Cakes in plastic: a study of implicit associations of compostable bio-based *versus* plastic food packaging

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Please accepted for publication in:

Koenig-Lewis, N., Grazzini, L., & Palmer, A. (2021) "Cakes in plastic: a study of implicit associations of compostable bio-based versus plastic food packaging", Resources, Conservation and Recycling, Special Issue 'Consumers' role in addressing plastic pollution'

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Abstract

This paper explores the disjuncture between consumers' expressed preferences for ecologically benign packaging and their subsequent purchase decisions. We investigate consumers' attitudes towards compostable bio-based food packaging, in contrast to fossil-based plastic packaging, framing our study within analysis of implicit attitudes. We address a gap in knowledge about the moderating effects of consumers' reported health consciousness on the relationship between implicit health associations with compostable packaging and subsequent purchase intentions. Specifically, across four studies employing Implicit Associations Tests (IATs), we analyse the relationship between implicit and explicit attitudes, relating packaging associations with consumers' behavioural intentions. Our findings confirm positive implicit (and explicit) perceptions of compostable bio-based packaging (vs. fossil-based plastic) regardless of the healthiness of the food contained. This is reflected in consumers' purchase intentions. We build on this to incorporate the effects of consumers' self-reported health consciousness. We find that low health-conscious consumers are more likely to be guided in their compostable packaging decisions by their unconscious and automatic health-packaging associations, than consumers with high health consciousness. We contribute to policy discussion about effective ways of reducing fossil-based plastic packaging use and note that environmental claims for non-plastic alternatives aimed at consumers with low-health consciousness should make appeals based on health benefits, tapping into implicit attitudes to evoke automatic responses.

Keywords: food packaging, compostable bio-based, plastics, attitudes, implicit association test, healthiness

Highlights

1. Empirical study examines implicit attitudes towards compostable bio-based packaging
2. Compostable packaging perceived as positive and healthy regardless of food content
3. Implicit and explicit attitudes predict purchase intentions of compostable packaging
4. Health consciousness moderates link between implicit health associations and intention
5. Less health-consciousness consumers guided by implicit health-packaging associations

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1. Introduction

There is now a consensus that the manufacture and disposal of plastics can be associated with ecological harm (European Commission, 2018; Heidbreder et al., 2019). Packaging is estimated to account for about 40 percent of plastic use (PlasticsEurope, 2021). In the UK alone, per capita generated plastic packaging waste is estimated to be 34.21 kgs per annum (Statista, 2021).

Policy approaches to reduce plastic packaging waste have been pursued through supply and demand-based initiatives. These include regulatory controls on producers of packaging materials – for example, in the UK, the Producer Responsibility Obligations (Packaging Waste) Regulations 2007 set requirements on packaging materials, including provisions for recycling. In this paper we focus on demand-side manipulations to encourage consumers' preference for products which use more environmentally benign packaging materials. We further focus on food packaging, which is commonly made of fossil-based plastics. Although these are increasingly recycled, some types of plastics and in some areas are not recycled, leading to long-term problems associated with planned disposal of plastic waste, and further problems where plastic waste accidentally escapes into natural eco-systems (Borrelle et al., 2020).

Attempts to change consumers' attitudes to plastic packaging waste takes various forms. One broad framework, sometimes referred to as "nudge" is conceptualised as a "choice architecture" comprising all the external factors which could subtly influence an individual's behavioural decisions (Thaler and Sunstein, 2008). This process typically works through changing an individual's attitude to an object, through passive or active learning processes (Fazio, 2007; Wegener et al., 2018) such that the attitude becomes congruent with external cues presented within this choice architecture. This can be more effective than supply-side regulation for implementing government policy (Arno and Thomas, 2016). However, it can sometimes be unclear what attitudes are driving behaviour, resulting in a disparity between an individual's expressed attitude and their subsequent behaviour. In the context of sustainable consumption this poses a great challenge for marketers, policy makers and companies (Luchs et al., 2010; Prothero et al., 2011; White et al., 2019).

Scholars have called for a deeper understanding of the relationship between attitude and behaviour (Bray et al., 2011; Carrington et al., 2010; Kristensson et al., 2017). One possible cause of disjuncture between attitudes and behaviour may be that attitude is typically measured as an explicitly stated, socially conditioned construct, rather than an implicitly held attitude. In

other words, people might explicitly state what they believe to be socially acceptable attitudes in response to a question, but these responses might not reflect their underlying attitudes (Dirzyte and Rakauskiene, 2016).

In this paper we pursue investigation of disjuncture between attitudes which are expressed and those which are deeply held but may nevertheless influence behaviour towards packaging choices. We compare conventional fossil-based plastic packaging, with more recent innovations of bio-based and compostable packaging. While plastic packaging is typically associated with many functional benefits (e.g. safety, durability and protection), these may be augmented or contradicted by attributes which arise through associations. These associations may derive through the "choice architecture", including the context of use and the nature of the contents being linked to the packaging materials. In short, is association of bio-based and compostable packaging with ecological benefits stronger or weaker than their associations with health benefits? Our study of implicit attitudes associated with bio-based and compostable packaging may inform communications policy which taps into implicitly held, rather than explicitly expressed attitudes.

We contribute to debate about the best way for firms and government agencies to influence consumers' behaviours in their choice of food packaging materials. For example, although firms frequently emphasise environmental benefits in their promotion of ecologically friendly food packaging, our study of implicit attitudes reveals that consumers perceive food in compostable bio-based packaging also as healthier than in plastic packaging. Particularly, less health-conscious consumers' purchase intentions of compostable food packaging are guided by these implicitly held health-associations. While these may not be expressed explicitly, they may nevertheless be important evaluative criteria when choosing food with different types of packaging.

The plan of this paper is as follows. First, we review the literature on plastic packaging waste to give an indication of the nature and magnitude of the "problem" that we address. We then review literature on attitudes relevant to understanding associations between packaging composition and the food contained in the packaging. From this review of literature, we summarise gaps in knowledge from which we specify refined research objectives. This informs our methodology, which comprises four linked studies which pursue questions identified in the literature review. We adapt our later studies to learnings from our preceding studies. We analyse the results of each study and synthesise these in a discussion of their generalisability and implications for behaviour change in plastic food packaging use.

2. Background

2.1 The "problem" of fossil-based plastic food packaging

Fossil-based plastics, including packaging, are increasingly recognised as depleting natural resources, being ecologically harmful in their production and disposal, and it is taking up to 1,000 years for conventional plastics to decompose (Statista, 2021; Sumrin et al., 2021). Global plastics production worldwide was 368 million tonnes in 2019, with packaging accounting for 39.6% of total plastic usage (PlasticsEurope, 2021). In 2018, 1.53 million tonnes of new plastic packaging was placed in the market - mostly single-use (Ellen Macarthur Foundation, 2017) - for consumption by UK households (Statista, 2021). Although recycling rates are increasing, less than 30% of collected plastic waste in Europe is recycled, with 31% being dumped in landfill and 39% incinerated (European Commission, 2018). Furthermore, over 80% of marine litter comprises plastics, with single-use plastic items most frequently found on EU beaches (European Commission, 2018).

Encouraging consumers' adoption of ecologically friendly packaging is a growing topic of interest (e.g., Friedrich, 2020; Karmarkar and Bollinger, 2015; Rhein and Schmid, 2020; Wang, 2013) reflecting increasing public concerns about ecological harm caused by plastic waste (Dilkes-Hoffman, Pratt, et al., 2019; Statista, 2021). Within this literature, there is emerging evidence of growing segments of consumers demanding packaging in a form which can be recycled or reused (Magnier and Schoormans, 2015), and it is suggested that significant consumer segments expect all packaging to be environmentally-friendly (Olsen et al., 2014).

Alternatives to traditional fossil-based plastic packaging have become available and can significantly reduce ecological harm. These include bio-based, biodegradable and compostable food packaging. *Bio-based packaging* is entirely or partly derived from biomass sources (i.e., materials of biological origin). This includes certain *bio-plastics* (e.g. PLA) which are commonly produced from starch or sugar, have similar durability as fossil-based plastics, are potentially biodegradable (Álvarez-Chávez et al., 2012), and considered ecologically safe (Herbes et al., 2018; van den Oever et al., 2017). Bio-plastics *per se* are a difficult concept for consumers as it could relate to biobased and/or biodegradable (Dilkes-Hoffman, Ashworth, et al., 2019). Furthermore, bio-plastics have been criticised because the cultivation of agricultural biomass can cause ecological harm due to conflicts with food production, land and fresh water use (Karan et al., 2019).

Whilst bio-based and fossil-based relate to the production process of food packaging, recyclability, biodegradability and compostability relate to end-of-life options. Biodegradable plastics refer to packaging which completely biodegrades through biological activity (i.e., through the action of living microorganisms) in 180 days (Dilkes-Hoffman, Ashworth, et al.,

2019; Karan et al., 2019). Compostable packaging relates to a subset of biodegradable plastics which disintegrates into water, biomass, and gasses under composting conditions (ideally industrial) in less than three months (HM Government, 2021; Karan et al., 2019). Thus, a product that is compostable is always biodegradable, while a product that is biodegradable is not necessarily compostable. Many biodegradable plastics require industrial composting facilities and when compostable/biodegradable packaging is disposed of incorrectly (e.g., landfill), it can lead to significant emission of greenhouse gases (Mendes and Pedersen, 2021).

Whilst the market for ecological packaging materials is growing, consumers' knowledge of compostable materials remains poor, especially regarding their disposal methods (Dilkes-Hoffman, Ashworth, et al., 2019; Meeks et al., 2015; Otto et al., 2021; Taufik et al., 2020). Taufik *et al.* (2020), note a number of reasons that might explain this lack of knowledge. First, consumers seem more familiar with recyclable than with compostable packaging. It follows that consumers often dispose of compostable bio-based packaging incorrectly. Second, consumers have limited knowledge of packaging disposal labels especially in relation to compostability (Boesen et al., 2019). Finally, consumers may be unable to differentiate between bio-based and fossil-based plastic packages when both are recyclable, with the former erroneously not being perceived to have additional ecological benefits (van den Oever et al., 2017).

Whilst consumers generally perceive 100% bio-based packaging as more environmentally friendly than conventional fossil-based plastic packaging (Reinders et al., 2017; Sijtsema et al., 2016), they placed a stronger emphasis on biodegradability (Herbes et al., 2018). Allison et al. (2021) found that positive beliefs about environmental impacts were the main reasons for consumers choosing compostable and biodegradable packaging. Furthermore, Taufik et al. (2020) found that in the context of plastic bottles, consumers perceived more environmental benefits from compostable bio-based packages, than recyclable (non-compostable) bio-based packaging. In this study we thus focus on attitudes towards compostable bio-based food packaging as this had the most environmental appeal to consumers (Taufik et al., 2020), in contrast to traditional fossil-based plastic packaging which is recyclable.

Attempts to shift packaging preferences must recognize its multiple purposes. Food packaging protects the contents for transportation and storage, as well as communicating messages which shape consumers' perceptions and expectations about the product (Ares and Deliza, 2010; Carrillo et al., 2012). However, there is limited research specifically on consumers' preferences toward eco-friendly packaging and associations with its contents. Prior studies have mainly focused on its communicative characteristics (e.g., labelling, functionality, colour, size), as determinants of consumers' preference (Orth and Malkewitz, 2008). There is

some evidence that packaging made from ecologically-friendly material is perceived as more natural, which in turn signals associations with higher quality (Magnier et al., 2016), while plastic food packaging which is chemical-based is viewed as less natural and less healthy. However, research on consumer perceptions and associations of compostable bio-based food packaging is scarce (Herbes et al., 2018, 2020; Zwicker et al., 2021). We address this gap in knowledge by investigating transfer of effects between the compostable packaging and its contents.

2.2 Attitudes and behaviour

Market researchers have traditionally sought to identify consumers' attitudes by direct elicitation techniques. Direct responses to questions are presumed to be good indicators of underlying attitudes, however they may be a reflection of perceived social norm, rather than indicating an underlying attitude. It may therefore be unsurprising that stated intention often does not correlate with subsequent behaviour and this may help to explain disjuncture between expressed preference for ecologically friendly packaging, and actual choice. The purchase of packaged food typically involves complex processes of evaluating the substantive food contents and the aesthetics and messaging of its packaging (Popovic et al., 2019). A number of frameworks have been used to distinguish between those elements of the choice process which involve habits and routines versus conscious deliberation (Dual Process theory of System 1 v System 2); or between choice elements which are vocalized and those which remain latent (implicit versus explicit attitudes) (e.g., Conner et al., 2007; Richetin et al., 2007).

Attitudes can exist externally of our conscious awareness and control (Greenwald and Banaji, 1995), and are able to form an individual's automatic reactions to an object and subsequent interactions with it. The concept of implicit attitude emerged to capture automatically activated evaluations of an object in an indirect and associative manner (Greenwald et al., 2009). Importantly, implicit attitude measures tap into evaluative associations without requiring subjects to consciously introspect on their feelings (Nosek et al., 2007). Because they are free of conscious reasoning, they are less likely to be guided by social influences and desire to conform to peer group norms. Implicit attitudes are therefore considered in some contexts to be a better predictor of behaviour than explicitly expressed attitudes (Govind et al., 2019). Measures of implicit attitudes have been applied in many domains of social sciences and psychology, e.g. studies of race, self-esteem, stereotypes such as gender (Greenwald et al., 2009; Petty et al., 2009). Implicit attitude measures have also been shown to enhance understanding of consumer preferences in the context of food choices (e.g., Ackermann and Palmer, 2014; Raghunathan et al., 2006; Richetin et al., 2007; Songa and

Russo, 2018), healthy eating (e.g., Ayres et al., 2012; Hollands et al., 2011) and sustainable consumption (e.g., Panzone et al., 2016; Songa et al., 2019; Steiner et al., 2018).

We believe the use of implicit measures of attitude is particularly useful in our study because of its associative abilities. Consumers frequently use food packaging attributes as heuristics/cognitive shortcuts in their evaluation processes (Marozzo et al., 2019), assessing food packaging by emotions rather than just cognitive reasoning (Otto et al., 2021). This may involve using salient cues unrelated to objective environmental impacts (Steenis et al., 2017). We seek to extend knowledge by exploring explicit and implicit associations with plastic and compostable food packaging and the food they contain.

2.3 Associations between packaging and its contents

Building on cue utilisation theory (Olson and Jacoby, 1972), packaging generates multiple impressions leading consumers to form product perceptions. Judgements of a product's perceived quality, healthiness, naturalness, or sustainability could be based on diverse packaging cues classified as structural (e.g., packaging size); informational (e.g., text); visual (e.g., colour, shape); or sensory (e.g., smell, texture) (Herbes et al., 2020). For example, packaging colour has shown to impact consumers' perceptions of a product's authenticity, quality, taste, healthiness and their willingness to pay (Mai et al., 2016; Marozzo et al., 2019; Seo et al., 2016; van Rompay et al., 2016). Becker et al. (2011) found that packaging design (i.e., shape/curvature) affected taste experiences, especially for consumers with an elevated sensitivity to design.

Whilst previous research consistently highlights the positive impact of sustainable packaging on consumers' attitudes and purchase intentions (e.g., Hao et al., 2019; Martinho et al., 2015; Rees et al., 2019), few scholars investigated the effects of sustainable packaging on consumers' evaluations of the contained food product (e.g., Donato et al., 2021; Magnier et al., 2016; Seo et al., 2016; Steenis et al., 2017). For example, research has demonstrated that a product's perceived food quality increases with sustainable packaging (Donato et al., 2021; Magnier et al., 2016). Steenis et. al. (2017) noted a "spill-over" effect of packaging impressions to the contained products, in that sustainable packaging material affects not only sustainability perceptions but also perceived quality and taste. Donato et al. (2021) further found that healthy food in sustainable (vs non-sustainable) packaging was perceived as more satiating.

Although limited prior works have investigated the relationship between food healthiness and packaging, very few have shed light on consumers' health associations of ecologically friendly packaging (e.g., Magnier et al., 2016). Moreover, these have tended not to probe

underlying attitudes, nor to investigate possible differences between consumers in the effects of health associations. We address this gap in our study.

2.4 Health consciousness and packaging

Consumers increasingly understand the health consequences of their food choices (Silchenko et al., 2020). Previous research demonstrated that health consciousness (i.e., the extent to which a person is interested in health and motivated to take part in preventative behaviours, Mai and Hoffmann, 2015) impacts attitudes towards food and subsequent purchase intentions (Buhrau and Ozturk, 2018; Tarkiainen and Sundqvist, 2005). Highly health-conscious consumers are more responsive to health-related food information cues (Mai and Hoffmann, 2015; Naylor et al., 2009), in contrast to less health-conscious consumers who make their food decisions mostly on attributes unrelated to health, e.g. taste (Mai and Hoffmann, 2012). Similarly, it has been suggested that consumers' level of health consciousness impacts their attitudes toward eco-friendly products (Padel and Foster, 2005; Wandel and Bugge, 1997), with highly health-conscious consumers being more likely to behave environmentally friendly than others (Goetzke et al., 2014; Prakash et al., 2019).

Previous research has focused on the role of packaging informational cues (e.g., labels) in communicating healthiness and shaping health-related purchasing behaviours (e.g., Mauri et al., 2021). Less attention has been paid to the role of packaging material composition. Donato et al. (2021) noted that sustainable packaging is frequently used to suggest healthfulness of food products, pointing towards an implicit association between sustainable packaging and healthy food. Moreover, sustainable packaging has been associated with being "homely", "nice" and giving a "feeling of healthiness" (Fernqvist et al., 2015).

Prior works have extensively used the halo effect to explain consumers' perceptual biases towards salient signals or external cues (e.g., packaging sustainability, labels; Bui et al., 2017; Donato et al., 2021). The 'halo effect' suggests that external cues lead consumers to develop favourable overall evaluations of a product, guiding their judgments about unknown or missing attributes (Donato et al., 2021; Sundar and Kardes, 2015). Through this effect, consumers might thus perceive products in sustainable packages as healthier (van Rompay et al., 2016).

Based on the above studies of sustainable packaging, we suggest extrapolation to the specific case of compostable bio-based packaging, in that consumers implicitly associate compostable packaging with perceived healthiness.

2.5 Summary of knowledge gap and research aims

The literature review presented several knowledge gaps, which we aim to fill. By exploring consumers' attitudes towards bio-based and compostable food packaging in contrast to fossil-based plastic food packaging, we respond to calls for further empirical research to understand attitudes towards particular packaging solutions (instead of sustainable packaging in general) (Ketelsen et al., 2020).

Previous studies have investigated consumers' positive attitudes towards sustainable packaging (e.g., Hao et al., 2019; Martinho et al., 2015; Rees et al., 2019) and purchase intentions (e.g., Magnier and Schoormans, 2015). Furthermore, research suggested a "spill-over" effect of sustainable packaging impressions to the contained food products (e.g., Donato et al., 2021; Steenis et al., 2017) and potential links to perceived healthiness (e.g., Magnier et al., 2016).

However, there is less evidence of the *mechanisms* by which favourable attitude and preference arises, and especially explanations of an apparent gap between expressed attitudes and subsequent behaviour. Based on this, we investigate this apparent disjuncture through the lens of *implicit* attitudes. By understanding these deeper and more enduring attitudes, we may be in a better position to understand what forms of communication will be most effective in changing attitudes and behaviour regarding purchase of food with fossil-based plastic packaging.

A simple appeal to reduce fossil-based plastic packaging use based on ecological harm may not be as powerful as appeals based on implicit attitudes relating to health. Although perceptions of product quality have been associated with sustainable packaging (Magnier et al., 2016), associations between sustainable packaging and health benefits are less clear. We therefore seek to contribute to understanding of associations between packaging composition and healthiness. If this is found to be an important association, communications may be more effectively aimed at a deep-seated implicit attitude relating packaging composition to healthiness/unhealthiness, rather than stressing direct links to ecological harm. Based on gaps in knowledge, our paper addresses the following research questions:

1. Does compostable food packaging trigger more positive associations with food contents than traditional plastic packaging, and does this differ with healthy and unhealthy food content?
2. To what extent do implicit and explicit attitudes towards compostable food packaging influence purchase intentions?
3. What are the links between packaging composition and associations with healthiness?

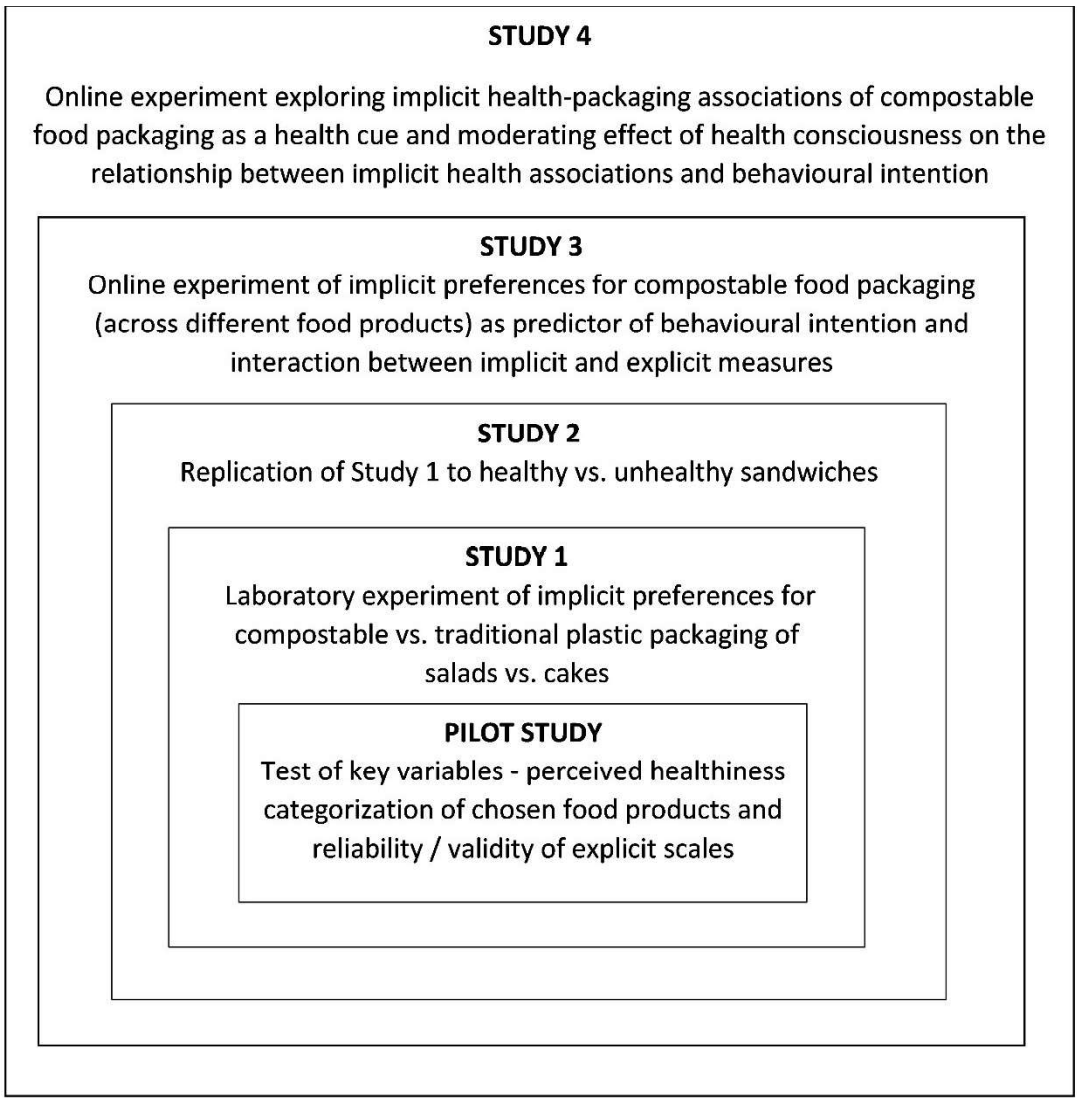
4. Are the effects of implicit associations of health benefits with packaging greater for consumers with high reported health consciousness than low?

3. Overview of Studies

Four Implicit Association Tests (IATs) were conducted to explore consumers' automatic associations with compostable food packaging (vs. traditional plastic packaging), and to further examine if these differ between healthy and unhealthy food products. In a pilot study, we tested the perceived healthiness of our chosen food products to ensure that these adequately represent the two food categories. Studies 1 and 2 were computer-based self-administered laboratory experiments and explored if implicit preferences for compostable food packaging vs. traditional plastic food packaging differed between cakes/bakery products and salad, and between healthy and unhealthy sandwiches. Study 3 examined in an online experiment to what extent implicit preferences for compostable food packaging (across different food products) predict behavioural intention, and to what extent implicit and explicit measures interplay in the prediction of intended choice of compostable packaging. Finally, Study 4, an online experiment, explored the role of compostable food packaging as a subtle health cue (i.e., implicit health-packaging associations) and assesses whether the relationship between implicit health associations and behavioural intention is moderated by self-reported health consciousness.

All studies formed part of a larger research project, conducted in the UK and approved by the University's ethics committee. Respondents provided informed consent before participation and were debriefed after the session. Figure 1 shows the evolution of the study stages and the intended contribution of each stage.

Figure 1: Overview of Studies



4. Pilot Study

Studies 1 and 2 explored whether implicit associations towards compostable and traditional plastic food packaging differed between healthy and unhealthy food categories. To ensure that the food adequately represented healthy and unhealthy categories, an online pilot study (n=68, 59.4% female, main occupation: 40.6% students (full/part-time), 53.1% employment (full/part-time), 6.3% other (e.g., retired), age: 29.7% 18-24, 43.8% 25-34, 17.2% 35-44 and 9.4% >45 years) was conducted to measure the perceived healthiness. Respondents rated different food products (3 to 4 per category, e.g., croissants, strawberry cupcakes, ready-to-eat salad, chicken salad, turkey salad sandwich on brown bread; beef, bacon, mayo sandwich) on a scale from 1 (very unhealthy) to 7 (very healthy). Presentation order was randomised to avoid an order effect. The results confirmed a significant difference in perceived healthiness between the two food categories (M_{salad}=4.80, SD_{salad}=.94, M_{bakery}=2.01, SD_{bakery}=.88, t(67)=16.53, $p\leq.000$;

$M_{healthy\_sandw}$=5.21, $SD_{healthy\_sandw}$=1.23, $M_{unhealthy\_sandw}$=2.44, $SD_{unhealthy\_sandw}$=1.05, t(67) = 16.65, $p \leq .000$).

We also asked participants to list three words which come spontaneously when thinking about plastic food packaging. These are displayed in Figure 2 as a wordcloud. Participants mainly perceived plastic food packaging as wasteful, polluting, toxic, overused, harmful, bad and unhealthy, however, they also acknowledged that it can be recycled, is cheap and convenient.

Figure 2: Wordcloud of perceptions of plastic food packaging[1]

5. Study 1

Study 1 explores implicit attitudes towards compostable versus plastic food packaging for cakes/bakery products and salad.

5.1 Procedure and Materials

Participants. Ninety-three participants were recruited through opportunity sampling to take part in a laboratory study of which 88 were deemed usable. The sample comprised students and staff of a large UK university (67% female, age: 75% 18-21 years old, 14.8% 22-24 years old, 10.2% >25 years, main occupation: 92% full-time students). Participants received a small incentive (a £5 study-neutral monetary online voucher) and were recruited via posters/flyers and online staff/student noticeboards.

[1] Wordcloud created by authors with www.jasondavies.com/wordcloud/

*Measures – Implicit Preferences***.** Implicit attitudes were measured using Direct RT software (Jarvis, 2004). Participants completed two IAT tests for the two different food categories, i.e., cakes/bakery products (IAT1) and ready-to-eat salads (IAT2), corresponding respectively to unhealthy and healthy food. To ensure that participants had the same level of knowledge about the two different packaging materials and were familiar with the labels used in the study, a short, balanced introduction was provided at the beginning of the study (see Appendix 1).

The IAT assesses how quickly participants sort stimuli (i.e., images and words) from four categories (images of food in compostable and traditional plastic packaging; 'good' (e.g., excellent, pleasant,) and 'bad' words (e.g., horrible, unpleasant) (see Ackermann and Palmer, 2014). Each IAT included five blocks with 140 trials in total. Blocks one, two and four are practice blocks. The third and fifths blocks combine target images and attribute words and are the critical stages of interest (see Appendix 2). In the combined blocks, participants are required to rapidly sort target images and attribute words appearing in the centre of the screen into categories located on the top left side (e.g., "compostable packaging" and "good") and top right side (e.g., "traditional plastic packaging" and "bad") by pressing one of two response keys. The positions of the attribute categories were exchanged after the first combined block. The target categories included labels to clearly distinguish and represent the packaging composition categories (see Appendix 1). The computer-based reaction-time measurements for the two combined blocks (i.e., differences in response latencies) assess the heuristic associations between target images and evaluative attributes and are an indicator of implicit attitudes.

If the respondent completes the task quicker when images of food in compostable packaging and 'good' words share the same side of the screen than when traditional plastic packaging images and 'good' words share the same side of the screen, this indicates a more positive association with compostable than with plastic packaging.

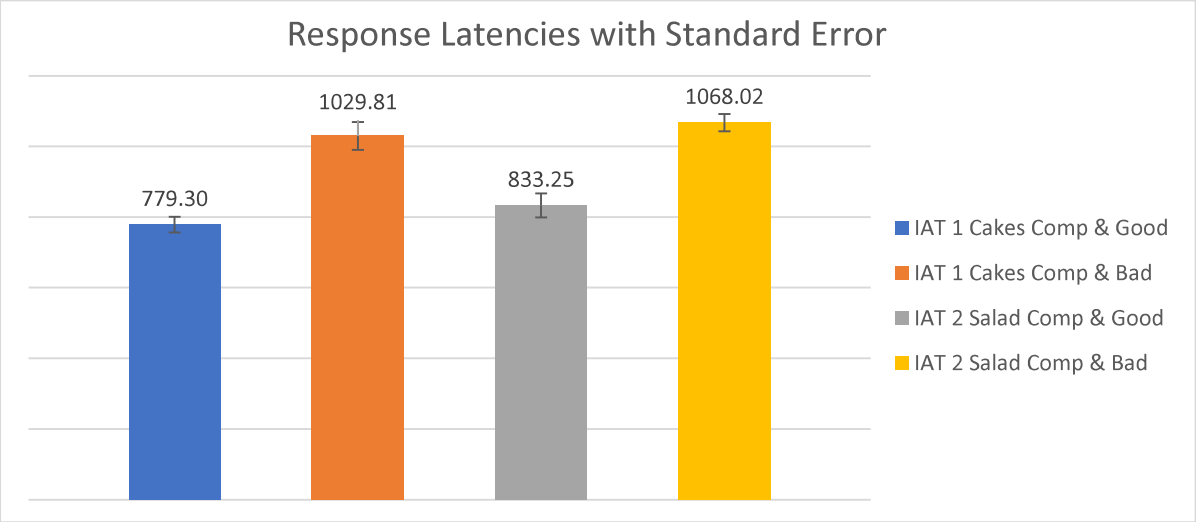
Participants then completed a second IAT which followed the same procedure, except that this time, they categorised images of ready-to-eat salad meals in compostable and traditional plastic food packaging. To avoid method artifacts, we randomized the order of both IATs and the order of the initial combined (i.e., compatible) and reversed combined (i.e., incompatible) discrimination tasks.

5.2 Results

Figure 3 shows that participants were significantly quicker when compostable food packaging was paired with 'good' words (M_{Cakes_good}=779.3ms, SD_{Cakes_good}=209.17ms, M_{Salad_good}=833.25ms, SD_{Salad_good}=229.58ms), than when paired with 'bad' words (M_{Cakes_bad}=1029.8ms, SD_{Cakes_bad}=369.75ms, M_{Salad_bad}=1068.0ms, SD_{Salad_bad}=320.66ms,

$t(87)_{Cakes}$=-8.31, $p \leq .001$, $t(87)_{Salad}$=-8.50, $p \leq .001$), thus indicating to an associative strength between 'compostable food packaging' and 'good'.

Figure 3: Mean response latencies in ms for each critical IAT block



To check whether implicit attitudes towards compostable packaging differed between healthy and unhealthy food categories (cakes/bakery products vs. salad), two IAT *D*-scores were calculated. Following Greenwald et al. (2003), any trials with response times >10,000ms were deleted and participants for whom >10% of the trials had latencies <300ms were removed. An IAT *D*-score can be interpreted similar to Cohen's *d*-measure of effect-size (Greenwald et al., 2003), with absolute effect sizes classified as small (<.20), medium (.20 to .49), moderate (.50 to .79) and large (>.80) effect sizes (Cohen, 1992).

IAT *D*-scores suggest a medium preference for compostable food packaging for both food categories (cakes: $M_{D\text{-score}}$=.47, $SD_{D\text{-score}}$=.38, salad: $M_{D\text{-score}}$=.42, $SD_{D\text{-score}}$=.38). Both *D*-scores were significantly different from zero (cakes: $(t(87)_{cakes}$=11.59, $p \leq .000$; salad: $t(87)_{salad}$=10.29, $p \leq .000$) indicating that participants associated 'compostable packaging' more with 'good' than with 'bad' words. Furthermore, there was no significant difference between the *D*-scores for the unhealthy and healthy food categories, i.e. cakes and salad ($t(87)$=1.27, $p \leq .21$), suggesting that participants held positive implicit associations for compostable vs. plastic food packaging regardless of the food content.

6. Study 2

Study 2 assesses the implicit attitudes towards compostable versus plastic food packaging for unhealthy and healthy sandwiches.

6.1 Procedure and Materials

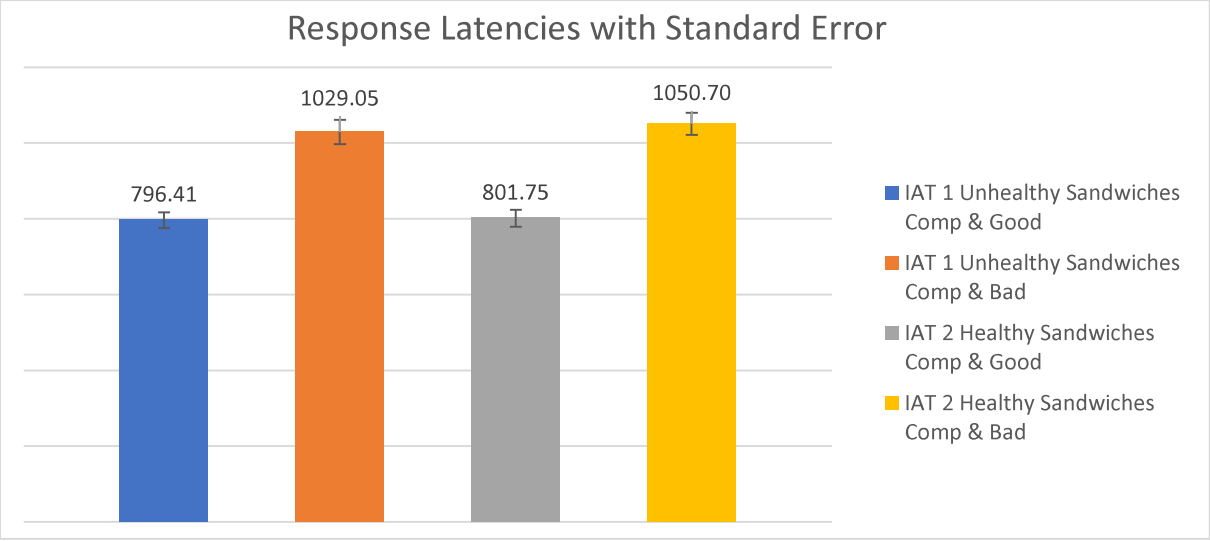
Participants. Ninety-one participants were recruited following the same procedure as for Study 1, with 90 deemed usable. The sample comprised university students and staff (64% female, age: 82% 18-21 years old, 9% 22-24 years old, 9% >25 years, main occupation: 94.4% full/part-time students).

Measures – Implicit Preferences. The same protocol and target attributes were used as for Study 1, but with different target stimuli (i.e., images of healthy sandwiches (IAT1) and images of unhealthy sandwiches (IAT2) in compostable/traditional plastic food packaging. To ensure that participants had information on the type of sandwiches in the packaging, a description was provided under the image.

6.2 Results

As in Study 1, participants responded significantly faster when compostable food packaging was paired with 'good' words ($M_{UnhealthySandw}$=796.41ms, $SD_{UnhealthySandw}$=196.78ms, $M_{HealthySandw}$=801.75ms, $SD_{HealthySandw}$=211.76ms), than when paired with 'bad' words ($M_{UnhealthySandw}$=1029.05ms, $SD_{UnhealthySandw}$=304.40ms. $M_{HealthySandw}$=1050.70ms, $SD_{HealthySandw}$ =275.03ms, $t(89)_{UnhealthySandw}$=-7.04, $p\leq.001$, $t(89)_{HealthySandw}$= -11.12, $p\leq.001$) (see Figure 4).

Figure 4: Mean response latencies in ms for each critical IAT block



The IAT *D*-scores indicate a medium preference for compostable food packaging for both IATs (unhealthy sandwiches: $M_{D\text{-score}}$=.39, $SD_{D\text{-score}}$=.40, healthy sandwiches: $M_{D\text{-score}}$=.46, $SD_{D\text{-score}}$=.34). These values were both significantly different from zero (unhealthy sandwiches: (t(89)=9.22, p<.000); healthy sandwiches: (t(89)=12.80, p<.000). Additionally, the *D*-scores for the two different food categories did not significantly differ (t(89)=-1.45, p=.15). This

confirms that participants held a positive implicit preference for compostable food packaging vs traditional plastic food packaging across the two different food categories.

7. Study 3

Studies 1 and 2 confirmed that implicit associations with compostable (vs. plastic) food packaging did not significantly differ between 'healthy' and 'unhealthy' food products. Thus, the packaging content had no significant impact on implicit attitudes towards the packaging. Study 3 examines the implicit/explicit attitudes towards compostable versus plastic food packaging (drawn from different food categories) and tests whether these can predict purchase intentions.

7.1 Procedure and Materials

Participants. Data were collected through an online survey platform and participants were recruited via the Qualtrics UK consumer panel. Qualtrics set quotas based on UK census data in terms of age, gender, UK regions. 105 participants fully completed the online study, of which 93 were usable (49.5% females, Age: 25.8% <34, 24.7% 35-49, 23.7% 50-64 and 25.8% >65 years). Appendix 4 presents an overview of the sample demographics and the UK population demonstrating that the sample includes a good representation across gender, age groups and UK regions. Participants first completed a survey-based IAT (administered with IATgen via Qualtrics, https://iatgen.wordpress.com/, see Carpenter et al., 2019), followed by online survey questions.

Measures – Implicit Preferences. Like Study 1 and 2, the IAT consisted of five blocks. To increase generalizability, the target stimuli of compostable and plastic food packaging were drawn from different food categories, including healthy (salad, fruit, healthy sandwiches) and unhealthy food (cakes/bakery, unhealthy sandwiches). The target attributes were the same as in Studies 1 and 2, i.e., 'good' and 'bad' words. A short introduction regarding the packaging materials and labels was provided to ensure similar levels of knowledge (Appendix 1).

Measures – Explicit Preferences. Explicit attitudes were captured applying five semantic differential scales adapted from Swanson et al. (2001) and Perugini (2005), i.e.., 'For me, buying food products in compostable [traditional plastic] food packaging is: bad-good, harmful-harmless, unpleasant-pleasant, not enjoyable-enjoyable, unhealthy-healthy' using a 7-point scale ($\alpha_{compostable}$=.87, $\alpha_{plastic}$=.89). As the IAT *D*-score is a relative measure indicating positive evaluation for compostable packaging relative to plastic packaging, we calculated the

explicit attitude score by subtracting the mean attitude score for compostable packaging from the mean score for plastic packaging (see Perugini, 2005).

Behavioural intention. Purchase intention was assessed with three items adapted from Mai et. al. (2016) and Ackermann and Palmer (2014), e.g. 'I would buy food products in compostable packaging (if available)', 'I prefer to increase my purchase of food products in compostable packaging in the next three months.', M_{BI}= 6.25, SD_{BI}=.87, α= .93), measured on a 7-point scale from 1-extremely unlikely to 7-extremely likely.

7.2 Results

The IAT *D*-score indicated a medium preference for compostable food packaging ($M_{D\text{-score}}$ =.46, $SD_{D\text{-score}}$ =.52). This value was significantly different from zero, (t(92)=8.64, p<.000), confirming an implicit preference for compostable food packaging across different food types. Respondents' average reaction time was significantly shorter when compostable packaging was paired with 'good' words, than when plastic packaging was paired with 'good' words. Explicit attitudes towards compostable food packaging were also significantly larger than those for plastic food packaging (M_{comp}=6.05, SD_{comp}=.94, $M_{plastic}$=2.56, $SD_{plastic}$=1.13, t(92)=17.89, p<.000). The explicit attitude difference score was also significantly different from zero (M_{diff}=3.48, SD_{diff}=1.88, t(92)=17.89, p<.000). This confirms that respondents had positive implicit and explicit attitudes towards compostable over traditional plastic food packaging. Whilst both explicit and implicit attitudes were positive, they were not significantly correlated (Pearson r=-.001, $p\leq$.99), providing evidence that these constructs are different.

A regression analysis assessed the relationship between implicit/explicit attitudes (independent variables) and purchase intention for food in compostable packaging (dependent variable). This showed that both, implicit attitudes ($IAT_{D\text{-score}}$: β=.18, t= 2.22, p<.029) and explicit attitudes (β=.63, t=7.80, p<.000) have a significant positive effect on purchase intention, explaining 42% of variance in the dependent variable (R^2=.42, F(2)=32.88, p<.000).

8. Study 4

Study 4 assesses the implicit and explicit health associations with compostable versus plastic food packaging and whether these predict purchase intentions. Additionally, study 4 examines health consciousness as a moderating factor which might weaken or enhance the link of implicit health associations with compostable packaging and purchase intention.

8.1 Procedure and Materials

Participants. Data were collected as in Study 3. 103 participants fully completed the online study, of which 98 were usable (52% females, Age: 25.5% <34, 25.5% 35-49, 25.5% 50-64 and 23.5% >65 years, see Appendix 4).

Measures – Implicit Preferences. As in Study 3, implicit associations were measured using IATgen administered via Qualtrics with the same target stimuli. However, this time the target attributes consisted of 'healthy' (e.g., fit, well) and "unhealthy" (e.g., harmful, unwell) words adopted from Mai et al. (2016).

Measures – Explicit Preferences. Explicit perception of healthiness related to food packaging was measured with one item on a 7-point scale consisting of a polar-opposite adjective pair, i.e. 'For me, buying food products in compostable [traditional plastic] food packaging is: unhealthy-healthy'. As in study 3, we calculated the difference score by subtracting the mean for plastic packaging from the mean for compostable packaging (see Perugini, 2005) (M_{diff}=2.67, SD_{diff}=2.57).

Health Consciousness. We adopted a four-item, seven-point Likert scale to measure diet-related health consciousness from Siegrist et al. (2015) (e.g., 'I think it is important to eat healthily', 'My health is dependent on how and what I eat', M_{health}= 4.98, SD_{health}=.92, α=.72).

Behavioural intention was measured as in Study 3 (M_{BI}=5.89, SD_{BI}=1.17, α=.94).

8.2 Results

The IAT *D*-score was positive and significantly different from zero ($M_{D\text{-score}}$=.37, $SD_{D\text{-score}}$=.53, (t(97)=6.97, p<.000), indicating that faster response latencies were observed when 'healthy' words were combined with compostable packaging than when 'healthy' words were paired with plastic packaging. This demonstrates that compostable food packaging triggered positive implicit health associations.

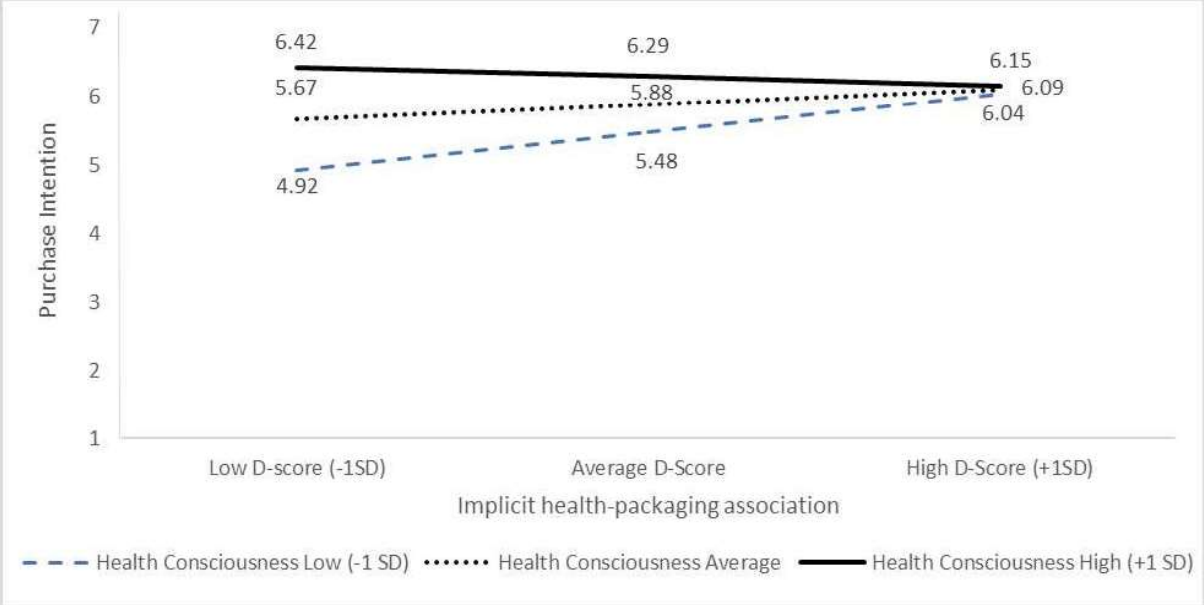
Buying food in compostable packaging was also explicitly seen as healthier than buying food in plastic packaging (M_{comp}=5.76, SD_{comp}=1.29, $M_{plastic}$=3.08, $SD_{plastic}$=1.77, (t(97)=10.31, p≤.000). The difference score was significantly different from zero (M=2.67, t(97)=10.31, p<.000). The Pearson correlation coefficient between explicit and implicit health associations was insignificant (r=-.011, p<.92), confirming the results from Study 3 in the context of health-packaging associations.

Regression analysis revealed that implicit ($IAT_{D\text{-score}}$: β=.22, t=2.49, p<.015) and explicit health associations (β=.46, t=5.20, p<.000) with compostable food packaging significantly influenced purchase intentions (R^2=.26, F(2)=17.13, p<.000).

To test whether the link between implicit health associations and purchase intention is contingent on consumers' health consciousness, we run a moderated regression analysis employing the Process macro (Model 1; 5,000 bootstrap samples) (Hayes, 2013) with implicit health-packaging associations ($IAT_{D\text{-score}}$) as the independent variable, purchase intention as the dependent variable and health consciousness as the moderator. All variables that defined the product were mean centred. The overall model was statistically significant explaining 25% of the variance in purchase intention (R^2=.25, F(3,94)=10.20, p<.000 (see Appendix 5.1, Model 1a). The results show that the IAT *D*-score ($B_{D\text{-score}}$=.40, t=2.01, p<.047) and health consciousness ($B_{health\_consciousness}$ = .437, t=3.83, p<.000) were positively related to purchase intention. Additionally, health consciousness moderated the effect of the IAT *D*-score on purchase intention. This is demonstrated by the significant negative interaction effect ($B_{D\text{-score*health\_consciousness}}$=-.711, t=-3.48, p<.001).

Implicit health associations with compostable packaging had a significant influence on purchase intention, only when health consciousness levels were low (one SD below the mean, B=1.06, t=4.12, p<.000) or average (B=.40, t=2.01, p<.047), but not when health consciousness was high (one SD above the mean (B=-.26, t=-.88, p<.381) (see Appendix 5.2). Thus, with increasing levels of health consciousness, the strength of the relationship between the implicit health associations and purchase intention decreased (Figure 5).

Figure 5: Moderation effect of health consciousness



Thus, for the less health-conscious consumers, the link between implicit health-packaging associations and purchase intention is enhanced. For these consumers, health aspects of the food are less relevant, but the packaging material might still signal healthiness benefits. In other words, automatic health-packaging associations play a greater role when stating their purchase intentions for compostable food packaging, than for the more health-conscious consumers.

In contrast, for highly health-conscious consumers, purchase intentions for compostable food packaging did not significantly change with implicit health-package associations. Thus, the higher a consumer's level of health consciousness, the lower the impact of implicit health-packaging associations on purchase intention. For these high health-conscious consumers, health aspects of the food might be more relevant than the packaging alone.

We also analysed the model controlling for biospheric values and explicit health associations with compostable food packaging as these variables might influence the moderated relationship. Similar results were gained (see Appendix 5.1 and 5.2 for more detail). Additionally, we also tested whether the link between explicit health associations with compostable packaging and purchase intention is contingent on consumers' health consciousness (see Appendix 5.3). No significant interaction effects were found. Thus, we can conclude that the effect of explicit health associations with compostable food packaging on purchase intention does not vary with different levels of health consciousness.

9. Discussion and Conclusion

Our investigation started with a suggestion that appeals to reduce single-use plastic food packaging based on ecological appeals may be insufficient on their own to change behaviour. We were particularly interested in the linkages between automatic associations with packaging materials and food within the packaging, and whether food packaged in compostable rather than traditional plastic-based materials had different associations.

Across four IAT studies (see Appendix 3 for a summary), the present research finds evidence for consumers' positive associations with compostable bio-based versus traditional plastic packaging. Studies 1 and 2 confirm that implicit associations with compostable (vs. plastic) food packaging did not significantly differ between 'healthy' and 'unhealthy' food products, while Study 3 shows that implicit and explicit attitudes towards compostable (vs. plastic) food packaging have a positive effect on consumers' purchase intentions. Based on the assumption that consumers may establish an associative linkage between packaging sustainability and healthiness, Study 4 further investigated and confirmed the role of implicit

health associations with compostable packaging in influencing purchase intentions, which was moderated by consumers' health consciousness.

Our study builds on and extends previous research which has found favourable attitudes towards ecologically benign food packaging, in contrast to traditional plastic packaging (Dilkes-Hoffman, Ashworth, et al., 2019; Herbes et al., 2018; Koenig-Lewis et al., 2014; Sijtsema et al., 2016). We add to recent previous research into perceived environmental benefits of compostable (bio-based) packages (Allison et al., 2021; Taufik et al., 2020), by examining attitudes towards healthy and unhealthy food in compostable biobased versus traditional plastic packaging. Additionally, we provide new evidence using explicit and implicit measures in the more contemporary context of compostable plant-based packaging, thereby extending Songa et al.'s (2019) findings of a positive implicit attitude towards recyclability of food packaging.

Whilst we found positive explicit and implicit associations in our studies, there was no significant correlation between them, confirming similar results from previous studies from the environmental domain (e.g., Friese et al., 2006; Songa et al., 2019; Vantomme et al., 2005). Perugini (2005) noted that this verifies discriminant validity between the two different types of measures; one based on self-report and cognitive explicit evaluations; the other relying on reaction speed times indicating unconscious and automatic packaging associations. Thus, it is important to understand the impact of both types of attitudes driving purchase intentions, especially in food shopping where behaviours might be automatic and habitual.

Furthermore, our results showed that compostable food packaging was explicitly and implicitly not only perceived more positively but also more healthy than conventional plastic food packaging. This extends previous research, which noted that sustainable packaging cues may evoke health inferences (Magnier et al., 2016; Steenis et al., 2017; van Rompay et al., 2016), to the context of compostable bio-based food packaging.

Finally, we enrich previous literature (e.g., Bui et al., 2017; Donato et al., 2021) by showing that an individual's reported health consciousness moderates the impact of implicit health associations on purchase intentions of food in compostable packaging. For consumers with high health consciousness, purchase intentions were high for all levels of implicit health-package associations. For this group, further policy efforts tapping into implicit health associations would be unlikely to achieve substantial further behavioural change. However, a more interesting finding emerged for respondents with lower self-reported health consciousness. Participants with low and moderate levels of health-consciousness were more guided by their unconscious and automatic health-packaging associations when indicating their intention to choose food with compostable packaging.

Our findings contribute to the academic literature in several ways. First, we advance previous literature on packaging cues by investigating the role of packaging material, which has been overlooked by prior studies (Lindh et al., 2016; Magnier and Crié, 2015; Nguyen et al., 2020; Steenis et al., 2017). Second, we shed light on the interaction between food contents, packaging and associations with healthiness, by adopting a relatively novel methodology - an Implicit Association Test - across several studies with good sample sizes. Ours is one of the first studies to examine implicit associations with traditional plastic and compostable bio-based food packaging and linking these with healthiness. The robustness of the IAT methodology was further supported by applying it in two settings – in a local laboratory study and online with a wider sample representing diverse age groups, genders, education levels and locations. Third, when studying different types of food (unhealthy and healthy), we found consistent positive implicit associations towards compostable bio-based food packaging. Thus, whilst sustainable packaging cues might positively affect perceptions of food contained within (Steenis et al., 2017), we found that the positive implicit attitudes towards compostable bio-based food packaging were not dependent on the type of food they contained.

Our findings highlight the importance of understanding consumers' implicit attitudes in developing policies to reduce fossil-based plastic packaging use. Communications which appeal to commonly expressed attitudes linking plastic waste with ecological degradation may not be as powerful to motivate change as tapping into implicit attitudes which link non-plastic alternative packaging to health benefits. Our study provides evidence that this is particularly true for consumers with low levels of health consciousness. Our findings build on the growing awareness of automatic and habitual processes in food choices, and therefore effective strategies to reduce fossil-based plastic use should target the faster, automatic system grounded in affective, moral and unconscious motives outside of conscious awareness and control (Perugini, 2005).

The results of this study have important managerial implications. In promoting the environmental benefits of compostable bio-based food packaging, companies should also focus on the health benefits related to the safety of natural packaging materials and/or the contained food, as these appeal to implicitly held attitudes influencing purchase intentions towards plastic packaging alternatives.

Furthermore, government agencies, seeking to encourage healthy food choices, should consider promoting compostable bio-based food packaging solutions as the food's perceived healthiness can be enhanced by cues relating to the packaging material, especially for the less health-conscious consumers who base their food decisions on attributes unrelated to the health information of the food. However, this is also true for unhealthy food which could lead less

health-conscious consumers to choose more unhealthy food if this is packaged in compostable material. Thus, we suggest that the health risks of unhealthy food in compostable bio-based packaging need to be clearly labelled (e.g., sugar, fat content) and easily identifiable. Our findings are relevant to government agencies seeking to change packaging use, and our caveat about healthy packaging potentially encouraging and justifying consumers' purchase of unhealthy food indicates a need for nuanced application.

The present research has limitations, providing directions for future research. First, a main limitation lies in not measuring consumers' actual behaviours. Hence, we propose future research to include a field experiment to measure consumers' real packaging choices, providing external validity to our results. Second, all studies have been conducted in one country (United Kingdom) with two out of four studies employing University students and staff samples. Replication studies in other countries and with more diverse samples would improve the generalizability of our findings and identify possible cultural differences. Our study explored consumers' explicit and implicit attitudes with 'bio-based compostable' and 'traditional recyclable plastic' food packaging. Future studies might elaborate the differences in associations between 'compostable', 'bio-based' and 'compostable bio-based' food packaging to determine the importance of each. Moreover, although we measured the perception of healthiness of different types of food and the general healthiness perception of buying food in compostable and plastic food packaging in the pilot test, we did not verify the perception of healthiness of each type of food in compostable versus plastic food packaging, nor did we replicate this measure in the main studies.

Also, we did not test for possible underlying mechanisms that might better explain the proposed relationship between implicit (health) associations and purchase intentions. We leave this for future research. Finally, we focus our research only on food packaging, and note increasing use of compostable bio-based packaging also in other product categories (e.g., beauty and laundry products). Therefore, additional research could extend the understanding of consumers' associations of sustainable packaging with other product categories.

Funding

This programme of research was funded by Cardiff Business School, Seedcorn Funding for Research and the Academy of Marketing Research Grant.

Acknowledgements

The authors would like to thank Prof. Greg Mayo for his support and expert advice at the design stage of this project. In addition, the authors would like to thank the reviewers for their constructive feedback and guidance.

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