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**McCarthy, Breda, and Wang, Pengji (2022) *Exploring the role of reef-friendly, edible packaging in reducing plastic pollution: proposition of a conceptual model explaining purchase intentions*. In: *Community Empowerment, Sustainable Cities, and Transformative Economies*, pp. 377-394. From: *BEMAS: 1st International Conference in Business, Economics, Management, and Sustainability*, 2-3 July 2021, Cairns, QLD, Australia.**

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Please refer to the original source for the final version of this work:

[https://doi.org/10.1007/978%2D981%2D16%2D5260%2D8\\_21](https://doi.org/10.1007/978%2D981%2D16%2D5260%2D8_21)

## **Exploring the role of reef-friendly, edible packaging in reducing plastic pollution: proposition of a conceptual model explaining purchase intentions**

Breda McCarthy<sup>a</sup> and Pengji Wang<sup>b</sup>

<sup>a</sup> College of Business, Law & Governance, James Cook University, Queensland, Australia.  
Email: breda.mccarthy@jcu.edu.au

<sup>b</sup> Business, James Cook University, Singapore. Email: pengji.wang@jcu.edu.au

### **Abstract**

The aim of this paper is to highlight the ways in which the sustainable packaging industry, in conjunction with consumers, can help to reduce environmental damage to fragile ecosystems. We discuss several theoretical models that have been widely used to explain behavioural change. The literature review suggests that lifestyle segmentation, and concepts from the extended theory of planned behaviour and adoption of innovation literature provide rich explanations for why individuals are likely to purchase and adopt novel forms of sustainable packaging. We propose a model identifying several factors that influence purchase intentions and further research is recommended with a focus on market segments defined by sustainable lifestyles.

**Paper type:** research paper

**Keywords:** *sustainable packaging; pro-environmental behaviour; lifestyle segmentation; spill-over effects.*

## **Introduction**

Plastic is ubiquitous in our environment. Although it has a significant role to play in food packaging – keeping food fresh and safe to eat, making products easy to transport and consume - plastic packaging is easily disposable and a pollutant. According to recent estimates, only 9% of all plastics ever produced have been recycled, and most has ended up in landfills or elsewhere in the environment (Geyer, Jambeck, & Law, 2017). Plastic waste is now so alarming that it is seen as a geological marker of the Anthropocene era. The cumulative amount produced, as of 2015, was around 5 billion tons of plastic, which is enough to wrap the Earth in a layer of cling-film (Zalasiewicz et al., 2016).

When plastic was first invented, it was hailed as a miracle, “the material of a thousand uses”, but today it is seen as an environmental disaster (UNEP, 2018). An estimated 6 to 12 million tonnes of plastic enters the ocean each year, resulting in a global pollution problem (Vince & Hardesty, 2016). There is a rapidly expanding literature on plastics, documenting its effects on the land, lakes, rivers and the sea, and on animals and marine mammals (Baird & Hooker, 2000). Plastic kills marine fauna such as turtles through ingestion (Gregory, 2009), and it is noted that all but one species of marine turtles are classified as threatened (Nelms et al., 2015). Surveys show that most micro-plastics (which are fragments of plastic invisible to the naked eye, typically <5 mm), collected from rivers (Rowley, Cucknell, Smith, Clark, & Morritt, 2020) and the offshore marine environment, are polyethylene (PE) and polypropylene (PP), two resins commonly used in single-use plastic food packaging (Zettler, Mincer, & Amaral-Zettler, 2013). Single use packaging is prevalent in plastic bottles, food wrappers and bags.

Communicating environmental sustainability through packaging can convey positive customer experiences and influence purchase intentions (Signori, Gozzo, Flint, Milfeld, & Nichols, 2019). There is a vast literature on pro-environmental behaviour (PEB), which refers to any practice (such as purchasing, use, post-use, management, activism) that consciously seeks to limit the impact of human activities on the environment. However, the number of studies assessing the effect of sustainable packaging on consumer decisions are relatively scarce (Boz, Korhonen, & Koelsch Sand, 2020). Since consumer perceptions of environmentally-friendly packaging are not well understood, this research responds to the call by Ketelsen, Janssen, & Hamm (2020, p.15) to focus on consumer response to specific packaging solutions. It is critical to understand the response of consumers to novel forms of packaging, such as edible packaging, since consumers have market power and ultimately it is

consumers who decide whether to buy, or not buy, products that are sustainably packaged. According to Steenis, van Herpen, van der Lands, Ligthart, van Trijp (2017, p. ), “one of the key challenges for packaging managers, marketers and designers is to develop sustainable packaging designs that are acceptable to consumers.”

The research questions of this study are as follows:

- (1) What are the factors affecting an individual’s decision to adopt and use edible packaging?
- (2) What are the recommendations for future consumer-oriented research in the area of edible packaging?

The outline of this paper is as follows. We provide a context by outlining the plastic pollution crisis and policy responses to plastic waste. This is followed by a discussion of theoretical models to explain consumer response to sustainable food packaging. Lastly, recommendations for future consumer-oriented research are laid down accordingly.

### **Context: The Plastic Packaging Crisis**

#### *Food packaging and plastic pollution*

Plastic is used in many industry sectors due to its flexibility, durability, water resistance and affordability and demand for plastic has grown exponentially (Sharma et al., 2020). In food and beverages industry, packaging plays an essential role such as protecting products throughout the supply chain and ensuring their safe delivery (Politis, Sarigiannidis, & Voutsinas, 2019). Food packaging serves numerous functions, such as maintaining freshness, extending shelf life and avoiding food waste (Wikström, Williams, Verghese, & Clune, 2014). It also plays a critical role in differentiating brands and serves as a means of marketing communications (Davison & Redhill, 1998). The recent Covid-19 has further increased reliance on plastics for food safety and hygienic purposes, and there is growing concern that the pandemic could fuel a rise in the throw away culture (Sharma et al., 2020).

Despite the utility of plastic in food packaging, a major side effect is its contribution to plastic pollution. Such plastic pollutions not only threatens the biodiversity, but also our economy. Plastic rubbish in marine environments is a major environmental issue, with many studies documenting the magnitude of the negative impact on wildlife (Eagle, Hamann, & Low, 2016; Pettipas, Bernier, & Walker, 2016; Wilcox, Mallos, Leonard, Rodriguez, & Hardesty, 2016). Such a hazard for wildlife remains for a considerable period of time given that plastics degrade very slowly (Jakovcevic et al., 2014). In addition, pollution of beaches

via plastic and other debris may impact adversely on visitor numbers, with potential negative impacts on tourism-based economies (Pettipas et al., 2016). Next, the majority of plastic packages are produced from fossil fuels, resulting in a large carbon footprint (Spierling et al., 2018). An estimate of the cost of externalities related to the use of plastics is US\$40 billion annually. Such externalities are attributed to the greenhouse gas emissions resulting from production phase (which consumes fossil feed-stocks) and after-use incineration, damage to natural systems such as the ocean and clogging sewers and other urban infrastructure, and health and environmental impacts from synthetic substances and additives (Ellen MacArthur Foundation, 2017). Calls are made for the adoption of a radically different model of consumption – one that does not involve single-use packaging – to help solve the plastic waste challenge (Ellen MacArthur Foundation, 2017).

### *Public policy response to the plastic waste challenge*

In Australia and elsewhere, bans on single-use plastic bags for grocery shopping have been enacted to reduce environmental harm (Australian Government Department of Agriculture, Water and the Environment, 2020) on account of their volume, the resource intensiveness (i.e. energy use) of their manufacture and the fact that 90% are used only once before being consigned to rubbish (Muralidharan & Sheehan, 2016). Plastic bags, are, however, part of a much wider pollution marine pollution problem in which other forms of plastics play a significant role (Duhec, Jeanne, Maximenko, & Hafner, 2015). For instance, it is reported that 30% of plastic packaging items that are too small or too complex to be recycled often find their way into the ocean, for example, coffee cup lids, food wrappers, take-away boxes, drink pouches and sachets.

In the European Union (EU), the circular economy approach is increasingly embraced by both industry and policy spheres, as evident in the EU waste legislation and directives to reduce plastic pollution (Foschi & Bonoli, 2019). A growing number of international agreements (e.g. UNEA-3) (Finska, 2018), EU policies and strategies (e.g. the Strategy for Plastics in a CE) (European Commission, 2018d), legislative initiatives on single-use plastics (SUPs), and voluntary agreements (e.g. UK Plastics Pact) demonstrate commitment to solving plastic waste. The voluntary Australian Packaging Covenant (APCC, 2010) have assisted the packaging supply chain to rethink the design of packaging materials and formats to reduce their environmental impacts.

In Australia, it is reported that only 11.5% of plastics are recovered for recycling or energy. Furthermore, “...*away-from-home plastic packaging collection systems are underdeveloped...and most of these products continue to be disposed to landfill at end of life*” (Australian Government Department of Agriculture, Water and the Environment, 2020, p. 9). This makes the need for collaboration between industry and government, to ensure the development of more sustainable materials for packaging, and the correct disposal thereof, particularly important. A recent literature review has shown that interest in the plastic problem had markedly increased in social science in the last few years (Heidbreder, Bablok, Drews, & Menzel, 2019). While the problem is complex and no one single solution is likely to have an immediate impact, a diverse range of stakeholders working collaboratively have the potential to make an impact (Heidbreder et al., 2019; Veiga et al., 2016; Vince & Hardesty, 2016).

#### *Industry response: bioplastics and edible packaging*

Sustainable packaging initiatives are aligned with the goal of sustainable development, i.e., development that meets the needs of the present, without compromising the needs of future generations (World Commission on Environment and Development, 1987). Sustainable packaging is defined as “packaging that has a comparatively low environmental impact as measured by life cycle models” (Steenis, van Herpen, van der Lans, Ligthart, & van Trijp, 2017, p. 278). One of the sustainable alternatives are packages that are bio-based (derived from biomass), and at least partially made from plant-based materials such as crops, wood or grasses, and are either recyclable or compostable (Taufik, Reinders, Molenveld, & Onwezen, 2020). However, terms such as bio-plastics and biodegradable are not unambiguously defined and labels confuse consumers (Van den Oever, Molenveld, van der Zee, & Bos, 2017). Despite the dynamic research and development on bio-sourced and/or biodegradable materials, market demand is hampered by green washing suspicion, confusion on the part of consumers and controversies about its environment benefit, such as resource utilization, GHG emissions, pollution (Guillard et al., 2018). In addition, considering potential impacts on end users’ health and safety is critical to securing public acceptance (Falcone & Imbert, 2018). Therefore, studies on consumers’ responses to edible packaging are needed.

Edible packaging goes a step further than bio-based packaging, since it has plant-based coatings and films that are edible. Edible films are derived from proteins, lipids and polysaccharide molecules, found in plant-based materials such as cassava, potato starch and seaweed (Umaraw et al., 2020). The films or coatings may be transparent or translucent,

flavourless and colourless, but they may also have a particular taste. The main purpose of edible coatings is to increase the natural barrier of perishable fruits and vegetables, but applications are expected to grow, such as in the use of ready-to-eat products (Aguirre-Joya et al., 2018). Edible packaging has gained wide interest among food scientists and industry (Parente Ribeiro Cerqueira, 2019) and falls within the mandates of the circular economy, and may help mitigate the problem of single-use packaging, linked to convenient consumption (Ellen MacArthur Foundation, 2017).

While edible packaging is a better option than using plastic, it is still in the development phase, with all the technical challenges, associated uncertainties around consumer acceptance and commercial viability (Jeya Jeevahan et al., 2020). The production of some types of edible packaging may have externalities, including land use and biodiversity (Patel, 2019). Practical applications are limited due to the high cost of the raw materials and limited production (Galgano, 2015). While there are niche opportunities for plant-derived packaging, such as edible water pouches for participants in marathons and for some single-use items (i.e., seasoning sachets, wraps for fast food and fresh goods, packets used in meal kits, straws), the higher price could limit its marketability (Patel, 2019). Furthermore, the package needs to be disposed of properly, if consumers do not wish to eat it. Studies have shown that consumers are not familiar with compostable bio-based plastic packaging, and this negatively affects disposal behaviour (Taufik et al., 2020). Despite these limitations, edible packaging has the potential to contribute to a cleaner environment, as the use of bio-based materials in general has lower greenhouse gas emissions than fossil-based materials (Bos, Meesters, Conijn, Corré, & Patel, 2016).

### **Literature review: theoretical models**

In this paper, we advance the literature by developing a conceptual model (see Figure 1) to explain the determinants of consumer adoption of edible packaging. We draw primarily on research into pro-environmental behaviour as well as sustainable lifestyles. The conceptual model draws on the well-known theory of planned behaviour originally developed by Fishbein and Ajzen in 1975, which has been extensively cited, extended and used to predict behaviour in various consumption domains (Bosnjak, Ajzen, & Schmidt, 2020). Such an evaluation of potential theoretical frameworks that can be used to guide future research into edible packaging.

## **Pro-environmental behaviour**

There is a vast literature on pro-environmental behaviour (PEB), which refers to any practice (such as purchasing, use, post-use, management, activism behaviors) that consciously seeks to limit the impact of human activities on the environment (Boz, Korhonen, & Koelsch Sand, 2020). Pro environmental behaviour is understood to be a mixture of self-interest and pro-social motives such as concern for other people, the next generation, other species and eco-systems (Bamberg & Möser, 2007). Research into the field of consumers and their response to sustainable packaging goes back more than twenty years (Herbes, Beuthner, & Ramme, 2018), for example, an early study focused on German consumers and their response to environmentally-friendly packaging (Thøgersen, 1996). Rational models of buyer behaviour, such the theory of planned behaviour (Van Birgelen, Semeijn, & Keicher, 2009) and the theory of reasoned action (TRA) (Prakash & Pathak, 2017), are frequently used in studies of sustainable packaging.

The model that informs this paper (see Figure 1) shows that the critical variables that underpin intentions are attitudes towards a specific behaviour, norms and self-efficacy. These concepts are influenced by beliefs and background influences further back in the causal chain. If perceived behavioural control or self-efficacy is weak (i.e. an individual's belief about their ability to positively influence outcomes such as solving an environmental problem), then a given behaviour may not be performed. Researchers have adopted and adapted these 'behavioural' frameworks and have sought to explore a broader set of influences on environmental behaviour, such as values (Schwartz, 1994) and moral norms (Schwartz, 1977), as well as environmental concern and socio-demographics (Barr, Shaw, & Coles, 2011). For instance, studies have emphasised particular socio-demographic variables, such as gender, education and income, as antecedents of individual ecological concern (Magnier & Schoormans, 2015).

Attitudes are a key variable in the theory of reasoned action (TRA) and they have received considerable attention in the packaging context. For example, scholars have found that consumers who have positive attitudes towards the environment are more likely to purchase eco-friendly products and dispose of packaging in a sustainable manner (Van Birgelen et al., 2009). Studies have also revealed positive attitudes towards 'environmentally friendly' packaging, in particular towards end-of-life attributes, such as recyclability, reusability and biodegradability (Herbes et al., 2018), but confusion and greenwashing



concerns exist (Lynch, Klaassen, & Broerse, 2017). Among various packages, it is found that compostable bio-based packages have the most environmental appeal for consumers, although a lack of familiarity hampers proper disposal (Taufik et al., 2020).

It is widely acknowledged in the consumer behaviour literature that attitudes have cognitive and affective components (Thodersen, 1999). For instance, consumers with a higher level of bio-based product familiarity generally have more positive attitudes towards bio-based products (Reinders, Onwezen, & Meeusen, 2017). Therefore some awareness or knowledge is needed to guide behaviour. Earlier research has shown that a low salience is given to environmentally-friendly packaging since cues were not obvious and consumers lacked awareness and knowledge of packaging waste (Thøgersen, 1996). In line with such a finding, recent literature shows that consumers do not have a clear idea of what sustainable packaging is (Boz et al., 2020), such as the materials used in bio-based containers and disposal methods available after use (Koutsimanis, Getter, Behe, Harte, & Almenar, 2012). On another note, eco-labels as a tool to communicate the information about the environmental outcomes, are seen as an enabler of consumer adoption in the literature on green purchase behaviour (Nath, Kumar, Agrawal, Gautam, & Sharma, 2013). It is further found that eco-label knowledge is positively associated with attitudes towards the environment, and trust in eco-labels affects 'green' purchasing behaviour (Taufique, Vocino, & Polonsky, 2017). Scholars thus have concluded that building consumer knowledge and trust in eco-labels is imperative<sup>1</sup>.

The limitations of behavioural models have been widely debated. Research has found a weak correlation between general environmental attitudes and specific behaviour (Alwitt & Pitts, 1996) and the attitudes-behaviour gap is well recognised in the literature (Ketelsen, Janssen, & Hamm, 2020). One study on Romanian consumers found that the main barriers to adoption of green packaging are the price and lack of information (Orzan, Cruceru, Bălăceanu, & Chivu, 2018). Likewise, a review of reusable packaging systems found that inconvenience, lack of availability, cost and pricing issues are barriers (Coelho, Corona, ten Klooster, & Worrell, 2020). Plastic use is embedded in everyday practices and their use can only be understood in terms of the services they provide, and the "wider networks and relations of which they are part." (Evans, Parsons, Jackson, Greenwood, & Ryan, 2020).

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<sup>1</sup> It must be noted that the assumption that increased knowledge will lead to pro-environmental behaviour is the subject of much debate in the literature (Ardoin, Wheaton, Bowers, Hunt, & Durham, 2015).

The theory of reasoned action (TRA) has been applied to sustainable packaging (Prakash & Pathak, 2017), where a study of young Indian consumers confirmed that purchase intention is significantly influenced by personal norms, attitudes, environmental concern and willingness to pay. Another study, based on structural equation modelling, revealed that environment- and health-related concerns associated with plastics are key drivers of plastic avoidance (Cavaliere). Environmental concern is frequently measured in the literature on the response of consumers to ‘green’ packaging (Ketelsen et al., 2020). In the context of green purchase behaviour, studies have found that peer influence is a top predictor of green purchase behaviour (Taufik et al., 2020).

#### *Habitual behaviour and consumer response to packaging design*

The theoretical frameworks discussed above largely imply that individuals make reasoned choices and tend to over-rationalise behaviour (Burgess, Harrison, & Filius, 1998). However, in many cases, behaviour is habitual and guided by automated cognitive processes, rather than being preceded by elaborate reasoning (Jakovcevic et al., 2014). Therefore, the application of these behavioural models to habitual practices, such as grocery shopping, may require further explanations.

Packaging has an important role in influencing in-store purchasing decisions, especially for food products where purchase decisions are characterized by low involvement, habits or impulsive processes (Liao, Corsi, Chrysochou, & Lockshin, 2015). In the food literature, a distinction is often made between intrinsic and extrinsic cues. The former refers to cues, which if changed would produce a change in the physical or chemical aspects of the product (such as colour, flavor, aroma, alcohol content), while the latter refers to non-physical characteristics (such as package design) (Szybillo & Jacoby, 1974). Design plays an important role in purchasing decisions and cues such as the packaging material, aesthetic elements such as the colour and graphics, and text elements, have been found to influence expectations and attitudes in relation to sustainable packaging (Rebollar et al., 2017). The literature on package design shows that consumers make use of simple visual elements with limited cognitive effort to make fast decisions in grocery stores (Clement, Kristensen, & Grønhaug, 2013). Therefore, quick, emotional responses to packaging must be taken into account and not just cognitive deliberations.

## **Market segmentation and sustainable lifestyles**

Segmentation studies are common in the literature, where attempts are made to assign individuals to particular groups or segments, based on a complex array of behaviours and attitudes (Barr et al., 2011). For instance, studies have identified three sustainability-related segments, such as 'greens', 'potential greens' and 'non-greens' (Verain et al., 2012). Scholars have argued that lifestyle segmentation is a sophisticated means of interpreting groups, rather than focusing exclusively on socio-demographic variables (Lubowiecki-Vikuk, Dąbrowska, & Machnik, 2021). Sociologists however adopt a different perspective and question the notion of individualistic lifestyle choices, and frame consumption as a set of day-to-day practices and habits that are interdependent and socially embedded (Shove & Warde, 2002).

### *Sustainable lifestyles and spill-over effects*

The notion of sustainable lifestyles has been critiqued within the context of the ongoing debate concerning 'spillover' effects. The concept of spill-over effects asserts that one pro-environmental behaviour increases the likelihood of performing additional pro-environmental behaviours (Truelove, Carrico, Weber, Raimi, & Vandenberg, 2014). Aligned with such a prediction, positive spillovers have been observed, where recycling positively correlates with the avoidance of excess packaging (Thøgersen, 1999). On the other hand, scholars have found that behaviours performed in one consumption setting, such as in the home, do not automatically lead to change in another setting, such as a reduction in air travel within leisure and tourism settings (Barr et al., 2011). The absence of spillovers may be explained by different factors such as decision making mode, motives and the characteristics of the behaviour, whether it is difficult or new (Truelove et al., 2014). Counter-arguing is put forward as another explanation, particularly when individuals are asked to take responsibility for solving problems they did not cause, and therefore the balance between personal cost and benefits needs to be adjusted (Thøgersen, 1999). Inconsistent findings in the literature suggest the need for further research.

### *Personal factors: perceived risk and uncertainty*

Perceived risk and uncertainty are key influences on consumer purchasing decisions (Koenig-Lewis, Palmer, Dermody, & Urbye, 2014). Perceived risk is related to the functional or physical properties of the new sustainable materials, as well as to health-related risks (Chen and Chang, 2013). In the case of products made of recycled ocean plastic, it is proposed that consumers might be afraid of contamination risk and this risk is high for

food and drink products (Magnier et al., 2019). A recent study on bio-based products found that highly ambivalent consumers are more sensitive to risks than less ambivalent consumers, and such a sensitivity is negatively associated with purchase intentions (Onwezen, Reinders, & Sijtsema, 2017).

#### *Interdependencies between the food product and packaging attributes.*

The adoption of new forms of packaging depends not only on the package, but also the product within it, so the interdependencies between packaging and products (i.e., foods) need to be analysed (Boz et al., 2020). One study reported that framing an edible package as one with environmental benefits can lead to negative judgements about the product attributes, such as health and taste (Aldred Cheek & Wansink, 2017). Several studies have found that environmentally-friendly packaging is less important to consumers than other product attributes, such as price, product quality (Martinho, Pires, Portela, & Fonseca, 2015) and healthiness (Cammarelle, Viscecchia, & Bimbo, 2020). Inconsistent findings in the literature suggest the need for further research.

#### **Propositions**

Based on the literature review and contradictory findings in the literature, we propose a research model, illustrated in Figure 2. This model deals with sustainable packaging from the consumer's point of view. A list of measurement scales obtained from prior literature can be found in Appendix 1. Consumers who are committed to being environmentally responsible are likely to buy edible packaging, due to positive spill-over effects. An adoption of sustainable patterns of living should reflect positive attitudes towards pro-environmental behaviour. Thus, we propose:

*Proposition 1: The adoption of a sustainable lifestyle has a direct and positive influence on purchase intentions of edible packaging.*

The literature review shows that attitudes have a cognitive component (Thodersen, 1999) and therefore some familiarity with edible packaging is needed to guide purchase. We propose:

*Proposition 2: Familiarity with edible packaging has a direct and positive influence on purchase intentions of edible packaging.*

The adoption of sustainable packaging is found to be influenced by the interdependencies between food attributes and the package. Consumers may find it difficult to accept edible packaging due to reservations about safety and hygiene.

*Proposition 3: Concern about safety will weaken purchase intentions of edible packaging.*

Pro environmental behaviour is understood to be a mixture of self-interest and pro-social motives. Concern about personal costs and risks are emphasized in the literature.

Therefore, the following hypotheses are formulated:

*Proposition 4: Concern about healthiness and naturalness will weaken purchase intentions of edible packaging.*

The literature emphasizes the concept of self-efficacy and this factor reflects the belief that one's action can, or cannot, contribute to solving environmental problems. The proposition is as follows:

*Proposition 5: Belief in one's ability to influence environmental outcomes, such as plastic pollution, has a direct and positive influence on purchase intentions.*

The literature highlights that trust is an enabler of consumer acceptance of sustainable packaging and the final proposition is as follows:

*Proposition 6: Trust in eco labels has a direct and positive influence on purchase intentions.*

## **Summary**

In the face of growing societal concerns about plastic pollution, the packaging industry is bringing new forms of packaging to the marketplace. The success of next generation sustainable packaging forms is strongly linked to consumer acceptance, so it is important to understand the factors underlying pro-environmental behaviour. Innovation models remain in the background and this paper contributes to the literature by reviewing theories relevant to the adoption of innovation, as well as the theory of reasoned action, lifestyle segmentation and the concept of spill-over effects. A model is proposed to explain purchase intentions in the context of edible packaging.

## References

- Ardoin, N. M., Wheaton, M., Bowers, A. W., Hunt, C. A., & Durham, W. H. (2015). Nature-based tourism's impact on environmental knowledge, attitudes, and behavior: a review and analysis of the literature and potential future research. *Journal of Sustainable Tourism, 23*(6), 838-858.
- Aguirre-Joya, J. A., De Leon-Zapata, M. A., Alvarez-Perez, O. B., Torres-León, C., Nieto-Oropeza, D. E., Ventura-Sobrevilla, J. M., . . . Ramos-Aguiñaga, M. E. (2018). Basic and applied concepts of edible packaging for foods. In *Food packaging and preservation* (pp. 1-61): Elsevier.
- Aldred Cheek, K., & Wansink, B. (2017). Making it part of the package: Edible packaging is more acceptable to young consumers when it is integrated with food. *Journal of food products marketing, 23*(6), 723-732.
- Baird, R. W., & Hooker, S. K. (2000). Ingestion of plastic and unusual prey by a juvenile harbour porpoise. *Can. J. Fish. Aquat. Sci, 51*, 172-178.
- Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*(1), 14-25.
- Barr, S., Shaw, G., & Coles, T. (2011). Times for (Un)sustainability? Challenges and opportunities for developing behaviour change policy. A case-study of consumers at home and away. *Global Environmental Change, 21*(4), 1234-1244.  
doi:<https://doi.org/10.1016/j.gloenvcha.2011.07.011>
- Bartolotta, J. F., & Hardy, S. D. (2018). Barriers and benefits to desired behaviors for single use plastic items in northeast Ohio's Lake Erie basin. *Marine pollution bulletin, 127*, 576-585.
- Bos, H. L., Meesters, K. P., Conijn, S. G., Corré, W. J., & Patel, M. K. (2016). Comparing biobased products from oil crops versus sugar crops with regard to non-renewable energy use, GHG emissions and land use. *Industrial Crops and Products, 84*, 366-374.
- Bosnjak, M., Ajzen, I., & Schmidt, P. (2020). The Theory of Planned Behavior: Selected Recent Advances and Applications. *Europe's Journal of Psychology, 16*(3), 352-356.
- Boz, Z., Korhonen, V., & Koelsch Sand, C. (2020). Consumer considerations for the implementation of sustainable packaging: A review. *Sustainability, 12*(6), 2192.
- Burgess, J., Harrison, C. M., & Filius, P. (1998). Environmental communication and the cultural politics of environmental citizenship. *Environment and planning A, 30*(8), 1445-1460.
- Cavaliere, A. Do Consumers Really Want to Reduce Plastic Usage? Exploring the Determinants of Plastic Avoidance in Food-Related Consumption Decisions. *Sustainability (Basel, Switzerland), 12*(22), 1-15. doi:10.3390/su12229627
- Clement, J., Kristensen, T., & Grønhaug, K. (2013). Understanding consumers' in-store visual perception: The influence of package design features on visual attention. *Journal of Retailing and Consumer Services, 20*(2), 234-239.
- Coelho, P. M., Corona, B., ten Klooster, R., & Worrell, E. (2020). Sustainability of reusable packaging-Current situation and trends. *Resources, Conservation & Recycling: X, 100037*.
- Davison, L., & Redhill, D. (1998). Structural packaging design: Building and protecting brand value. *Journal of Brand Management, 6*(1), 13-26. doi:10.1057/bm.1998.41
- Duhec, A. V., Jeanne, R. F., Maximenko, N., & Hafner, J. (2015). Composition and potential origin of marine debris stranded in the Western Indian Ocean on remote Alphonse Island, Seychelles. *Marine pollution bulletin, 96*(1), 76-86.

- Eagle, L., Hamann, M., & Low, D. R. (2016). The role of social marketing, marine turtles and sustainable tourism in reducing plastic pollution. *Marine pollution bulletin*.
- Evans, D. M., Parsons, R., Jackson, P., Greenwood, S., & Ryan, A. (2020). Understanding plastic packaging: The co-evolution of materials and society. *Global Environmental Change*, 65, 102166.
- Falcone, P. M., & Imbert, E. (2018). Social life cycle approach as a tool for promoting the market uptake of bio-based products from a consumer perspective. *Sustainability*, 10(4), 1031.
- Galgano, F. (2015). Biodegradable packaging and edible coating for fresh-cut fruits and vegetables. *Italian Journal of Food Science*, 27(1), 1-20.
- Geiger, S. M., Fischer, D., & Schrader, U. (2018). Measuring what matters in sustainable consumption: an integrative framework for the selection of relevant behaviors. *Sustainable Development*, 26(1), 18-33.
- Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science advances*, 3(7), e1700782.
- Gregory, M. R. (2009). Environmental implications of plastic debris in marine settings—entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 364(1526), 2013-2025.
- Guillard, V., Gaucel, S., Fornaciari, C., Angellier-Coussy, H., Buche, P., & Gontard, N. (2018). The next generation of sustainable food packaging to preserve our environment in a circular economy context. *Frontiers in nutrition*, 5, 121.
- Heidbreder, L. M., Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of The Total Environment*, 668, 1077-1093.
- Herbes, C., Beuthner, C., & Ramme, I. (2018). Consumer attitudes towards biobased packaging—A cross-cultural comparative study. *Journal of Cleaner Production*, 194, 203-218.
- Jakovcevic, A., Steg, L., Mazzeo, N., Caballero, R., Franco, P., Putrino, N., & Favara, J. (2014). Charges for plastic bags: Motivational and behavioral effects. *Journal of Environmental Psychology*, 40, 372-380.
- Jeya Jeevahan, J., Chandrasekaran, M., Venkatesan, S. P., Sriram, V., Britto Joseph, G., Mageshwaran, G., & Durairaj, R. B. (2020). Scaling up difficulties and commercial aspects of edible films for food packaging: A review. *Trends in Food Science & Technology*, 100, 210-222. doi:<https://doi.org/10.1016/j.tifs.2020.04.014>
- Ketelsen, M., Janssen, M., & Hamm, U. (2020). Consumers' response to environmentally-friendly food packaging - A systematic review. *Journal of Cleaner Production*, 254, 120123. doi:<https://doi.org/10.1016/j.jclepro.2020.120123>
- Koenig-Lewis, N., Palmer, A., Dermody, J., & Urbye, A. (2014). Consumers' evaluations of ecological packaging—Rational and emotional approaches. *Journal of Environmental Psychology*, 37, 94-105.
- Koutsimanis, G., Getter, K., Behe, B., Harte, J., & Almenar, E. (2012). Influences of packaging attributes on consumer purchase decisions for fresh produce. *Appetite*, 59(2), 270-280.
- Liao, L. X., Corsi, A. M., Chrysochou, P., & Lockshin, L. (2015). Emotional responses towards food packaging: A joint application of self-report and physiological measures of emotion. *Food Quality and Preference*, 42, 48-55. doi:<https://doi.org/10.1016/j.foodqual.2015.01.009>

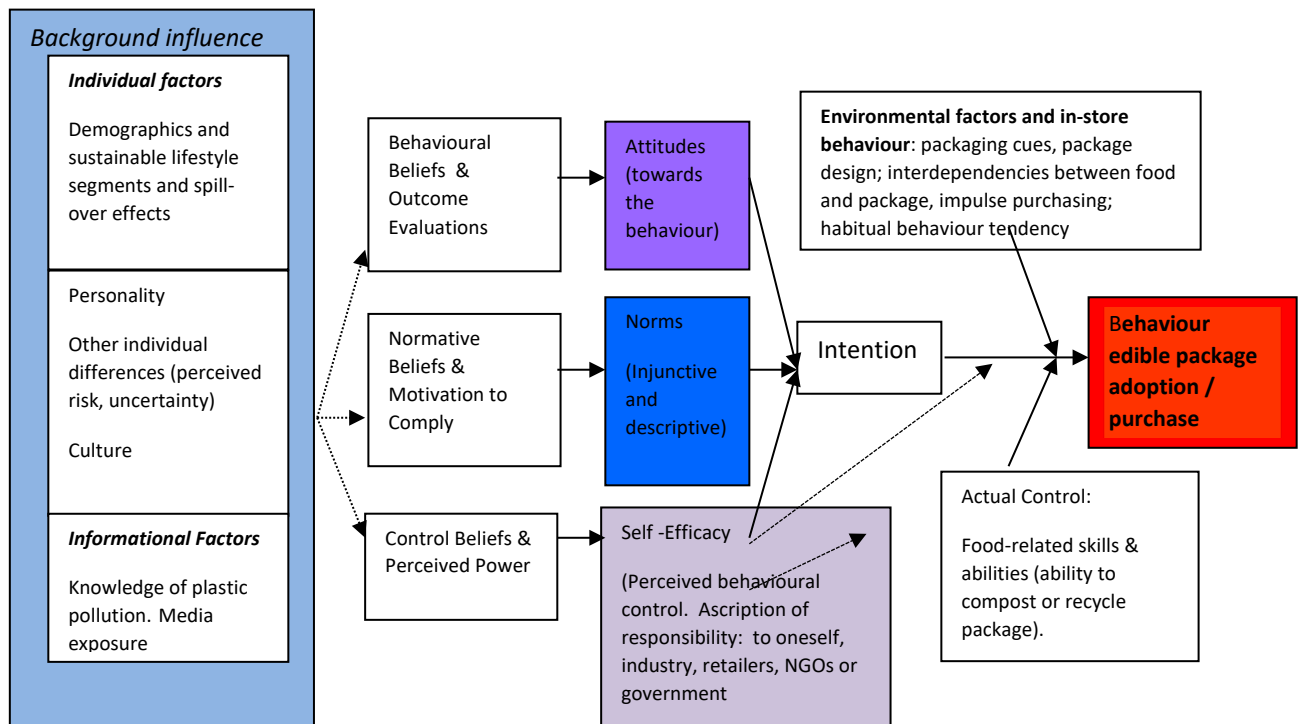
- Lubowiecki-Vikuk, A., Dąbrowska, A., & Machnik, A. (2021). Responsible consumer and lifestyle: Sustainability insights. *Sustainable Production and Consumption*, 25, 91-101. doi:10.1016/j.spc.2020.08.007
- Lynch, D. H., Klaassen, P., & Broerse, J. E. (2017). Unraveling Dutch citizens' perceptions on the bio-based economy: The case of bioplastics, bio-jetfuels and small-scale bio-refineries. *Industrial crops and products*, 106, 130-137.
- Magnier, L., & Schoormans, J. (2015). Consumer reactions to sustainable packaging: The interplay of visual appearance, verbal claim and environmental concern. *Journal of Environmental Psychology*, 44, 53-62.
- Martinho, G., Pires, A., Portela, G., & Fonseca, M. (2015). Factors affecting consumers' choices concerning sustainable packaging during product purchase and recycling. *Resources, conservation and recycling*, 103, 58-68.
- Muralidharan, S., & Sheehan, K. (2016). "Tax" and "Fee" Message Frames as Inhibitors of Plastic Bag Usage Among Shoppers: A Social Marketing Application of the Theory of Planned Behavior. *Social Marketing Quarterly*, 1, 18.
- Nath, V., Kumar, R., Agrawal, R., Gautam, A., & Sharma, V. (2013). Consumer adoption of green products: Modeling the enablers. *Global business review*, 14(3), 453-470.
- Nelms, S. E., Duncan, E. M., Broderick, A. C., Galloway, T. S., Godfrey, M. H., Hamann, M., . . . Godley, B. J. (2015). Plastic and marine turtles: a review and call for research. *ICES Journal of Marine Science: Journal du Conseil*, fsv165.
- Onwezen, M. C., Reinders, M. J., & Sijtsema, S. J. (2017). Understanding intentions to purchase bio-based products: The role of subjective ambivalence. *Journal of Environmental Psychology*, 52, 26-36.  
doi:<https://doi.org/10.1016/j.jenvp.2017.05.001>
- Orzan, G., Cruceru, A. F., Bălăceanu, C. T., & Chivu, R.-G. (2018). Consumers' Behavior Concerning Sustainable Packaging: An Exploratory Study on Romanian Consumers. *Sustainability*, 10(6), 1787.
- Parente Ribeiro Cerqueira, M. Â. (2019). Edible Packaging. In L. Melton, F. Shahidi, & P. Varelis (Eds.), *Encyclopedia of Food Chemistry* (pp. 173-176). Oxford: Academic Press.
- Patel, P. (2019). Edible Packaging. *ACS Central Science*, 5(12), 1907-1910.  
doi:10.1021/acscentsci.9b01251
- Pettipas, S., Bernier, M., & Walker, T. R. (2016). A Canadian policy framework to mitigate plastic marine pollution. *Marine Policy*, 68, 117-122.
- Politis, A. E., Sarigiannidis, C., & Voutsinas, V. (2019). *The Environmental Aspects of Packaging: Implications for Marketing Strategies*, Cham.
- Prakash, G., & Pathak, P. (2017). Intention to buy eco-friendly packaged products among young consumers of India: A study on developing nation. *Journal of Cleaner Production*, 141, 385-393.
- Reinders, M. J., Onwezen, M. C., & Meeusen, M. J. (2017). Can bio-based attributes upgrade a brand? How partial and full use of bio-based materials affects the purchase intention of brands. *Journal of Cleaner Production*, 162, 1169-1179.
- Rowley, K. H., Cucknell, A.-C., Smith, B. D., Clark, P. F., & Morritt, D. (2020). London's river of plastic: High levels of microplastics in the Thames water column. *Science of The Total Environment*, 740, 140018.  
doi:<https://doi.org/10.1016/j.scitotenv.2020.140018>
- Schnurr, R. E., Alboiu, V., Chaudhary, M., Corbett, R. A., Quanz, M. E., Sankar, K., . . . Walker, T. R. (2018). Reducing marine pollution from single-use plastics (SUPs): A review. *Marine pollution bulletin*, 137, 157-171.



- Schwartz, S. H. (1977). Normative influences on altruism. *Advances in experimental social psychology*, 10(1), 221-279.
- Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? *Journal of social issues*, 50(4), 19-45.
- Sharma, H. B., Vanapalli, K. R., Cheela, V. S., Ranjan, V. P., Jaglan, A. K., Dubey, B., . . . Bhattacharya, J. (2020). Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic. *Resources, conservation and recycling*, 162, 105052.
- Shove, E., & Warde, A. (2002). Inconspicuous consumption: the sociology of consumption, lifestyles and the environment. *Sociological theory and the environment: classical foundations, contemporary insights*, 230(51).
- Signori, P., Gozzo, I., Flint, D. J., Milfeld, T., & Nichols, B. S. (2019). Sustainable Customer Experience: Bridging Theory and Practice. In *The Synergy of Business Theory and Practice* (pp. 131-174): Springer.
- Spierling, S., Knüpfper, E., Behnsen, H., Mudersbach, M., Krieg, H., Springer, S., . . . Endres, H.-J. (2018). Bio-based plastics-a review of environmental, social and economic impact assessments. *Journal of Cleaner Production*, 185, 476-491.
- Steenis, N. D., van Herpen, E., van der Lans, I. A., Ligthart, T. N., & van Trijp, H. C. (2017). Consumer response to packaging design: The role of packaging materials and graphics in sustainability perceptions and product evaluations. *Journal of Cleaner Production*, 162, 286-298.
- Szybillo, G. J., & Jacoby, J. (1974). Intrinsic versus extrinsic cues as determinants of perceived product quality. *Journal of Applied Psychology*, 59(1), 74.
- Taufik, D., Reinders, M. J., Molenveld, K., & Onwezen, M. C. (2020). The paradox between the environmental appeal of bio-based plastic packaging for consumers and their disposal behaviour. *Science of The Total Environment*, 705, 135820. doi:<https://doi.org/10.1016/j.scitotenv.2019.135820>
- Taufique, K. M. R., Vocino, A., & Polonsky, M. J. (2017). The influence of eco-label knowledge and trust on pro-environmental consumer behaviour in an emerging market. *Journal of Strategic Marketing*, 25(7), 511-529.
- Thøgersen, J. (1996). The demand for environmentally friendly packaging in Germany.
- Thøgersen, J. (1999). Spillover processes in the development of a sustainable consumption pattern. *Journal of economic psychology*, 20(1), 53-81.
- Truelove, H. B., Carrico, A. R., Weber, E. U., Raimi, K. T., & Vandenberg, M. P. (2014). Positive and negative spillover of pro-environmental behavior: An integrative review and theoretical framework. *Global Environmental Change*, 29, 127-138.
- Umaraw, P., Munekata, P. E. S., Verma, A. K., Barba, F. J., Singh, V. P., Kumar, P., & Lorenzo, J. M. (2020). Edible films/coating with tailored properties for active packaging of meat, fish and derived products. *Trends in Food Science & Technology*, 98, 10-24. doi:<https://doi.org/10.1016/j.tifs.2020.01.032>
- Van Birgelen, M., Semeijn, J., & Keicher, M. (2009). Packaging and proenvironmental consumption behavior: Investigating purchase and disposal decisions for beverages. *Environment and Behavior*, 41(1), 125-146.
- Van den Oever, M., Molenveld, K., van der Zee, M., & Bos, H. (2017). *Bio-based and biodegradable plastics: facts and figures: focus on food packaging in the Netherlands*: Wageningen Food & Biobased Research.
- Veiga, J. M., Vlachogianni, T., Pahl, S., Thompson, R. C., Kopke, K., Doyle, T. K., . . . Loizidou, X. I. (2016). Enhancing public awareness and promoting co-responsibility for marine litter in Europe: The challenge of MARLISCO. *Marine pollution bulletin*, 102(2), 309-315.

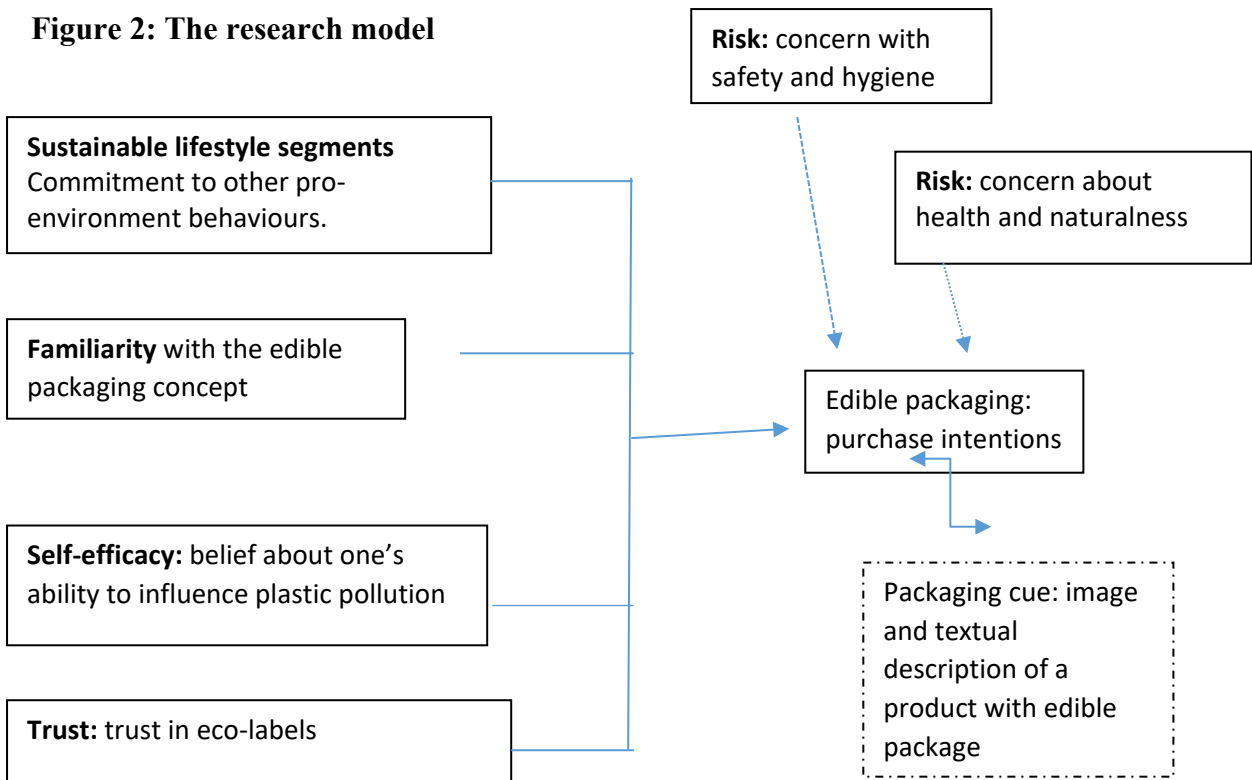
- Verain, M. C., Bartels, J., Dagevos, H., Sijtsema, S. J., Onwezen, M. C., & Antonides, G. (2012). Segments of sustainable food consumers: a literature review. *International journal of consumer studies*, 36(2), 123-132.
- Vince, J., & Hardesty, B. D. (2016). Plastic pollution challenges in marine and coastal environments: from local to global governance. *Restoration Ecology*.
- Wikström, F., Williams, H., Verghese, K., & Clune, S. (2014). The influence of packaging attributes on consumer behaviour in food-packaging life cycle assessment studies - a neglected topic. *Journal of Cleaner Production*, 73, 100-108.  
doi:<https://doi.org/10.1016/j.jclepro.2013.10.042>
- Wilcox, C., Mallos, N. J., Leonard, G. H., Rodriguez, A., & Hardesty, B. D. (2016). Using expert elicitation to estimate the impacts of plastic pollution on marine wildlife. *Marine Policy*, 65, 107-114.
- Zalasiewicz, J., Waters, C. N., do Sul, J. A. I., Corcoran, P. L., Barnosky, A. D., Cearreta, A., . . . Leinfelder, R. (2016). The geological cycle of plastics and their use as a stratigraphic indicator of the Anthropocene. *Anthropocene*, 13, 4-17.
- Zettler, E. R., Mincer, T. J., & Amaral-Zettler, L. A. (2013). Life in the “plastisphere”: microbial communities on plastic marine debris. *Environmental science & technology*, 47(13), 7137-7146.

**Figure 1: An integrative Model of the Determinants of Sustainable Packaging Adoption**



Source: Adapted from Fishbein & Cappella (2006).

**Figure 2: The research model**



## Appendix 1

**Table 1.** Summary of Measures of Sustainable Consumption

Scale name	Authors	Description	Items
Purchase intention	(Prakash & Pathak, 2017)	I would prefer to buy products with packaging materials that are environmentally-friendly. I would buy products with packaging materials that are environmentally-friendly, even if they belong to a less well-known company.	2 items; 5 point Likert scale, from strongly agree to strongly disagree.
Sustainable consumption behaviour	(Geiger, Fischer, & Schrader, 2018)	Four key dimensions of sustainable consumption behaviour (SCB) and impact. Covering phases from acquisition, to usage and disposal of products and services; covering consumption domains such as food, housing, mobility and clothing.	16 item; 5 point frequency scale, never to always.
Behaviours specifically related to use of single use plastics.	(Schnurr et al., 2018) (Bartolotta & Hardy, 2018)	I use single use plastic bags I use plastic water bottles	2 items; 5 point frequency scale, never to always.
Behaviours related to recycling and mindful consumption	(Schnurr et al., 2018). (Bartolotta & Hardy, 2018).	I recycle as much as I can I try to reduce my amount of rubbish. I try to reduce my consumption.	3 items; 5 point frequency scale, never to always
Familiarity with edible packaging	(Herbes et al., 2018)	Hygiene and safety: the product with edible packaging may not be as safe as standard products.	1 item; 5 point familiarity scale, not at all to very familiar.
Concern about healthiness	(Aldred Cheek & Wansink, 2017)	Healthiness: the ingredients may not be as nutritious as other foods	1 item; 5 point concern scale, from not at all concerned to very concerned
Concern about naturalness	Author-derived	Naturalness: the ingredients of the edible package may not be as natural or as pure as other products	1 items; 5 point concern scale, from not at all concerned to very concerned
Self-efficacy (ascription of responsibility)	Adapted from Herbes, Beuthner, & Ramme, 2018.	Protecting the environment from plastic pollution is the responsibility of the consumer. Protecting the environment from plastic pollution is the responsibility of our government. Protecting the environment from plastic pollution is the responsibility of environmental organisations (like WWF or Greenpeace). Protecting the environment from plastic pollution is the responsibility of business / corporations.	5 items, 5 point scale, most responsible to least responsible.
Trust in eco-labels	(Taufique et al., 2017)	The labels are genuinely committed to environmental protection. Most of what labels say about its products is true. If the label makes a claim or promise about its product, it's probably true.	3 items, 5 point Likert scale, ranging from strongly agree to strongly disagree.