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Article

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Pre-cycling contemplation – an explanation on the interplay between recycling consideration and purchase intention, and the role of semiotic knowledge

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ABSTRACT

The waste crisis in Australia has been exacerbated in recent years, emphasising the need to investigate consumer recycling. Purchasing intention of products with recyclable packaging, or recycling shopping behaviour, is identified as a more relevant touchpoint to improve overall recycling efforts, indicating that recycling signs and relevant constructs are important to be investigated. Drawing the conceptual framework from the Theory of Planned Behaviour and extending it, the study aimed at investigating the influences of semiotic knowledge, or the knowledge of signs, on recycling shopping behaviour in the context of Fast-Moving Consumers' Goods. The construct of precycling was also conceptualised and incorporated in the model to establish the prerequisite conditions for semiotic knowledge. Using Structural Equation Modelling and AMOS 26 software, the research validated moral norms and recycling considerations as the factors constituting one's pre-cycling contemplation, with semiotic knowledge displaying a moderating effect. The research contributes to the domain of recycling shopping behaviour and precycling, in which semiotic knowledge is found to enhance consumers' tendency for purchasing products with recyclable packaging. Recommendations were made towards manufacturers in retail environments and policymakers for waste reduction.

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1. Introduction

Consumers' recycling is always considered as a post-purchase decision (Babin & Harris, 2018), which is true when people's participation in the whole waste management process begins with putting containers, boxes, or recyclable packaging into the right bins for sorting later and being properly recycled, in both out-of-home or at-home occasions (Environmental Protection Authority Victoria, 2020). Indeed, post-purchase decision has become a key touchpoint for recycling efforts among consumers, understandably drawing relevant attention for research, through which recycling intention is the desired behavioural outcome. However, household recycling in Australia, as post-purchase behaviour, will not necessarily lead to waste reduction if the packaging of purchased products is non-recyclable in the first place. In fact, an alarming figure of only 13% of consumer-generated wastes is recyclables (Australian Bureau of Statistics, 2020), indicating the significance of purchasing products with recyclable packaging in the first instance as a more relevant touchpoint, to facilitate the actual behaviour afterwards. Purchase decisions of products with recyclable packaging, or recycling shopping behaviour (Biswas et al., 2000), can lead to an overarching understanding of consumers' choice in retail stores, effectively and directly improving recycling behaviour at home. In light of this, the focus of this paper is on recycling shopping behaviour in retail stores as the behaviour of interest, and its influencing factors.

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While consumers' likelihood of recycling shopping behaviour (Biswas et al., 2000) in general has been widely investigated in research, the explored antecedents were limited to the individuals' personal factors such as environmental concerns (EC), moral norms, and recyclability communication cues including packaging colours or materials (Martinho et al., 2015; Prakash & Pathak, 2017; Steenis et al., 2017, Kim & Seock, 2019, Kautish & Sharma, 2019, Moshood et al., 2022, Sun et al., 2022), indicating some neglected construct to be further investigated in the domain of recycling shopping behaviour. Enhanced communication on packaging recyclability is suggested to be the primary driver for recycling shopping; however, the role of packaging signs/symbols, the primary mediums to deliver such communication and persuasion effects is not well researched (Kauppinen-Räsänen, 2013; Magnier & Schoormans, 2015, 2017; Mai et al., 2016; Seo & Scammon, 2017; Steenis et al., 2017). Past research even posited that this may have resulted in either short-term attitudinal change towards the behaviour or inconsistent behaviour (Steenis et al., 2017, Grunert, 2011, Kwetelsen et al., 2020), due to the messages on packaging recyclability being processed through the peripheral route. This indicates a significant research gap in which the role of these recyclable packaging signs needs to be further explored with regards to their impacts on recycling shopping behaviour. The construct of interest is referred to as semiotic knowledge - consumers' awareness and comprehension of recyclable packaging signs/symbols, which will shed light on how recycling shopping can be enhanced as a both theoretical and practical contribution.

On a theoretical perspective, the paper draws its conceptual framework from the Theory of Planned Behaviour, with a proposed contribution as semiotic knowledge as a new antecedent. Research that seeks to expand the model is abundant yet still required (Chan & Bishop, 2013; Botetzagias et al., 2015; Mak et al., 2018; Kim & Seock, 2019; Sun et al., 2022); thus, the theoretical contribution with this construct is even more desirable and significant, considering recycling signs are the official indicator of packaging recyclability yet underwhelmingly studied. In this manner, the findings will present valuable theoretical contributions to the Theory of Planned Behaviour and the research domain of recycling shopping behaviour as a whole.

On a practical perspective, the theoretically justified addition of semiotic knowledge will encourage both retailers and manufacturers to further utilise recycling signs on packaging which are the official indicator of packaging recyclability and general sustainability (Australian Packaging Covenant, 2018). The research findings will therefore provide retailers and manufacturers recommendations towards the enhancement of recycling shopping behaviour in retail stores, ensuring their compliance with Government's initiatives for waste reduction.

2. Literature review and hypothesis development

2.1. The theory of planned behaviour

Theory of Planned Behaviour (TPB) is an extension of Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). With the incorporation of the construct of Perceived Behavioural Control (PBC), TPB addressed the limitations of TRA in dealing with "*behaviours over which people have incomplete volitional control*" (Ajzen, 1991). The Theory of Planned Behaviour is among the most extensively quantitatively tested, and subsequently widely used in both social and commercial marketing contexts (Eagle et al., 2013), including sustainable consumption. TPB examines one's behavioural intentions using the three constructs – attitude towards the behaviour, subjective norms, and PBC. Ajzen (1991) refers to the components of the TPB model, for instance, attitudes refer to the extent to which a person has favourable or unfavourable appraisal of an act, whereas subjective norms, usually being translated into social norms and personal norms/moral norms (i.e., the social norms that have been personally internalised), refer to the perceived social pressure on performing or not performing the behaviour. The last construct, which is also the additional antecedent to TPB, is PBC – one's perceptions of the required resources and opportunities towards carrying out the behaviour in question. While the constructs of attitudes and subjective norms are measured using consistent scales, within the domain of eco-friendly behaviour, those of PBC may vary according to the contexts, ranging from convenience, opportunities, costs and available infrastructure for household recycling intention (Botetzagias et al., 2015; Chan & Bishop, 2013; Ramayah et al., 2012), or availability and affordability of purchasing green products (Paul et al., 2016; Scalco et al.,

2017; Hsu et al., 2017; Prakash & Pathak, 2017; Singh & Pandey, 2018). Some studies seek to measure PBC using more generic scales of one's perceived levels of difficulties or ease of taking action (White et al., 2009; Brockhaus et al., 2016; Mak et al., 2018; Clark et al., 2019). In this sense, PBC has also been measured as the perceived ability to carry the behaviour in question. The first hypotheses are therefore formed to reflect the original constructs of the model, which will be used to investigate the behavioural intention in question:

H1a/b/c – (a) Attitudes/(b) Subjective norms/(c) PBC positively influence the intention of purchasing products with recyclable packaging.

2.2. Pre-cycling meditation – the integrated concept of recycling consideration and moral norms as motivations for processing information

Being one of the most popular theories of behavioural change, the TPB has reasonably attracted a plethora of academic papers expanding the framework through additional constructs, strengthening the behavioural intention. These factors were employed as either antecedents or moderators/mediators of TPB's existing constructs. This approach attracted many studies attempting to further develop the model, in which individuals' antecedents on sustainable purchases include the prevalent environmental concern (Setyawan et al., 2018; Thyroff & Kilbourne, 2017; Prakash & Pathak, 2017; Paul et al., 2016; Ramayah et al., 2012; Polonsky et al., 2014; Kilbourne & Pickett, 2008), willingness to buy (Setyawan et al., 2018; Prakash & Pathak, 2017; Paul et al., 2016; Abdul-Muhmin, 2007), country of origins and price sensitivity (Hsu et al., 2017), moral norms (Chan & Bishop, 2013; Botetzagias et al., 2015; Mak et al., 2018; Kim & Seock, 2019), product knowledge and impacts from social media marketing (Sun et al., 2022). Recent studies adopting the TPB were inclined to include these antecedents to expand the exploratory power of the framework by providing the conditions for the occurrence of the constructs being investigated. For instance, Kautish and Sharma (2019) included general environmental knowledge, environmental concerns, and perceived consumer effectiveness to investigate individuals' willingness to be environmentally friendly and how it engenders behaviour. In this research context, in order to investigate the role of semiotic knowledge, constructs to motivate the processing of recycling signs in a retail environment are relevant antecedents to include. One of the latest constructs that engenders in-store motivations and considerations of recyclable packaging signs is pre-cycling meditation (Carrington et al., 2014; Kumar et al., 2021).

Pre-meditated purchase behaviour, or consumers' planning process prior to purchasing was proposed by Carrington et al. (2014) as an effective remedy for the purchase intention-behaviour gap. This construct was later referred to as "*pre-cycling contemplation/meditation*" in the context of recycling by Kumar et al. (2021), being defined as thorough thoughts of recycling and personal commitment before the actual behaviour. Pre-cycling generates one's consistent commitments to the behaviour, motivating the individuals to go through the in-process constructs which eventually constitute the behavioural intention in question (Carrington et al., 2014; Kumar et al., 2021). The fundamental notion of this construct is the maintenance of the conditions for the behavioural intention of interest to occur, the absence of which explain the gap between intention and behaviour (Carrington et al., 2010, 2014; Belk, 1975). In the same sense, pre-cycling contemplation is required to ensure a commitment to recycling shopping behaviour, motivating consumers to process recyclable packaging signs in retail stores, so that semiotic knowledge as a construct can be investigated. Precycling meditation or contemplation will be referred to as precycling in the rest of the paper.

Precycling, according to its definitions compiled above (Carrington et al., 2014; Kumar et al., 2021), comprises two different components of "*planning to recycle*" and "*commitment to recycle*". Among these, the very first component is recycling consideration. Relevant hypotheses are therefore formed to reflect the first component of pre-cycling:

H2a – Recycling consideration has a positive influence on purchase intention

H2b/c/d – Recycling consideration has an indirect effect on purchase intention, via the positive mediating effects of (b) attitudes, (c) subjective norms, and (d) PBC

As per the second component of precycling, this behaviour requires voluntary consideration and commitment before actual behaviour. A sense of self-obligations towards sustainable behaviour, or moral norms would therefore be relevant to its conceptualisation. Among the investigated factors influencing pro-environmental behaviour, moral norms are regarded as an intrinsic value and known to reflect internalised norms (Kim & Seock, 2019), hence motivating commitments to behavioural change (Smallbone, 2005). Furthermore, moral norms have been known to have direct effect on both behavioural intention and change, and indirect effect through attitudes or social norms as a mediator (Kim & Seock, 2019; Thyroff & Kilbourne, 2017; Paul et al., 2016; Hsu et al., 2017).

H3a – Moral norms have a positive influence on purchase intention

H3b/c/d – Moral norms have an indirect effect on purchase intention, via the positive mediating effects of (b) attitudes, (c) subjective norms, and (d) PBC

In this sense, moral norms and recycling considerations will be considered as precycling contemplation towards recycling shopping in retail stores, encouraging the occurrence of the construct of semiotic knowledge in question.

2.3. Semiotic knowledge as a construct for recyclable packaging signs

Research in sustainable behaviour identified environmental concern (EC) and environmental knowledge (EK) as the two most prominent factors influencing the decision (Joshi & Rahman, 2015; Chang et al., 2014; Kumar et al., 2017; Moshood et al., 2022). Among these, EC is the conventional and prevailing factor in the literature on sustainable consumption and sustainable packaging advocacy. Despite displaying significant impacts, consumers with high levels of EC show rather inconsistent behaviour (Magnier & Cri , 2015; Steenis et al., 2017), indicating that they are more driven to contribute to the environment in the way they are more knowledgeable about. This suggests the necessary switch to EK as a more worthwhile variable.

There are two types of knowledge within the domain of sustainability. One is general environmental knowledge – consumers' awareness and understanding of the environment's current critical issues, or the consequences of environmentally unfriendly consumption and usage (Kumar et al., 2017; Kautish & Sharma, 2019; Sun et al., 2022). Meanwhile the other is sustainability knowledge which reflects one's judgments of which kinds of products or product-derived elements, such as packaging, will help them contribute to saving the environment (D'Souza et al., 2011). When it comes to recyclability, such knowledge is provided via recyclable packaging signs, such as the recycle/reuse/reduce symbols on packaging. Research on recyclable packaging cues remains quite limited (Spack et al., 2012; Rees et al., 2019; Pancer et al., 2017; Karnal et al., 2016; Atkinson & Rosenthal, 2014; Andrews et al., 2011), with current findings mostly presented on peripheral cues including recyclable packaging materials or colours (Grunert 2011; Magnier & Cri , 2015; Steenis et al., 2017; Herbes et al., 2018; Ketelsen et al., 2020). Primary recyclable packaging cues including the signs and symbols are inadequately studied, and an investigation of consumers' knowledge of them may provide interesting insights into the research aims at hand, especially when general environmental knowledge has been widely investigated in this domain (Kumar et al., 2017; Moshood et al., 2022). This validates the proposal and justifies the significance of semiotic knowledge as a new construct to be investigated when it comes to recycling signs. Practical implications will also be provided on this basis since these signs are the official indicator of packaging recyclability.

Similar to environmental concerns, knowledge, with its pre-determined levels of high vs. low, is traditionally investigated for its moderating effects (Smith et al., 2004; Joshi & Rahman, 2015; Chang et al., 2014; Kumar et al., 2017). Semiotic knowledge, as a recycling-related construct, will hypothetically strengthen the currently combined effects of moral norms and recycling consideration on TPB's existing factors (Figure 1). As a result, the following hypotheses on semiotic knowledge can be formed:

H4a/b/c/d – Semiotic knowledge strengthens the effect of moral norms on (a) attitudes, (b) subjective norms, (c) PBC, and (d) purchase intention

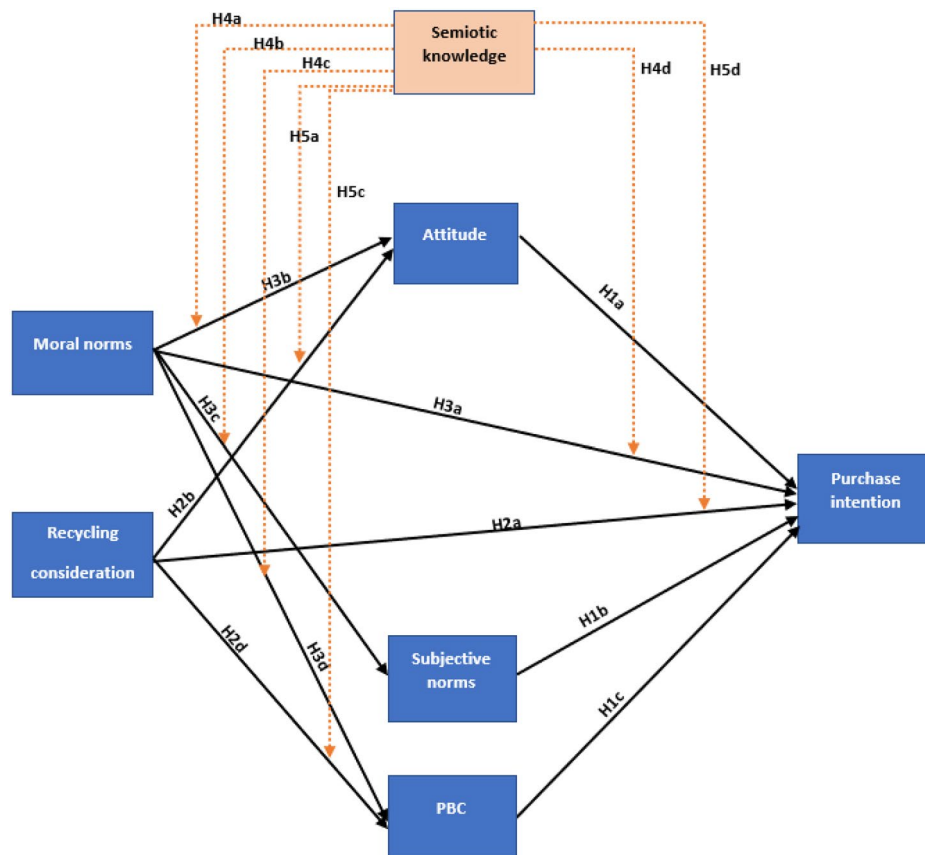


Figure 1. Hypothesised model.

H5a/b/c/d – Semiotic knowledge strengthens the effect of recycling consideration on (a) attitudes, (b) subjective norms, (c) PBC, and (d) purchase intention

3. Methods

3.1. Data collection

A total of 426 respondents were recruited, of which 6 were removed from the final dataset due to their excess of neutral answers (3 on a scale of 1–5). The final number of respondents amounted to 420 which is adequate for structural equation analysis (Boomsma, 1987), of which 43.8% were males and 56.2% were females. The study also aimed to recruit a sample of respondents which were well spread across the age groups and demographics to avoid biases potentially engendered by these variables in sustainable consumption (Kim & Seock, 2019). The respondents were recruited, and the survey was managed by the popular online survey company Qualtrics. A quota on age groups was applied and controlled by Qualtrics to ensure a non-biased sample.

The first screening question asked the respondents about their recycling frequency, in which “Never” or “Rarely” would be deemed ineligible. This is to ensure that the consumers do engage in the behaviour, and the thought of recycling does occur. All questions provided a specification of the product category as FMCG, which is clarified as “the products which you usually find at supermarkets or convenience stores”.

All questions were asked about products with “recyclable packaging”, which is not to be mistaken with those having recycled content. Many products with recycled packaging cannot be recycled any further; therefore, are out of the research’s scope (Table 1).

3.2. Measure

The questions to measure the TPB’s constructs, and moral norms were derived from existing literature and reworded (Ajzen & Fishbein, 1980; Ajzen, 2006; Yadav & Pathak, 2016; Paul et al., 2016;

Table 1. Respondents' demographics.

	Frequency	Percent
Gender		
Male	184	43.8
Female	236	56.2
Total	420	100.0
Age		
18–24	16	3.8
25–34	70	16.7
35–44	63	15.0
45–54	65	15.5
55–64	73	17.4
65+	133	31.7
Total	420	100.0
Recycling frequency		
Occasionally	46	11.0
Often	159	37.9
Always	215	51.2
Total	420	100.0
Level of environmental concern		
0	43	10.2
1	17	4.0
2	34	8.1
3	29	6.9
4	37	8.8
5	20	4.8
6	17	4.0
7	44	10.5
8	63	15.0
9	51	12.1
10	65	15.5
Total	420	100.0

Mak et al., 2018; Botetzagias et al., 2015). The authors adapted the measuring scales for semiotic knowledge from Yoo (2014) and Bulmer and Buchanan-Oliver (2006), both of which measured respondents' knowledge of brands and visual rhetoric. The other questions were drawn from highly ranked academic sources (A* or A journals according to the ABDC's Journal List), compiled in Bruner's (2009) *Marketing Scales Handbook*. When measuring moderating constructs, the measuring scale should have sufficient scale points to avoid information loss (Memon et al., 2019). A seven-point Likert scale is advised in countries with collectivistic cultures (Memon et al., 2019); thus, a five-point Likert scale would be sufficient for measuring the answers collected in Australia, a more individualistic country.

The survey and its questions were framed in a way that facilitated the respondents' completion as they read through the questionnaire online; however, full explanations were provided before individual question. Therefore, although the attached questionnaire items seem to be one-word items; they were all asked after a more detailed, generic question on the construct had been given. These questions were adapted from the articles published in top journals such as *Journal of Consumer Research* and *JAMS*, which investigated the same constructs of attitudes and considerations.

4. Analysis

4.1. Measurement model

The two-step approach suggested by Timm (2002) and Byrne (2004) to building a model was employed. The measurement model was investigated prior to the structural model, so that the lack of fit could be attributed to the measurement alone. The relevant fitness indices were referenced to ensure the fitness of the measurement model. To maximise the model fit, an assessment of the item's factor loadings and modification indices was completed. Only measuring items with factor loadings of above 0.5 were retained. Although 0.6 is sometimes the preferred threshold (Kautish & Sharma, 2019; Kautish et al., 2019), Timm (2002) and Byrne (2004) suggested that 0.5 should be deemed acceptable. As a result, 9 items were removed based on statistical and theoretical justifications. The table of measuring items with factor loading scores is presented in [Appendix A](#).

Table 2. Discriminant validity.

Construct	1	2	3	4	5	6
1. ATT	0.886					
2. SN	0.638	0.891				
3. PBC	0.622	0.588	0.831			
4. MR	0.789	0.798	0.646	0.912		
5. PI	0.748	0.769	0.685	0.863	0.893	
6. RC	0.679	0.419	0.528	0.561	0.546	0.812
AVE	0.79	0.79	0.69	0.83	0.80	0.66
CR	0.95	0.94	0.92	0.96	0.92	0.91
Cronbach's α	0.96	0.95	0.92	0.96	0.95	0.94

Note: ATT=attitude, SN=subjective norms, PBC=perceived behavioural control, MR=moral norms, PI=purchase intention, RC=recycling consideration.

All measuring items had a factor loading of above 0.5, indicating that convergent validity had been achieved (Churchill, 1979). The model also realised the required levels of fitness indices for all categories of model fit, with GFI (Goodness-of-fit index) = 0.902, CFI (Comparative fit index) = 0.975, RMSEA (Root mean square error of approximation) = 0.047, and Chi-square/df = 1.916.

To assess reliability and internal consistency, Average Variance Extracted (AVE), Cronbach's α scores, and Composite Reliability (CR) were calculated. An AVE ≥ 0.5 , $\alpha \geq 0.7$, and CR ≥ 0.6 is required for each construct. With all AVE values being above 0.5, CR ≥ 0.6 , and Cronbach's α scores ranging between 0.92–0.96, the scale's reliability and internal consistency were achieved (Hair et al., 1998). A discriminant validity index summary was computed to prove the constructs in the model are discriminant of each other. Essentially, the square root value of each construct's AVE needs to be higher than the correlation between respective constructs, to achieve discriminant consistency (Fornell & Larcker, 1981).

4.2. Common method variance (CMV)

Common method bias is popular in behavioural research due to its emphasis on cognitive efforts (Podsakoff et al., 2003). For this reason, approaches to countering the problem were proposed with reference to designing the measuring scales even before commencing the fieldwork, in addition to using Harman's one-factor test for detection afterwards (MacKenzie & Podsakoff, 2012; Baumgartner & Steenkamp, 2001). The conditions that can potentially cause method bias are presented below, together with the study's remedies to eliminate them. The Table 2 (Appendix B) is based on proposed procedural changes suggested by MacKenzie and Podsakoff (2012) and supported by Baumgartner and Steenkamp (2001). The measures include such remedies as removing ambiguous or double-barrelled questions and ensuring the anonymity of responses.

Harman's single-factor test was then used where all scales were considered for calculating CMV in SPSS. Results showed the single factor explained <50% of the total variance.

From the above measures, CMV bias was determined to be unlikely.

4.3. Measurement invariance procedure and results

Prior to performing multigroup analysis (MGA) in the structural model, one must confirm the non-invariance between the two groups as validated evidence to proceed with MGA. The testing strategy started with measuring the invariance in CFA within each group separately for evidence of fit (Byrne, 2009). Using the same measurement model in CFA, tests for configural invariance, metric variance, and scalar variance were undertaken to achieve evidence of invariance across groups, as per the Table 3 below. The metric invariance indicated an insignificant p -value and as such metric invariance was achieved indicating acceptable measurement invariance across the groups.

A Chi-square difference test ($\Delta\chi^2/\Delta df$) is suggested by Hu and Bentler (1998) to examine the model comparisons and determine whether the decrease in model fitness is significant (p -value ≤ 0.05). These results indicated acceptable measurement invariance across the levels of semiotic knowledge.

4.4. Hypotheses and multigroup testing

To test the main hypotheses, the structural model was estimated using the combined sample ($n=420$). The structural model showed adequate model fit across the fitness categories, with GFI = 0.997, CFI = 0.999, RMSEA = 0.048, and Chi-square/df = 1.969.

Table 3. Multigroup measurement invariance tests.

	χ^2	d.f	$\chi^2/\text{d.f}$	$\Delta\chi^2$	Δdf	P-value
Configural	1133.828	670	1.692			
Metric	1165.943	692	1.685	32.115	22	0.075456

Table 4. Hypotheses testing results.

Combined sample				Multi-group testing			
	Path		β	Result	$\beta_{(\text{high SK})}$	$\beta_{(\text{low SK})}$	
H1a	Attitudes	→	Purchase intention	.096*	Supported	0.072 ^{ns}	0.107 ^{ns}
H1b	Subjective norms	→	Purchase intention	.159***	Supported	0.183 ^{ns}	0.117 ^{ns}
H1c	PBC	→	Purchase intention	.184***	Supported	0.217 ^{ns}	0.125 ^{ns}
H2a	Recycling consideration	→	Purchase intention	.015 ^{ns}	Not supported		
H2b	Recycling consideration	→	Attitudes	.452***	Supported	0.402 ^{ns}	0.339 ^{ns}
H2d	Recycling consideration	→	PBC	.327***	Supported	0.349*	0.202*
H3a	Moral norms	→	Purchase intention	.447***	Supported	0.491 ^{ns}	0.645 ^{ns}
H3b	Moral norms	→	Attitudes	.485***	Supported	0.572 ^{ns}	0.599 ^{ns}
H3c	Moral norms	→	Subjective norms	.732***	Supported	0.753 ^{ns}	0.825 ^{ns}
H3d	Moral norms	→	PBC	.409***	Supported	0.449 ^{ns}	0.471 ^{ns}

Note: *** $p < 0.001$, * $p < 0.05$, ^{ns} non-significant.

All hypotheses were supported except for H2a. The p-values displayed significant results across paths except for recycling consideration and purchase intention, indicating there was no direct path between these two constructs. All the original constructs of the TPB (attitudes, subjective norms, and PBC) were found to have positive and significant impacts on purchase intention ($\beta_{\text{attitude}} = 0.96$, $\beta_{\text{subjective norms}} = 0.159$, $p < 0.001$; $\beta_{\text{PBC}} = 0.184$ respectively, $p < 0.05$). Moral norms displayed positive and significant impacts on attitudes, SN, PBC, and purchase intention, indicating both direct and indirect effects ($\beta = 0.447, 0.485, 0.732, 0.409$ respectively, $p < 0.001$). Recycling consideration, on the other hand, displayed an indirect effect on purchase intention via attitudes ($\beta = 0.452$, $p < 0.001$), and PBC ($\beta = 0.327$, $p < 0.001$).

The multigroup structural model ($n_{\text{high semiotic knowledge}} = 275$, $n_{\text{low semiotic knowledge}} = 145$) was estimated. To draw comparisons between the two groups of high vs. low semiotic knowledge, a χ^2 difference test was conducted between an unconstrained and a constrained model. The χ^2 difference results displayed a significant change ($\Delta\chi^2 = 52.835$, $\Delta\text{d.f.} = 22$, $p = 0.000239$), confirming the model was not invariant across the two groups, suggesting a moderating effect from semiotic knowledge. The findings showed that only the path from recycling consideration to PBC was significantly stronger for those with high levels of semiotic knowledge ($\beta_{\text{high semiotic knowledge}} = 0.349$, $\beta_{\text{low semiotic knowledge}} = 0.202$, $p < 0.05$) (Table 4).

5. General discussion

5.1. Theoretical contributions

The preceding literature review suggested an essential need for investigating the role of recycling signs towards recycling shopping behaviour as the primary touchpoint for recycling efforts, indicating a significant theoretical contribution to both the research domain of recycling shopping behaviour and the Theory of Planned Behaviour (TPB). The proposed framework was also drawn from the concept of pre-cycling contemplation (Carrington et al., 2014; Kumar et al., 2021). The new construct as semiotic knowledge was investigated and successfully established as an important moderator.

Additional theoretical discussion with valuable implications can be produced on precycling contemplation. Precycling was affirmed to be essentially constituted by moral norms, the presence of which secures the generation of personal obligations to produce sustainable behaviours (Chan & Bishop, 2013), and recycling consideration. Recycling consideration and moral norms enable the essential “*plan to recycle*” well ahead of purchasing products, driving consumers to actively select environmentally friendly packaged products. Specifically, one’s thoughts of recycling beforehand will positively enhance their attitudes, subjective norms, and PBC, strengthening the purchase intention. It is also noteworthy that recycling consideration displayed no direct effect on purchase intention, suggesting a full mediating effect from attitudes, subjective norms, and PBC. This is plausible and significant, since recycling and purchasing were conventionally treated as two separate behavioural patterns (Chan & Bishop, 2013; Botetzagias

et al., 2015; Ramayah et al., 2012; Sun et al., 2022; Kumar et al., 2021; Moshood et al., 2022; Pelet et al., 2020; Kim & Seock, 2019; Han & Yoon, 2015; Paul et al., 2016; Prakash & Pathak, 2017; Hsu et al., 2017; Singh & Pandey, 2018); therefore, no direct effect would be expected. Although the research was not initially set out to investigate the interplay between recycling consideration and recycling shopping behaviour; the relationship was also addressed in this sense, contributing to the literature of sustainable behaviour. On the other hand, moral norms were partially mediated by attitudes, subjective norms, and PBC, simultaneously showing a direct effect on purchase intentions (Kim & Seock, 2019).

The inclusion and significance of recycling consideration in the framework triggered the occurrence of semiotic knowledge for investigation and analyses. The study successfully established the moderating effect of semiotic knowledge on the relationship between recycling consideration and PBC, justifying the relevance and significance of recycling signs in the process of recycling shopping behaviour. The presence of semiotic knowledge as a moderator further clarifies the mediating effect of PBC on recycling consideration-purchase intention. Specifically, those with higher levels of semiotic knowledge demonstrated more heightened PBC levels made possible by recycling consideration. Suggested here is that those who contemplate to recycle will be more inclined to process recycling signs on recyclable packaging, subsequently enhancing their relevant knowledge of recycling activities and reasonably strengthening their perceived abilities of recycling shopping decisions. This finding is significant and desirable, considering past studies suggested that consumers' decisions were mostly based on their knowledge of peripheral cues such as colour or materials (Ketelsen et al., 2020; Grunert 2011), or environmental concern (Joshi & Rahman, 2015; Chang et al., 2014; Kumar et al., 2017; Moshood et al., 2022). In other words, the findings successfully established the importance of recycling signs and semiotic knowledge in the context of recycling shopping behaviour – the two constructs which have been neglected in both theoretical and practical domains.

The addition of semiotic knowledge also extends the Theory of Planned Behaviour (TPB). Research studies seeking to expand the framework are abundant but still required, considering the growing complexity of sustainable behaviour (Chan & Bishop, 2013; Botetzagias et al., 2015; Mak et al., 2018; Kim & Seock, 2019; Sun et al., 2022) and the negligence on recycling signs/semiotic knowledge as a relevant factor. Therefore, semiotic knowledge as a new construct makes significant and desirable contribution to the model, and to the literature on recycling as a whole.

It is understandable that semiotic knowledge displayed a moderating effect on only recycling-PBC, since PBC is defined as perceived ability or ease/difficulty of taking actions (Ajzen, 1991), and semiotic knowledge is essentially the knowledge of recyclability signs which seek to improve consumers' abilities of how to recycle properly. It is true that the relationship between recycling consideration and PBC is further deciphered by semiotic knowledge, providing valuable insights into how purchase intention can be ultimately influenced by recycling consideration and its related factors. Thus, the recommendations below will be dedicated to how practitioners and policy makers can enhance one's semiotic knowledge.

5.2. Managerial implications

As part of their agreements and attempts to curtail waste generation (The United Nations, 2021; Department of Agriculture, Water, and the Environment, 2021; The Coca-Cola Company Australia, 2022), companies have deployed various strategies to induce consumers' recycling efforts both in stores and at home. The findings of this research provide valuable recommendations to firms to achieve these goals through their initiatives in retail stores.

Instead of focusing on communicating with consumers via packaging materials or colours, companies should provide sufficient knowledge of packaging recyclability through relevant signs, in an effective manner. In retail environments, certain initiatives can be employed by companies to facilitate consumers' acquisition of such knowledge of packaging cues, such as re-positioning the signs to packaging fronts or redesign them to maximise shoppers' attention, as the very first step in a consumer' perception process (Babin & Harris, 2018). Additionally, it is also suggested that firms attribute sufficient meanings to these signs. In fact, a quite thorough categorisation of recycle signs and their meanings are available on Government agencies' websites and some FMCG firms (The Coca-Cola Company Australia, 2022; Sustainability Victoria, 2022). Bringing this information to consumers is totally within the ability of manufacturers and retailers.

Such information should be shared among consumers to inform what the signs mean in each type of packaging in their marketing campaigns, directly encouraging further consumer recycling. It is understandable that companies including Coca-Cola wish to prioritise primary benefits in their ads or packaging fronts; however, considering the urgency of tackling the issues of landfills and climate change, it is time these firms promote their packaging sustainability in commercials, especially after major industry contributors to plastic wastes such as Nestle, Woolworths, Coles, and Coca-Cola already signed a deal with ANZPAC to curtail plastic wastes by 2025 (The United Nations, 2021). This will also help trigger consumers' recycling consideration, enhancing their PBC towards purchase intention.

5.3. Policy recommendations

The link between recycling consideration and purchase intention was well justified in this research, suggesting a switch in the local government's social marketing campaigns towards promoting people's pre-purchase thought of recycling, instead of the mere act. Indeed, most consumers in Australia may engage in recycling activities as a household routine every fortnight which does not necessarily benefit waste reductions. Thus, constituting consumers' contemplation to recycle before purchases will enhance the subsequent proper recycling activities after use, ultimately enhancing recycling rates in the country.

Following the suggested recommendation towards commercial partners' enhanced efforts to provide consumers with adequate knowledge of signs through their in-store packaging modifications or advertising campaigns, policies can be introduced to ensure compliance. Mandating certain pieces of information in advertising or product packaging is not a new initiative when such details as ingredients, calory intakes, or health star rankings are compulsory in advertising materials (Australian Competition & Consumer Commission, 2021). In the same sense, since manufacturers have already signed agreements to achieve recycling/waste reduction targets by 2030 (The United Nations, 2021; Department of Agriculture, Water, and the Environment, 2021; The Coca-Cola Company Australia, 2022), enforcing relevant regulations is not at all unreasonable. Enforcing or incentivising the emphasis of recycling signs on product packaging will encourage manufacturers and retailers to redesign their packaging to fortify the retrieval of semiotic knowledge. The combined efforts from both local councils and businesses will generate heightened semiotic knowledge among people, boosting both purchasing and recycling behaviours.

6. Limitation and future research

First, it is worth noting that the outcome of interest in this study was consumers' perceived intention of purchasing products with recyclable packaging and how it was influenced by consumers' thought of recycling, not actual recycling behaviour. The rationale was that purchasing products with recyclable packaging would be the prerequisite for a subsequent recycling behaviour at home.

The study set out to investigate only the behavioural intention of purchasing products with recyclable packaging in retail stores, instead of actual behavioural change as the ultimate goal of the Theory of Planned Behaviour. A follow-up study could have further validated the role of semiotic knowledge and provided a full application of the model. However, it is notable that the exclusion of actual behaviour as the ultimate dependent variable should not be treated as a research flaw, since past studies did use TPB to examine behavioural intentions only (Paul et al., 2016; Prakash & Pathak, 2017; Hsu et al., 2017; Moshood et al., 2022), and the factors directly bridging the intention-behaviour gap were not the focus of this study. Therefore, the limitation being acknowledged is a missed opportunity to even further strengthen the already-confirmed moderating role of semiotic knowledge, which has been otherwise sufficiently theoretically justified. Further research can measure actual behavioural change to provide more conclusive findings, through an experimental study.

Even though the paper only explored consumers' subjective knowledge of packaging recyclability and not the contributing factors to this nature, it would be useful to also investigate whether consumers in reality purchase products that have less packaging and thus less to recycle through an experimental study on "Reduction" initiatives. Another interesting subject for future research is recycled content, which may or may not result in packaging recyclability, and whether this feature constitutes consumers' semiotic knowledge.

Future research can also investigate how different types of signs influence consumers' semiotic knowledge. Most recycling signs are confined to symbols which present certain limitations to comprehension (Mick, 1986); thus, exploring how different types of signs such as icons and indexes generate differentiated levels of semiotic knowledge will be a worthwhile investigation.

Additional details on product packaging to assign sufficient meanings to recycle signs may create information overload on packaging fronts (Fernqvist et al., 2015; Ketron et al., 2016) and can subsequently prevent comprehension. In light of this, future research can further validate this and explore the best means of communicating these meanings to customers. For instance, recycle signs' meanings can be achieved through products' advertisements. In this sense, these signs in retail stores will only play the role of signifiers of packaging recyclability, and companies will only need to perform a minor task of making the signs more noticeable.

Finally, it would be beneficial to conduct a comparative study across multiple product categories to investigate how the effects of semiotic knowledge are differentiated.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix A

FACTOR ANALYSIS FOR ALL VARIABLES	
Purchase intention AVE = 0.80 CR = 0.92 $\alpha=0.95$	Factor loading scores
PI_1 What is the likelihood that you would buy products, with the sustainability information provided by the eco-friendly packaging cues, if they were available in your local area?	.612
PI_1.0 Please rate the probability that you would consider buying products, with the sustainability information provided by eco-friendly packaging cues, if it were available in your local area?	.698
PI_1.1 In the future, I am going to purchase products with eco-friendly packaging	.672
PI_2 In the future, I will try to purchase products with eco-friendly packaging	.823
PI_3 In the future, I will plan to purchase products with eco-friendly packaging	.710
Recycling consideration AVE = 0.66 CR = 0.91 $\alpha=0.94$	
RI_1 Likely	.737
RI_2 Existent	.594
RI_4 Possible	.535
RI_5 Certain	.917
RI_6 Definitely would recycle	.944
RI_7 Very frequent	.856
RI_8 Certain	.925
Attitude AVE = 0.79 CR = 0.95 $\alpha=0.96$	
ATT_1 Good	.830
ATT_2 Beneficial	.914
ATT_3 Important	.801
ATT_4 Satisfactory	.788
ATT_5 Favourable	.816
ATT_6 Positive	.840
ATT_8 Excellent	.789
ATT_9 Useful	.750
Subjective norms AVE = 0.79 CR = 0.94 $\alpha=0.95$	
SN_1 Most people who are important to me would purchase products with eco-friendly packaging	.597
SN_2 Most people who are important to me would want me to purchase products with eco-friendly packaging	.633
SN_3 Most people who are important to me would think I should purchase products with eco-friendly packaging	.649
SN_4 My friends' positive opinions influence me to purchase products with eco-friendly packaging	.964
SN_5 My family's positive opinions influence me to purchase products with eco-friendly packaging	.984
SN_6 My neighbours' positive opinions influence me to purchase products with eco-friendly packaging	.931
Moral norms AVE = 0.83 CR = 0.96 $\alpha=0.96$	
MR_1 It is morally responsible for me to purchase products with eco-friendly packaging	.816
MR_3 It is my moral obligation to the environment to purchase products with eco-friendly packaging	.895
MR_4 Purchasing products with eco-friendly packaging makes me feel like making a personal contribution to something better	.887
MR_5 Purchasing products with eco-friendly packaging seems like a morally right thing to do	.822
MR_6 Purchasing products with eco-friendly packaging makes me feel like a better person	.709
Perceived behavioural control AVE = 0.69 CR = 0.92 $\alpha=0.92$	
PBC_1 Whether or not I purchase products with eco-friendly packaging is completely up to me.	.713
PBC_2 I have the necessary resources, time, and opportunities to purchase products with eco-friendly packaging	.746
PBC_3 I am confident that I have the ability to purchase products with eco-friendly packaging	.734
PBC_4 I feel that purchasing products with eco-friendly packaging is totally within my control	.887
PBC_5 There are likely to be plenty of opportunities for me to purchase products with eco-friendly packaging	.817
PBC_6 I see myself as capable of purchasing products with eco-friendly packaging	.773
PBC_7 Products with eco-friendly packaging are generally available in the shops where I usually do my shopping	.671

Appendix B

Conditions that can potentially cause CMB	Remedies (adapted from MacKenzie & Podsakoff, 2012)
"Lack of verbal ability, education, or cognitive sophistication"	The questionnaire was pre-tested and pre-viewed by peers to ensure the comprehensibility of the written language. The questions were about purchasing and recycling, involving no technical terms or jargons.
"Lack of experience thinking about the topic"	One of the screening questions was the respondents' frequency of recycling, indicating their sufficient level of relevant knowledge of the topic of investigation. Questions about respondents' behavioural intention had a time frame of one month only, ensuring their abilities to recall or predict their actions.
"Complex or abstract questions"	All questions were pre-viewed by peers to ensure the comprehensibility. No complex concepts were used. Additional instructions were also provided to further explain concepts which were considered potentially confusing.
"Item ambiguity"	Simple questions were phrased, no complex concepts were presented, and easy-to-understand language was used through the survey.
"Double-barrelled questions"	No double-barrelled questions were used
"Questions that rely on retrospective recall"	No questions were asked about respondents' past experiences. Questions about intentions were asked later in the survey, after they were introduced to some information about their current states, e.g., knowledge, understanding, and screening questions.
"Written presentation of item"	All questions were essentially brief. The options were straight-forward with a 5-point Likert scale.