3.38	1.02	0.31	3.40
Degree	0.93	0.26	3.35	0.86	0.25	2.94
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.57	0.27	1.17	0.67	0.35	1.30
IV & V	1.27	0.38	4.29	1.19	0.36	3.87
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	1.10	0.34	3.51	0.73	0.23	2.30
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	5.00	2.03	12.30	**5.90**	**2.37**	**14.69**

Appendix 18, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with cannabis dependence, models 5 through 8, complete case data

	Model 5			**Model 6**			**Model 7**			**Model 8**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	1.02	0.98	1.06	1.04	0.98	1.11	1.00	0.95	1.05	1.02	0.94	1.10
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.53**	**0.30**	**0.95**	0.56	0.15	2.06	0.05	0.00	27.99	0.01	0.00	4325.30
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.92	0.66	1.26	0.63	0.34	1.14	0.13	0.00	4.22	0.05	0.00	22.84
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.05	0.92	1.21	1.10	0.82	1.46
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.04	0.97	1.12	1.06	0.93	1.20
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.48**	**0.28**	**0.82**				**0.49**	**0.28**	**0.83**

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.68	0.11	4.14	0.64	0.10	4.14
Behavioural Difficulties	1.02	0.96	1.08	1.02	0.95	1.08
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.87	0.16	4.72	0.94	0.17	5.09
O level	1.71	0.53	5.45	1.91	0.59	6.17
A level	0.82	0.23	2.93	0.89	0.25	3.17
Degree	0.83	0.23	3.05	0.89	0.24	3.29
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.66	0.31	1.40	0.67	0.31	1.41
IV & V	1.45	0.42	5.03	1.47	0.43	5.09
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	0.97	0.29	3.29	0.97	0.28	3.33
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**4.79**	**1.85**	**12.40**	**4.87**	**1.85**	**12.82**

Appendix 19: Odds ratios and 95% CIs for the association of PCRQ, popular in schools and accepted in school with cannabis dependence, analysis 1 through 3, imputed data

Appendix 19, Table 1: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with cannabis dependence, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	0.99	0.97	1.01	1.00	0.98	1.03						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							**0.60**	**0.38**	**0.96**	**0.54**	**0.33**	**0.87**
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.49**	**0.37**	**0.63**				**0.48**	**0.37**	**0.63**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.53	0.28	1.01				0.53	0.27	1.02
Behavioural				1.03	1.00	1.06				1.03	1.00	1.06
Difficulties												
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.83	0.40	1.71	0.85	0.41	1.77
O level	0.88	0.55	1.43	0.88	0.54	1.43
A level	**0.59**	**0.35**	**0.99**	**0.59**	**0.35**	**1.00**
Degree	0.74	0.42	1.31	0.74	0.41	1.31
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.93	0.64	1.34	0.93	0.64	1.35
IV & V	1.28	0.75	2.20	1.29	0.75	2.23
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.86**	**1.10**	**3.17**	**1.82**	**1.07**	**3.10**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.59**	**1.00**	**2.54**	**1.62**	**1.01**	**2.58**

Appendix 19, Table 2: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools with cannabis dependence, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	0.99	0.97	1.01	1.00	0.98	1.02	0.99	0.96	1.02	1.00	0.97	1.03
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.58**	**0.36**	**0.92**	**0.54**	**0.33**	**0.87**	0.84	0.06	11.59	0.70	0.05	10.54
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.99	0.93	1.05	0.99	0.93	1.06
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.48**	**0.37**	**0.63**				**0.48**	**0.37**	**0.63**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.53	0.28	1.01				0.53	0.28	1.01

Behavioural Difficulties	1.03	1.00	1.06	1.03	1.00	1.06
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.85	0.41	1.77	0.85	0.41	1.77
O level	0.88	0.54	1.44	0.88	0.54	1.44
A level	**0.59**	**0.35**	**0.99**	**0.59**	**0.35**	**1.00**
Degree	0.74	0.41	1.31	0.73	0.41	1.31
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.93	0.64	1.35	0.93	0.64	1.35
IV & V	1.29	0.75	2.24	1.29	0.74	2.23
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.82**	**1.07**	**3.11**	**1.82**	**1.06**	**3.11**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.62**	**1.01**	**2.57**	**1.62**	**1.01**	**2.58**

Appendix 19, Table 3: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with cannabis dependence, models 1 through 4, imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	0.99	0.97	1.01	1.00	0.98	1.03						
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.86	0.65	1.14	0.81	0.61	1.09
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.49**	**0.37**	**0.63**				**0.49**	**0.38**	**0.64**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.53	0.28	1.01				0.53	0.27	1.01
Behavioural				1.03	1.00	1.06				1.03	1.00	1.06
Difficulties												
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.83	0.40	1.71	0.84	0.41	1.73
O level	0.88	0.55	1.43	0.88	0.55	1.43
A level	**0.59**	**0.35**	**0.99**	**0.59**	**0.35**	**1.00**
Degree	0.74	0.42	1.31	0.74	0.41	1.30
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.93	0.64	1.34	0.92	0.63	1.34
IV & V	1.28	0.75	2.20	1.25	0.73	2.14
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.86**	**1.10**	**3.17**	**1.87**	**1.10**	**3.19**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.59**	**1.00**	**2.54**	**1.60**	**1.01**	**2.56**

Appendix 19, Table 4: Odds ratios and 95% CIs for the association of PCRQ, whether participants are accepted in schools with cannabis dependence, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	0.99	0.97	1.01	1.00	0.98	1.03	1.00	0.96	1.03	1.01	0.98	1.04
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.84	0.64	1.12	0.82	0.61	1.09	1.32	0.15	11.24	1.40	0.15	13.34
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.99	0.94	1.04	0.99	0.94	1.04
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.49**	**0.37**	**0.63**				**0.49**	**0.37**	**0.63**
Ethnicity												
White				1.00	(reference)					1.00	(reference)	
Non-white				0.52	0.27	1.00				0.52	0.27	1.00
Behavioural Difficulties				1.03	1.00	1.06				1.03	1.00	1.06
Maternal Education												
CSE				1.00	(reference)					1.00	(reference)	

Vocational	0.83	0.40	1.73	0.83	0.40	1.71
O level	0.88	0.54	1.43	0.87	0.54	1.42
A level	**0.59**	**0.35**	**0.99**	**0.58**	**0.35**	**0.99**
Degree	0.73	0.41	1.30	0.73	0.41	1.29
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.92	0.63	1.34	0.92	0.63	1.34
IV & V	1.25	0.73	2.16	1.25	0.72	2.16
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.88**	**1.10**	**3.19**	**1.88**	**1.10**	**3.19**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.60**	**1.01**	**2.55**	**1.60**	**1.01**	**2.55**

Appendix 19, Table 5: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with cannabis dependence, models 1 through 4, imputed data

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	0.99	0.97	1.01	1.00	0.98	1.03						
Popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.62	0.38	1.01	**0.56**	**0.34**	**0.93**
Accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.94	0.70	1.27	0.90	0.67	1.22
Interaction: PCRQ * popular in school												
Agree												
Disagree												
Interaction: PCRQ * accepted in school												
Agree												
Disagree												
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.49**	**0.37**	**0.63**				**0.48**	**0.37**	**0.63**

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.53	0.28	1.01	0.53	0.27	1.01
Behavioural	1.03	1.00	1.06	**1.03**	**1.00**	**1.06**
Difficulties						
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.83	0.40	1.71	0.85	0.41	1.77
O level	0.88	0.55	1.43	0.88	0.54	1.44
A level	**0.59**	**0.35**	**0.99**	**0.59**	**0.35**	**1.00**
Degree	0.74	0.42	1.31	0.73	0.41	1.31
Maternal Social						
Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.93	0.64	1.34	0.93	0.64	1.35
IV & V	1.28	0.75	2.20	1.28	0.74	2.20
Maternal cannabis						
use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.86**	**1.10**	**3.17**	**1.83**	**1.07**	**3.12**
Paternal cannabis						
use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.59**	**1.00**	**2.54**	**1.62**	**1.02**	**2.58**

Appendix 19, Table 6: Odds ratios and 95% CIs for the association of PCRQ, whether participants are popular in schools, whether participants are accepted in schools with cannabis dependence, models 5 through 8, imputed data

	Model 5			Model 6			Model 7			Model 8		
	OR	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**		**OR**	**(95% CI)**	
Main Variables												
PCRQ	0.99	0.96	1.01	1.00	0.97	1.02	0.99	0.96	1.03	1.01	0.97	1.04
Popular in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	**0.59**	**0.36**	**0.97**	**0.56**	**0.34**	**0.92**	0.69	0.04	10.86	0.53	0.03	9.84
Accepted in school												
Agree	1.00	(reference)		1.00	(reference)		1.00	(reference)		1.00	(reference)	
Disagree	0.92	0.69	1.24	0.90	0.66	1.22	1.56	0.16	14.95	1.81	0.16	20.35
Interaction: PCRQ * popular in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							1.00	0.93	1.06	1.00	0.94	1.07
Interaction: PCRQ * accepted in school												
Agree							1.00	(reference)		1.00	(reference)	
Disagree							0.99	0.94	1.04	0.98	0.93	1.04
Covariates												
Gender												
Male				1.00	(reference)					1.00	(reference)	
Female				**0.48**	**0.37**	**0.63**				**0.48**	**0.37**	**0.63**

Ethnicity						
White	1.00	(reference)		1.00	(reference)	
Non-white	0.53	0.27	1.01	0.52	0.27	1.00
Behavioural Difficulties	1.03	1.00	1.06	1.03	1.00	1.06
Maternal Education						
CSE	1.00	(reference)		1.00	(reference)	
Vocational	0.85	0.41	1.77	0.85	0.41	1.76
O level	0.88	0.54	1.44	0.87	0.53	1.43
A level	**0.59**	**0.34**	**0.99**	**0.58**	**0.34**	**0.99**
Degree	0.73	0.41	1.31	0.73	0.41	1.30
Maternal Social Class						
I & II	1.00	(reference)		1.00	(reference)	
III	0.93	0.64	1.35	0.93	0.64	1.35
IV & V	1.27	0.73	2.21	1.27	0.73	2.22
Maternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.83**	**1.07**	**3.12**	**1.83**	**1.07**	**3.13**
Paternal cannabis use						
No	1.00	(reference)		1.00	(reference)	
Yes	**1.62**	**1.02**	**2.58**	**1.62**	**1.02**	**2.59**