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Women's intentions to use fertility preservation to prevent age-related fertility decline



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Abstract The optimal age to cryopreserve oocytes for later use is before 36 years. Current users are on average 38 years old. In this cross-sectional study an online survey was constructed about the factors associated with the intentions of childless women aged 28–35 years to use fertility preservation (FP). Questions were derived from the Theory of Planned Behaviour (attitudes and subjective norms regarding FP and perceived behaviour control to do FP) and the Health Belief Model (perceived susceptibility of infertility, perceived severity of childlessness, barriers and benefits of FP and cue to use FP). Also addressed were parenthood goals, fertility knowledge and intentions to use FP within 2 years. The data were analysed using structural equation modelling. The Health Belief Model showed a good fit to the data ($\chi^2 [14, n = 257] = 13.63, P = 0.477; CFI = 1.000; RMSEA = .00, 90\% CI [0.00-0.06]$). Higher intentions to use FP were associated with feeling susceptible to infertility, considering FP useful to achieve parenthood, perceiving the implications of infertility as severe, expecting to have children at a later age and having fewer ethical concerns. This suggests an increase of fertility awareness is necessary for the optimal use of FP. 

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Introduction

Recent European data show that women are changing their reproductive behaviour and postponing childbearing (Mills et al., 2011). This has important implications for their fertility status (Dunson et al., 2004). People tend to believe that assisted reproductive techniques will help them to conceive at a later age (Lampic et al., 2006), but research has shown that assisted reproductive techniques can only partially compensate for the fertility decline (Leridon, 2004). Therefore, postponing childbearing is linked to a higher rate of involuntary childlessness and smaller families (Schmidt et al., 2012).

One available option to prevent age-related fertility decline is fertility preservation (FP) via oocyte cryopreservation. This technique allows women to retrieve and cryopreserve oocytes for later use, as an extra possible option to reach parenthood. Financial costs are around £6000 for the oocyte retrieval and £300 per year for storage. However, ovarian ageing causes a decrease in the number and quality of oocytes (Broekmans et al., 2007) and results from a recent meta-analysis suggest that the optimal age to cryopreserve oocytes is before 36 years. This meta-analysis concluded that cryopreservation of oocytes before 36 years had the highest discrimination capability for success versus failure, with an area under the curve (AUC) of 0.72 (Cil et al., 2013). However, studies conducted in Belgium and the US suggest that the average age at which women are currently cryopreserving their oocytes is 38 years (Gold et al., 2006; Mertes et al., 2012; Nekkebroeck et al., 2010). In a survey among 183 patients who did at least one cryopreservation cycle (84% older than 35), 79% indicated that they wished they had undergone FP earlier. Of the women who did an FP cycle, 53% felt more secure about their reproductive future than those who did not cryopreserve their oocytes (Hodes-Wertz et al., 2013). These data suggest that if women are aware of the impact of age on fertility potential they may choose to act sooner to preserve their fertility than they are currently acting.

Several researchers have investigated women's motivations to use FP. The most commonly cited reasons have been the pressure of the biological clock, taking off the time pressure to find the right partner and giving a future relationship more time to develop before parenthood is discussed (Gold et al., 2006; Nekkebroeck et al., 2010). This body of research also showed that a large group of women considered using FP. Two different large surveys ($n > 1000$) with women aged between 20 and 50 indicated that around 31.5% (Stoop et al., 2011) and 34.5% (Daniluk and Koert, 2012) of women considered using FP. In another survey with 234 childless women aged 34 years and older, 46% considered cryopreserving their oocytes (Proodfout et al., 2009). These data indicate a potential demand for FP, but this need is not fully realised. Indeed, of the women who inquire about FP treatment by phone (call centre at Extend Fertility, Boston, USA), only 4% go on to use the technique; and those that do tend to do so at a less than optimal age (i.e. 37.2 ± 2.3 years of age; Sage et al., 2008).

To optimize the appropriate use of FP the factors that predict women's intentions to use it at an optimal age (i.e. under 36 years) should be identified. The paradox is that women cannot be expected to consider using FP before

they consider parenthood in general. On average women in Organisation for Economic Co-operation and Development (OECD) countries have their first child at the age of 28.2 (OECD, 2015). Because social norms influence fertility behaviour (Bernardi, 2003; Mills et al., 2011), it can be expected that childless women will start considering parenthood at about this age. These women are entering the age range when fertility starts to decline, but this decline is not yet too accentuated to prevent the use of FP. As the optimal age to cryopreserve oocytes is before 36 years (Cil et al., 2013), women in the age range 28–35 years are the most suitable candidates for FP. A better understanding of these women's FP knowledge, their views on FP and their intentions to use it may identify motivating factors to inform educational strategies to optimize the use of FP techniques.

Two extensively validated psychological theories are useful to understand women's intentions to use FP: the Theory of Planned Behaviour (TPB) and the Health Belief Model (HBM). A schematic representation of the TPB is presented in Figure 1 (Ajzen and Koblas, 2013). The TPB proposes that individuals will have stronger intentions and be more likely to perform a specific behaviour if they have positive attitudes about it, when they perceive social pressure for them to do the behaviour (subjective norms) and when they feel able to actually perform the behaviour (perceived behavioural control, PBC).

Figure 2 presents a schematic representation of the HBM (Fish Ragin, 2011; Rosenstock, 1974). Similarly to the TPB, the HBM proposes that individuals will be more likely to perform specific health behaviour if they do not face barriers and expect benefits from performing the behaviour. However, the HBM differs from the TPB because it also proposes that, to implement the behaviour, people need to feel susceptible to a specific associated health risk (perceived susceptibility) and perceive the consequences of that health risk to be severe (perceived severity). Furthermore, the HBM also postulates that specific cues can trigger the individual to do the behaviour (cues to action). In summary, the HBM differs from the TPB in that it also contemplates the level to which individuals assess risk to decide if they need to perform the behaviour. Finally, both models take into account individual differences (e.g. socio-demographic factors and parenthood plans), which are expected to influence behaviour via their effect on the models' theoretical variables.

The aim of this research project was to use the TPB and the HBM to explain the intentions of childless women aged 28 to 35 to use FP within the next 2 years to prevent age-related fertility decline. An online survey was developed to assess intentions to use FP, the theoretical variables of the TPB and the HBM and other relevant individual factors (e.g. socio-demographic and parenthood goal variables). The relevance of these factors and decisional stage has been highlighted by the theories. In addition the study was also interested in assessing women's fertility knowledge, as it affects reproductive decision-making. It was postulated that both models would account for intentions to use FP, but that the HBM would have more explanatory power than the TPB because it includes the perceived threat of infertility (the combination of perceived susceptibility and perceived severity).

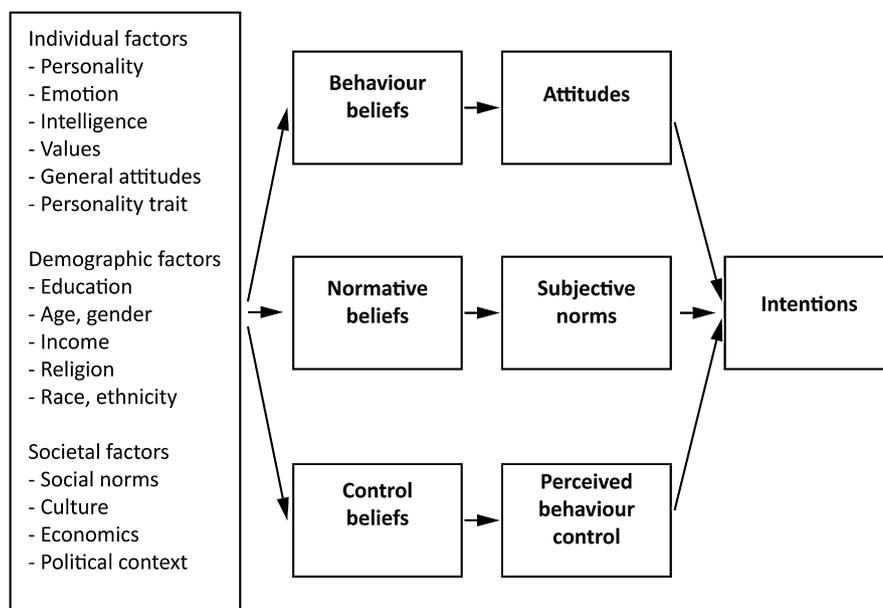


Figure 1 Theory of Planned Behaviour (adapted from Ajzen and Koblas, 2013).

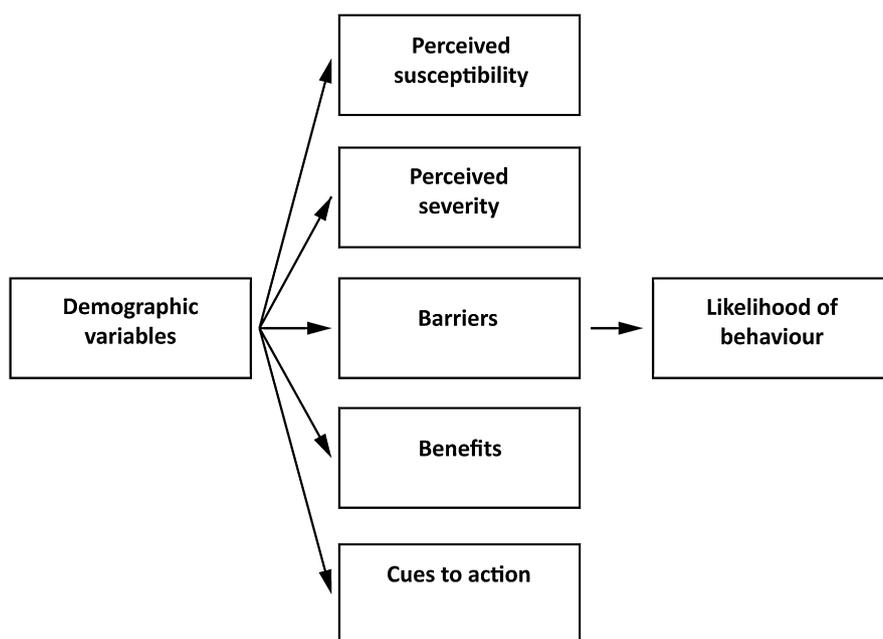


Figure 2 Health Belief Model (adapted version Fish Ragin, 2011).

Materials and methods

Participants

Eligible participants were childless women aged 28–35 years old who wished to have children. Exclusion criteria were currently trying to conceive or currently pregnant, having a disease or condition that affects fertility (e.g. polycystic ovary syndrome; cancer treatment in the past) and having undergone FP in the past. If the woman had a partner, an additional exclusion criterion was the partner having a disease or condition that affects fertility. This was to ensure that in-

tentions to use FP were not influenced by a higher susceptibility to infertility due to existing health problems from self or partner.

The survey

The Cardiff fertility preservation survey was organized in multiple sections that assessed individual factors (socio-demographic variables, parenthood goals and fertility knowledge), the decisional stage women were at concerning the use of FP, their intentions to use FP and the

variables of the TPB and the HBM. All three authors contributed to the design of the survey, which was extensively discussed at several work-meetings. The survey encompassed questions already used in previous research by the Cardiff Fertility Studies Group and proved valid and reliable, and questions built following established guidelines to formulate questions for the TPB. To ensure that all participants had the same basic knowledge that would allow them to answer questions, a brief objective description of FP was provided at the start of the survey. The survey was posted online using Qualtrics software (Qualtrics, 2013; USA).

Individual factors

Socio-demographic variables

Participants {XE 'Participants'} were asked about their age, if they were in a relationship, if they lived together with their partner (these last two variables were combined in a new variable 'in an intimate relationship and living together': 1 = yes and 0 = no), how long they were in that relationship and lived together in years, their sexual orientation (heterosexual; bisexual; lesbian), employment status (employed; unemployed or other) and level of completed education (no university education; university education).

Parenthood goals

Participants {XE 'Participants'} were asked about their desire to have children in the future (e.g. 'How strong is your desire to have a child? By desire we mean your wish for a child', 1 = no desire at all to 10 = very strong desire) and their intentions to have biological children (e.g. 'Do you intend to have biological children in the future? (By biological we mean genetically your own)', 1 = not at all to 7 = very much). These questions were based on unpublished research from our department (Fulford, 2014, unpublished doctoral dissertation). Women were also asked about the age they intended and expected to have their first and last child (in years), how many children they intended to have and if they considered other options beyond biological parenthood to have children (yes: adoption, fostering, stepchildren, other; no).

Fertility knowledge

Participants {XE 'Participants'} were asked six questions about fertility. Three questions focused on general fertility knowledge (e.g. 'A woman is less fertile after the age of 36 years', 'For women over 30, overall health and fitness level is a better indicator of fertility than age' and 'These days a woman in her 40s has a similar chance of getting pregnant as a woman in her 30s', 1 = true, 2 = false and 3 = I do not know) and three questions were FP-specific (e.g. 'Frozen eggs are guaranteed to result in pregnancy in the future', 'In order to collect enough eggs for freezing women receive daily injection of female hormones' and 'The ideal age to freeze eggs is after the age of 35 years', 1 = true, 2 = false and 3 = I do not know). Questions were based partly on the IFDMS study (Bunting et al., 2013) and partly on the FAS study (Daniluk et al., 2012). Correct answers were coded as 1 and incorrect or 'don't know' answers were coded as 0. The scores of the six questions were summed into a score varying from 1 to 6, with higher values indicating higher fertility and FP knowledge.

Decisional stage

To assess the decisional stage women were at concerning the use of FP, the study used the 'Stage of Decision Making questionnaire' (O'Connor, 2000). This stated 'Women can decide whether they want to use FP at different times in their lives. At this time, would you say you: (1) 'haven't begun to think about the choices'; (2) 'haven't begun to think about the choices, but am interested in doing so'; (3) 'are considering the option now'; (4) 'are close to selecting an option'; (5) 'have already made a decision, but am willing to reconsider'; and (6) 'have already made a decision and am unlikely to change my mind' '. Women had to choose one of these options.

Intentions to use fertility preservation

The main outcome considered was intention to use FP within the next 2 years ('I intend to use FP within the next two years to prevent age-related fertility decline', response scale 1 = extremely unlikely to 7 = extremely likely). This question was developed following the guidelines provided in the TPB manual (Ajzen, 2006). Higher values indicated a stronger intention to use FP within 2 years.

Variables of the theory of planned behaviour and the health belief model

Questions were developed to access the main constructs of the TPB (Ajzen, 1985) in the context of FP using the guidelines provided in the TPB manual (Ajzen, 2006). Attitudes were assessed with two questions about whether women thought the use of FP within 2 years was good and pleasant (e.g. 'Freezing my eggs within the next two years to prevent age-related fertility decline would be', response scale 1 = extremely bad to 7 = extremely good). The scores were averaged to create an overall 'Attitude' score, with higher values indicating more positive attitudes. Subjective norms were assessed with three questions about what women think their friends, partner and the women like them, respectively, think about them using FP (e.g. 'Close friends and family approve of my using FP within the next two years to prevent age-related fertility decline', 1 = strongly disagree 7 = strongly agree). The scores were averaged to create an overall 'Subjective Norms' score, with higher values indicating greater pressure from significant others. 'Perceived Behaviour Control (PBC)' was assessed with two questions about how confident women felt to use FP and whether the decision was up to them (e.g. 'I am confident that if I want, I would be able to use FP within the next two years', 1 = definitely false to 7 = definitely true). The scores were averaged to create an overall PBC score, with higher values indicating higher PBC. The internal reliability (standardized Cronbach Alpha coefficient) was 0.83 for Attitudes, 0.70 for Subjective Norms and 0.65 for PBC.

Questions were also developed to assess the main variables of the HBM. 'Perceived Susceptibility' was assessed with four questions about how susceptible women think they are to be biologically infertile and how susceptible to infertility women are in general (e.g. 'In general, how likely do you think

you/other women your age are to be biologically infertile', response scale 1 = extremely unlikely to 7 = extremely likely). These questions were based on IFDMS-study of the Cardiff Fertility Studies Research Group (Fulford et al., 2013). Two questions were included about their current situation and two questions about their predicted situation in 2 years. The scores were averaged to create an overall perceived susceptibility score, with higher values indicating higher perceived susceptibility. 'Perceived Severity' was assessed with three new developed questions (e.g. 'I can accept a life without biological children', 'Women without children are just as happy as those with children', 'A future without a child would frighten me', 1 = strongly disagree to 7 = strongly agree). The scores were averaged to create an overall 'Perceived Severity' score, with higher values indicating higher perceived severity. The internal reliability (standardized Cronbach Alpha coefficient) was 0.86 for 'Perceived Susceptibility' and 0.74 for 'Perceived Severity'. Finally, a cue to action (trigger to use FP) was the age at which women expected to have their first child.

FP beliefs were also assessed as these are expected to influence attitudes and perceived behaviour control according to the TPB (see Figure 1) and the barriers and benefits according to the HBM (see Figure 2). Women indicated their agreement with 16 statements about FP (1 = disagree, 7 = agree). These questions were developed based on published (Fulford et al., 2013) and unpublished (Fulford, 2014, unpublished doctoral dissertation) qualitative research conducted by the Cardiff Fertility Studies Research Group about FP. There were 11 negative statements (e.g. 'the technique goes against nature', 'the technique is very expensive', 'not having the considerable knowledge about the technique') and five positive ones (e.g. 'the procedure is a useful technique to postpone childbearing', 'most women eventually get pregnant after FP'). A principal axis factor analysis with varimax rotation was conducted to investigate if the 16 statements would group into common factors. Four factors were extracted with eigenvalues over 1, which explained 62.61% of the total variance. From these, two factors proved satisfactorily reliable and were retained. The two factors were labelled 'Behaviour/control beliefs-Ethical concerns' and 'Behaviour/control beliefs-Usefulness'. 'Behaviour/control beliefs-Ethical concerns' contained three beliefs (e.g. 'FP is morally and ethically wrong', 'FP goes against nature' and 'FP has negative effects on the child's health', $\alpha = 0.76$). 'Behaviour/control beliefs-Usefulness' contained three beliefs (e.g. 'FP reduces the pressure for me to have children', 'FP is a useful technique to postpone childbearing' and 'FP increases my chances of having biological children', $\alpha = 0.66$). [Supplementary Table S1](#) shows the loadings after rotation, descriptive statistics and internal reliability for the four extracted factors.

Procedure

The Ethics committee of the School of Psychology at the University of Cardiff approved the study on 29 April 2014. The survey was posted online from the 9 of May 2014 until the 15 of June 2014. Multiple recruitment strategies were used. For university recruitment, 483 heads of departments in 23 universities (United Kingdom, USA and Canada) were contacted by email and asked to send an invitation letter with

information about the project and a direct link to the survey to their staff and postgraduates. Universities within the USA and Canada were also contacted to get as many participants as possible. Within Cardiff University a message with the direct link to the survey was also posted on the digital noticeboard. An invitation letter with a direct link to the survey was also sent to all 122 eligible women aged 28-35 in the Cardiff University community research panel members. Social media recruitment included posting messages on 69 different female-orientated Facebook pages (e.g. LGBT, dating, fertility and magazines) and posting a message with a direct link to the survey at Google+ and Twitter. Advertisements at Google and Facebook were also paid for. The advertisement consisted of a small information message with a direct link to the survey. The Google advert ran for three days and the Facebook advert ran for 10 days. Seven female communities (e.g. women networks, LGBT networks) were contacted with a gatekeeper letter that asked for an invitation letter to be distributed among the community members or to post a message on their social media page. The administrators of 13 private fertility clinics and websites from the United Kingdom and United States were contacted and asked whether it was possible to post a message with a direct link to the survey on their website. Finally, a message with information about the project and a direct link to the survey was posted at three experiment websites.

Statistical analysis

The data were analysed using the Statistical Package for Social Sciences version 20 (IBM Corp, 2011; USA) and Amos Graphics version 22 (IBM Corp, 2013; USA). First, descriptive statistics were performed to describe individual factors (socio-demographic variables, parenthood goals and fertility knowledge), decisional stage, intentions to use FP to prevent age-related fertility decline and the variables of the TPB and HBM. Pearson correlations were used to investigate associations between women's parenthood goals and intentions to use FP.

Path analyses were computed using Structural Equation Modelling (SEM) to test the predictive power of the TPB and HBM on intentions to use FP. First, correlations were calculated to investigate associations between individual factors and the variables of the two theories. Individual factors were chosen based on the theories. For the TPB these were age, university education, being in an intimate relationship and cohabiting, intentions to have biological children, expected age to have first child, fertility knowledge and beliefs about FP (behaviour/control beliefs-ethical concerns and behaviour/control beliefs-usefulness). For the HBM the same individual factors were used, however expected age to have the first child was considered as a cue to action and behaviour/control beliefs-ethical concerns and behaviour/control beliefs-usefulness as barriers and benefits, respectively. One SEM model was then tested for each theory (see [Supplementary Figures S1 and S2](#)). These included all theory relevant variables and the individual factors that were found to be significantly associated with at least one variable of the theory ($P < 0.05$). In order to develop a better fitting final model, individual factors that had no significant associations with the main theory variables in the initial models were removed in subsequent models. Model fitness was assessed with the χ^2

statistics, Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA) (Byrne, 2010). Model fitness was considered good when the χ^2 was not significant, the CFI was ≥ 0.90 , and the RMSEA was below 0.10 (Kline, 2005).

Results

The final sample for this study consisted of 257 women. One hundred and thirty four heads of departments (28% of those contacted) replied to the gatekeeper letter and 68 (14% of those contacted) agreed to send the invitation to their staff and postgraduates. Of the seven communities contacted, three LGBT-groups and one women's network responded. They all agreed to post an advert of the project on their website or newsletter or to send an invitation email to their members. Of the 13 fertility clinics and websites, two clinics' and three websites' administrators replied. No clinic was able to help with the recruitment. Two fertility website administrators posted the information and link to the survey on their website or social media.

Due to the recruitment procedures it is impossible to calculate the response rate. The survey included a question where women could indicate how they found out about the survey. In total, 191 (75.5% of respondents) women found out about the survey through an email from their university or the noticeboard, 25 (9.9%) via social media, one (0.4%) via Google, four (1.6%) through the community panel, two (0.8%) via an advertisement on a website and 30 (11.9%) via other ways (e.g. via friends and colleagues).

Of a total of 399 participants who answered the survey, 128 were excluded because they either did not meet at least one of the inclusion criteria or did not answer all the inclusion criteria questions. 271 participants met the inclusion criteria. From these, 257 participants (64% of total participants) completed the main outcome variable of intentions to use FP within the next 2 years to prevent fertility decline and were therefore included in the final sample.

Individual factors

Women's socio-demographic characteristics are shown in Table 1. Women were on average 31 years old, the majority were in a relationship, considered themselves to be heterosexual, were employed, had a university education and were resident in the UK.

Women's parenthood goals are presented in Table 2. On average, women wanted to have two children. The average ages at which women intended and expected to have their first child were 33.1 and 34.4, respectively. As shown in Table 2 there is a significant difference between the intended and expected age to have their first child, between the intended and expected age to have their last child and the difference between the expected age to have their first and last child (all $P < 0.001$). Also the difference between the intended age to have their first child and their current age and the difference between the expected age to have their first child and their current age was significant (both $P < 0.001$).

From the parenthood goals listed above, only two were significantly associated with women's intentions to use FP. The

Table 1 Sample socio-demographics characteristics.

Demographic data		
Age in years (mean \pm SD)	$n = 257$	30.6 ± 2.3
Age category n (%)	$n = 257$	
28-31 years		168 (65.4)
32-35 years		89 (34.6)
In intimate relationship n (%)	$n = 256$	185 (72.3)
Duration of relationship in years (mean \pm SD)	$n = 184$	4.6 ± 3.5
In intimate relationship and living together n (%)	$n = 256$	131 (51.2)
Sexual orientation n (%)	$n = 257$	
Heterosexual		235 (91.4)
Lesbian		5 (1.9)
Bisexual		17 (6.6)
Employed n (%)	$n = 257$	175 (68.1)
University education n (%)	$n = 256$	237 (92.6)
UK-resident n (%)	$n = 206$	175 (85.0)

later women expected to have their first ($r = 0.19$, $P = 0.003$) and last child ($r = 0.14$, $P = 0.037$), the stronger their intentions to use FP.

On average women scored 4 points on fertility knowledge (mean = 3.5, SD = 1.4, [0-6] $n = 239$). Regarding women's decisional stage ($n = 252$), 49.2% of the women had not thought about the choice to preserve their oocytes. Another 35.7% had not thought about the choice to preserve their oocytes, but were interested to consider FP. At the moment of the survey 8.3% were considering the option of using FP, 2% were close to making a decision, 2.4% had made their decision, but were willing to consider FP and another 2.4% had made their decision and were unlikely to change their mind.

Women's intentions to do FP

The overall intentions to use FP to prevent age-related fertility decline within 2 years (mean = 2.5, SD = 1.5 [1-7] $n = 257$) and at some point in the future (mean = 3.0, SD = 1.6 [1-7] $n = 255$) were low.

Variables of the TPB and HBM

TPB

Positive attitudes about the use of FP to prevent age-related fertility decline were moderate (mean = 4.1, SD = 1.5 [1-7] $n = 257$). Subjective norms were moderate (mean = 3.8, SD = 1.3 [1-7] $n = 255$) and PBC was moderate to high (mean = 4.6, SD = 1.4 [1-7] $n = 257$).

HBM

Women felt moderately susceptible to infertility (mean = 3.1, SD = 1.2 [1-7] $n = 239$) and perceived the severity of its consequences as moderate (mean = 3.8, SD = 1.5 [1-7] $n = 242$). As mentioned, expected age to have a first child was used as a cue to action. On average women expected to have their first child at 34.4.

Table 2 Women’s parenthood goals (*n* = 257).

	Mean ± SD [range]	
Desire to have children [scale 1-10]	7.4 ± 2.1 [2-10]	
Intention to have biological children [scale 1-7]	6.0 ± 1.2 [2-7]	
Number of children wanted	2.1 ± 0.7 [1-4]	
Age to have first biological child, in years	Intended 33.1 ± 2.9 [25-44]	Expected 34.4 ± 2.7 [24-44]
Age to have last biological child, in years	Intended 36.6 ± 2.9 [30-46]	Expected 37.6 ± 2.9 [30-46]
Difference in intended age to have first child and expected age to have first child, in years.	Mean ± SD [range] 1.3 ± 2.2 [-10,10]	Paired <i>t</i> -test <i>t</i> (255) = 9.27, <i>P</i> < 0.001
Difference in intended age to have last child and expected age to have last child, in years.	1.1 ± 2.0 [-6,10]	<i>t</i> (213) = 7.42, <i>P</i> < 0.001
Difference in intended age to have first child and current age, in years.	2.5 ± 2.6 [-7,12]	<i>t</i> (256) = 15.84, <i>P</i> < 0.001
Difference in expected age to have first child and current age, in years.	3.8 ± 2.2 [-9,12]	<i>t</i> (255) = 27.60, <i>P</i> < 0.001
Difference in expected age to have last child and expected age to have first child, in years.	3.5 ± 1.8 [0,10]	<i>t</i> (215) = 27.70, <i>P</i> < 0.001

Beliefs about FP

On average women did not have many ethical concerns about using FP (mean = 2.3, SD = 1.3 [1-6.33] *n* = 244) and considered that FP is a useful technique (mean = 4.6, SD = 1.3 [1-7] *n* = 244).

Preliminary correlation analysis between individual factors and beliefs about FP and the variables of the TPB and HBM

Table 3 shows the correlation between the individual factors and beliefs about FP and the variables of the TPB and HBM.

There was a significant positive correlation between age and attitude (*r* = 0.18, *P* ≤ 0.01, *n* = 257), age and subjective norms (*r* = 0.22, *P* ≤ 0.01, *n* = 255) and age and PBC (*r* = 0.15, *P* ≤ 0.05, *n* = 257). Education was negatively associated with subjective norms (*r* = -0.13, *P* ≤ 0.05, *n* = 254) and PBC (*r* = -0.13, *P* ≤ 0.05, *n* = 256). A higher expected age to have biological children was positively associated with a positive attitude towards FP (*r* = 0.15, *P* ≤ 0.05, *n* = 255) and more subjective norms (*r* = 0.13, *P* ≤ 0.05, *n* = 253). The associations found indicate that the age, university education and the expected age to have their first child were related with the variables of the TPB and should therefore be included in the path-analysis. In addition, the two factors that capture behaviour/control beliefs-ethical concerns and behaviour/control beliefs-usefulness were also included. More ethical concerns were associated with a more negative attitude toward FP (*r* = -0.31, *P* ≤ 0.01, *n* = 244) and less subjective norms (*r* = -0.34, *P* ≤ 0.01, *n* = 242). For those participants who thought FP was useful, the attitude toward FP (*r* = 0.50, *P* ≤ 0.01, *n* = 244), the subjective norms (*r* = 0.33, *P* ≤ 0.01, *n* = 242) and the PBC (*r* = 0.28, *P* ≤ 0.01, *n* = 244) were higher.

For the HBM variables, significant positive associations were found between age and perceived susceptibility (*r* = 0.41, *P* ≤ 0.01, *n* = 239) and age and cues to action (expected age to have your first child) (*r* = 0.62, *P* ≤ 0.01, *n* = 255) and nega-

tive association between age and perceived severity (*r* = -0.16, *P* ≤ 0.05, *n* = 242). Being in an intimate relationship and cohabiting was negatively associated with the cue to action (expected age to have your first child) (*r* = -0.18, *P* ≤ 0.01, *n* = 254). The intention to have biological children was positively associated with perceived severity (*r* = 0.43, *P* ≤ 0.01, *n* = 241) and negatively with the cue to action (expected age to have your first child) (*r* = -0.37, *P* ≤ 0.01, *n* = 254). Fertility knowledge was associated with less ethical concerns (*r* = -0.16, *P* ≤ 0.05, *n* = 234). Therefore, age, being in an intimate relationship and cohabiting, the intention to have biological children and fertility knowledge were included in the postulated HBM model.

Model testing

Supplementary Figure S1 shows the initial TPB postulated model tested. The model showed poor fit, χ^2 (8, *n* = 257) = 97.06, *P* < 0.001; CFI = 0.83; RMSEA = 0.21 (90% confidence interval [CI] 0.17-0.25). University education and expected age to have their first child were removed because they were not associated with any of the theory variables. **Supplementary Figure S2** shows the standardized regression weights for the final TPB model. Despite all postulated associations but one being significant, the final model showed an even poorer fit to the data, χ^2 (6, *n* = 257) = 94.31, *P* < 0.001; CFI = 0.78; RMSEA = 0.24 (90% CI 0.20-0.28). Because the model had poor fit, significant associations will not be described here.

Supplementary Figure S3 shows the initial HBM postulated model tested and **Figure 3** the final model retained. This model showed a good fit to the data χ^2 (14, *n* = 257) = 13.63, *P* = 0.477 significant; CFI = 1.000; RMSEA = 0.00 (90% CI 0.00-0.06). All the variables had a significant association with one of the constructs of the HBM. In this model, individual factors were associated with intentions to do FP via perceived susceptibility, perceived severity and the cue to action (expecting to have children at a later age). More precisely, older women reported less ethical concerns (β = -0.13, *P* < 0.05), expected to have their first child at a later age (β = 0.39,

Table 3 Correlations between individual factors and beliefs about fertility preservation and the variables of the TPB and HBM ($n = 257$).

	Theory of Planned Behaviour				Health Belief Model			
	Attitude	Subjective Norms	Perceived behaviour control	Behaviour/control beliefs-Ethical concerns	Behaviour/control beliefs-Usefulness	Perceived Susceptibility	Perceived Severity	Cue to action-Expected age to have first child
Age of Woman	0.18**	0.22**	0.15*	-0.12	-0.02	0.41**	-0.16*	0.62**
University degree	-0.10	-0.13*	-0.13*	0.06	-0.08	-0.12	0.04	-0.02
In an intimate relationship and cohabiting	-0.05	0.02	-0.04	0.07	-0.02	0.12	0.01	-0.18**
Intention to have biological children	0.05	0.01	-0.02	0.00	0.03	-0.11	0.43**	-0.37**
Expected age to have first child	0.15*	0.13*	0.10	-	-	-	-	-
Fertility knowledge	0.03	0.08	-0.02	-0.16*	-0.04	0.05	0.00	-0.07
Behaviour/control beliefs - Usefulness	0.50**	0.33**	0.28**	-	-	-	-	-
Behaviour/control beliefs-Ethical concerns	-0.31**	-0.34**	-0.08	-	-	-	-	-

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

$P < 0.001$) and felt more susceptible to infertility ($\beta = 0.59$, $P < 0.001$). Women with higher intentions to have biological children reported higher perceived severity ($\beta = 0.42$, $P < 0.001$) and expected to have children at a younger age ($\beta = -0.25$, $P < 0.001$). Cohabiting women expected to have their first child at a younger age ($\beta = -0.20$, $P < 0.001$). And finally, women with more fertility knowledge tended to have less ethical concerns about FP ($\beta = -0.17$, $P < 0.05$). The variables of the HBM were all significantly associated with women's intentions to use FP within the next 2 years, the strongest associations being for perceived susceptibility and behaviour/control beliefs - usefulness. Women with less ethical concerns ($\beta = -0.11$, $P < 0.05$), who felt the technique was useful ($\beta = 0.29$, $P < 0.001$), who felt more susceptible to infertility ($\beta = 0.29$, $P < 0.001$), who perceived infertility as severe ($\beta = 0.18$, $P < 0.05$) and/or expected to have their first child at a higher age ($\beta = 0.14$, $P < 0.05$) had higher intentions to use FP.

Discussion

The women in this study had low intentions to use FP, despite being childless, wanting to have biological children and being in the age range when fertility starts to decline. The low intentions to use FP do not seem to be related with negative attitudes about FP, a lack of acceptance from significant others or not feeling able to use it. Rather, low intentions were related to a lack of need for the technique due to low perceived susceptibility to fertility problems. These results support this studies hypothesis that the HBM is a good model to explain intentions to use FP. Considering the late and short childbearing window women give themselves to achieve their parenthood goals (34.4 to 37.6, i.e. around 3 years to have on average two children) this lack of perceived susceptibility to infertility may be overly optimistic, especially since this window is already in a period of moderate to fast reproductive decline. Healthcare professionals and policy makers should focus on increasing fertility awareness and supporting women to delineate realistic plans to achieve their parenthood goals, for instance via educational campaigns or at family planning consultations.

Overall, women reported low intentions to use FP. In previous studies the proportion of women considering using FP was 31.5%–46% (Daniluk and Koert, 2012; Proodfout et al., 2009; Stoop et al., 2011). However, in these studies the participants were in a wider age-range (20–50 years), than in this current study, and some are at risk to be infertile due to age-related fertility loss. The low intentions seem to be related with three main issues that cannot be dissociated: failure to consider the use of FP, lack of perceived susceptibility to infertility and defining overly optimistic parenthood goals.

The data show that most women had not really engaged in a decision-making process about using FP. In total 85% of the women had not thought about it and only 4.8% had actually made a decision. Therefore, the low intentions reported do not result from a careful consideration followed by rejection of FP but rather from not considering it at all. It may be that women were not aware of the existence of FP or did not have enough knowledge about it. However, data from this study show that they have reasonable fertility

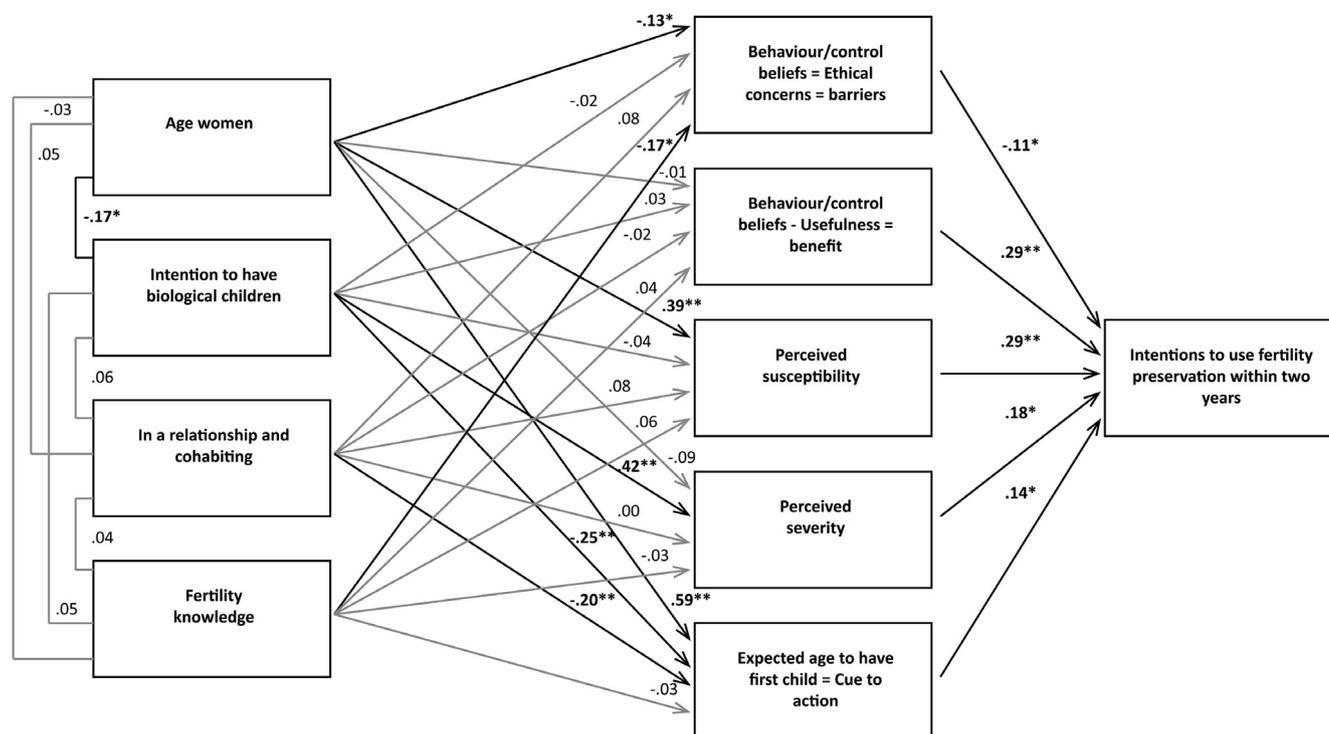


Figure 3 Final structural equation modeling (SEM)-model for the Health Belief Model. Black arrows represent significant standardized regression weights ($P < 0.05$). Grey arrows represent non-significant regression weights. * $P < 0.05$, ** $P < 0.001$.

knowledge. Another explanation is that they may have known about it but never considered using it. This is in line with work that tries to explain the diffusion of innovations. According to Rogers, the first stage of diffusion happens when individuals know about the technology but have not been inspired to get more precise information (Rogers, 1962). They may also be relying on artificial reproductive techniques with fresh oocytes as the solution to overcome eventual fertility problems. Daniluk et al. showed in a survey with 2000 childless women that they thought the upper limit to be assisted in becoming pregnant was 45 years old (Daniluk and Koert, 2012). However, as was pointed out in the introduction, this is not a plausible solution due to the inability of assisted reproductive techniques to compensate for age-related fertility decline (Leridon, 2004).

Results from the application of the TPB and the HBM suggest that women did not intend to use FP because they did not feel susceptible to infertility and did not consider childlessness as a severe consequence. Nonetheless, older women felt more susceptible and had higher intentions to use FP. In general, women seem to know that fertility declines with age (Bunting et al., 2013). This is also shown by our HBM model, as the older the women are, the more susceptible they feel to infertility. Although their knowledge is reasonable, it may lack precision, about fertility decline and the success rates of FP. This may explain why currently women are cryopreserving their eggs too late (around 38 years). They may only feel susceptible to infertility at this age and not realize that at that time FP success rates are not optimal. Women should be informed that the best age for oocyte preservation refers to the fertilizability of the oocytes (i.e. before 36) and not the imminent lack of fertility.

The women in this studies sample also seem to have set for themselves overly optimistic parenthood goals. On average women intended to have their first child at 33 but expected it to only happen at 34, suggesting they already knew the intention was optimistic. Considering that pregnancy takes 9 months then women are giving themselves a 6–7 months safety interval to get pregnant. According to Leridon’s estimates, around one third of these women ($n \approx 86$ in this sample) would not be able to conceive in the first year of trying (Leridon, 2004). A further 56% of these women ($n \approx 48$) would do fertility treatment (Boivin et al., 2007) and their cumulative success rates would not be higher than 25% (Leridon, 2004). The scenario will be worse in relation to their last child. Overall, these data suggest that, although women do wish to have children, their actual goals and planning are not adequately informed to meet those goals. More specifically, the data suggest that many women lack precision in their knowledge about the relationship between age and this reflects in the lack of a feasible parenthood plan. According to psychological theories, the lack of a feasible plan suggests that these women are not sufficiently engaged with their parenthood goals (Heckhausen et al., 2010). A higher level of engagement would lead to greater knowledge and the awareness that such goals are overly optimistic. However, it can also be that precise knowledge about age and fertility is not easily accessible or not provided in a useful way for parenthood decision-making. For instance, information about fertility risk factors is usually provided in a general way and not personalized to the individual, despite the fact that research has shown that focusing on personal risk is more effective to promote change (Fischhoff et al., 1993; Greening et al., 2005) and that there are now available

evidence-based tools to help women to get personal fertility guidance (e.g. FertiSTAT, (Bunting and Boivin, 2010)). These data also show the relevance of providing family planning for young adults that involves value and preference clarification about future parenthood goals, as we argued elsewhere (Boivin et al., 2013) and which positive impact seems promising (Stern et al., 2013).

In conclusion, this studies results highlight a lack of perceived susceptibility and perceived severity to infertility and childlessness that needs to be addressed. Healthcare workers need to prompt women to think realistically about their parenthood goals and how they are going to achieve them. Campaigns may want to target women in our sample age range, as younger women may not yet be responsive and older women may already not benefit from it. Indeed, women's actions should be based more on clear pre-defined plans rather than as a last option response, as currently happens with FP. For instance, the data suggest that most women in this studies sample should at least consider FP to ensure that they can give birth to their last child, but that is not the case. It could be useful for women deciding about the use of FP if they could apply information about pregnancy rates to their own situation to model different possible scenarios (e.g. having children earlier, doing FP at different ages, no use of FP and use of assisted reproductive techniques if needed).

This was an online research project focusing on 257 childless women aged 28–35 who want to have children. It is always challenging to recruit people who are outside the medical system and the use of a restricted age range and exclusion criteria made it even more challenging. The women recruited profile the ideal candidate for successful use of FP. However, as is usually the case with online surveys, response rates could not be calculated (it was impossible to know how many women were reached). Therefore it is unclear if the sample is representative of all women in this situation. In particular, most women in this study were employed and highly educated. In the United Kingdom 93.1% of the women had an academic education, in Canada 75% and in the United States 100%. While this means that fertility knowledge and PBC (e.g. financial resources) may have been overestimated, this is the socio-demographic profile of FP users. It should also be noted that many participants might never have heard or thought about FP before taking part in the study. This study was precisely interested in evaluating this but, to ensure that all participants had the same basic knowledge that would allow them to answer questions, a brief objective description of FP was provided at the start of the survey. Around 72% of the women in this study were in an intimate relationship. Because having a partner is associated with a younger expected age to have a first child and lower intentions to use FP, the low percentage of single women might have led to an underestimation of the intention to use FP. Finally, another limitation is that the study focused on intentions to use FP and not on actual behaviour. A meta-analysis about the TPB indicates that the association between intentions and behaviour is moderate, ranging from 0.44 to 0.47 (Armitage and Conner, 2001). Research on FP also shows that intentions do not necessary translate into behaviour. Therefore, future research should strive to predict actual behaviour.

To conclude, women are not considering using FP because they do not feel the threat of infertility. Healthcare professionals and policy-makers should focus on providing accurate and useful information for women to delineate accurate plans about their reproductive behaviour. The decision to use FP should be made in the context of a broader decision-making process whereby women consider different feasible plans to achieve their desired parenthood goals.

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Appendix: Supplementary material

Supplementary data to this article can be found online at doi:10.1016/j.rbmo.2015.10.007.

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