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Consumer Perceptions of Food Packaging in Its Role in Fighting Food Waste

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Abstract: Consumers are vital stakeholders in creating and reducing food waste. However, limited research into consumers' perceptions of food waste and food packaging is available to inform research, packaging design or policy so that sustainable consumption practices among consumers might be better encouraged and enabled. By applying multivariate linear modelling to a sample of 965 Australian consumers, this study investigated consumers' perceptions of packaging and packaging's relationship to food waste. Overall, consumers perceived packaging waste as a more serious environmental issue than food waste. Most consumers did not consider food waste as an extreme environmental issue. Consumers' perceptions of the seriousness of food waste also influenced their perceptions of packaging designed to reduce food waste. Significant differences between men and women and older and younger consumers were found regarding the relationship between packaging and food waste as well as food waste as an environmental issue. This study provides a detailed understanding of consumers and packaging, and it alerts designers and decision-makers to the differing attitudes towards food and packaging waste as well as the likelihood of consumers taking up more sustainable consumption practices.

Keywords: consumer perceptions; packaging design; food waste; packaging information; save food packaging; date labelling; packaging innovation

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1. Introduction

Food waste is a significant global sustainability issue [1]. Among its impacts, food waste contributes up to ten percent of global greenhouse gas emissions [2] and is occurring alongside rising rates of food and nutrition insecurity [2]. The problem is not just wasted food but also the resources involved in its growth or production and distribution [2]. Stakeholders across the entire food chain, from primary production to manufacturing, retail and households, are involved in this issue [3–7].

Consumers make a considerable contribution to total food waste [1]. According to recent estimates, more than 60 percent of global food waste is generated at the household level [3]. The drivers of consumer food waste are many and varied, but they are broadly based on the relationship between consumers' willingness to consume based on freshness or perceived freshness [8] and their willingness to waste food [9]. The literature supports that there are four broad categories of factors that drive consumer food waste: (1) broader values, e.g., feelings about wasted food [10]; (2) the challenges of everyday life, e.g., shopping behaviours [11–13] and predetermined portion sizes [14,15]; (3) managing stock in households, e.g., food storage [12,13,16,17]; (4) material factors related to both the material and properties of food and packaging [18–20], e.g., food safety risk [14,21,22]. Prior research

has also shown that perceptions and intended behaviours related to food waste differ based on income, age, household makeup, gender and values [12,23,24]. For example, high materialistic values could be associated with higher levels of self-reported household food waste [25], low-income households striving for the appearance of abundance may waste more food [26], and awareness and attitudes towards food waste as an environmental problem could impact the levels of food waste produced by households [10,11,27,28]. However, consumers' relationship with food waste and sustainable consumption practices related to food waste are complex, as are their perceptions of the dynamic between food waste and food packaging [4,5].

The increased availability and consumption of packaged foods in the past sixty years can be associated with a broader transformation of the food system [29]. Much food packaging is single-use and related to negative environmental consequences [5,30]. However, packaging can help to reduce food waste by extending the shelf-life of food and protecting food from damage, spoiling or contamination [4,31,32], and can therefore play a role in addressing food waste and developing more sustainable consumption practices. Furthermore, packaging designed to reduce environmental impact is most successful if it also reduces food waste [33,34]. Despite this, a recent review found that less than five percent of studies related to food and packaging or food waste and consumer behaviour had investigated packaging or supply chain innovations that could reduce food waste [3].

The Australian Institute of Packaging defines save food packaging (SFP) as: packaging designed to minimise or prevent food waste from paddock to plate using innovative and intuitive design features that can contain and protect, preserve, extend shelf life, easily open and reseal and provide consumer convenience and portion control all while meeting global sustainable packaging targets and with the lowest environmental impacts [35]. SFP sits within the category of general food packaging; the difference is that SFP is specifically designed for food waste minimisation and prevention.

To date, research on food packaging waste has focused on recycling, waste management and materials engineering [30] rather than whether or how consumers use sustainable packaging designs, especially in relation to food waste reduction. This is despite the understanding that consumers' perceptions are integrally linked to their eventual behaviours and thus to their ability to reduce food waste through their choices and use of packaging. Although research has shown that consumers associate some value with particular food packaging technologies [36–38], several studies have also found that consumers have insufficient knowledge of food packaging technologies that are designed to reduce food waste [39], or that they did not trust packaging technologies [36]. This lack of understanding of consumers' perceptions of food packaging and its capacity to reduce food waste is a problem because researchers, packaging designers and food companies have little to no understanding about whether consumers are likely to accept or use food packaging that has been designed to reduce food waste. If this packaging is not accepted or used by consumers, then the potential food waste reduction benefits are lost.

The following sections outline the aims and hypotheses of this research, describe the methods employed to collect and analyse data, and present the survey results. The paper concludes by outlining the implications of the findings for policy- and decision-makers, packaging designers and researchers.

Aims and Hypotheses

Both consumers' perceptions of food waste and the role of packaging in reducing food waste have gained attention in recent years [1,6,33,40]. In this work, there has been an emphasis on consumer attitudes and awareness, including an association between environmental impacts and negative views of food packaging. However, due to the scarcity of empirical research, consumer perceptions of food packaging have been identified as a gap in scholarship [3]. This paper is part of a larger study designed to address the lack of understanding of consumers' perceptions of food packaging by investigating their perceptions of packaging and their relationship to food waste [41]. Hence, this study

aims to contribute to the body of literature by investigating whether consumers positively perceive food packaging as playing a role in minimising food waste and, if not, their reasons why not.

To address this aim, four hypotheses were formulated as informed by a literature review and an in-home consumer journey mapping project [3,6]. For a concise readership, the entire project protocol used for the current study, including overarching research questions, can be accessed through Brennan et al. [41].

Research posits that consumers are unwilling and unlikely to adopt or demand the use of advancing packaging technologies [41,42]. Therefore, Hypothesis 1 (H1) set out to provide empirical evidence to distinguish whether there are common clusters drawn from consumer demographics and their perceptions, for or against, with the thinking that packaging plays a role in food waste reduction.

As a waste product of the food chain, packaging is widely perceived to negatively impact the environment [41,43], and this negative reputation overrides packaging's perceived benefits in mitigating food waste. Hypothesis 2 (H2) tested if differences exist between consumers' views on packaging waste and food waste in terms of their respective perceived environmental impacts.

Thirdly, the literature supports that food waste reduction is a choice and the consumers' decision to participate is broadly linked to their willingness to act [8,9]. Hypothesis 3 (H3) tested if consumers differ in their motivation or willingness to reduce their household-generated food waste across demographic profiles.

Finally, the concept of save food packaging (SFP) supports that packaging specifically designed to target food waste reduction through functions such as extending shelf-life, preserving or resealing food contents, or portion control drives positive behaviour [41]. Hypothesis 4 (H4) tested whether consumers concerned with food waste as an environmental issue correlates with their perceptions of SFP value as a means of reducing food waste. In summary, the proposed hypotheses are as below:

H1. *There are differences between consumer perceptions when considering packaging and its role in reducing food waste across demographic profiles of gender, age, residential state, living arrangements, education and income.*

H2. *There are differences between consumers' rating of food waste and food packaging's perceived environmental impact.*

H3. *There are differences between consumers' motivational levels to reduce household food waste across demographic profiles and opinions on whether packaging reduces food waste.*

H4. *Consumers' level of concern over food waste and its environmental impact relates to their perceived value of packaging as a strategy to reduce food waste.*

2. Materials and Methods

2.1. Survey Design

The existing perceptions of packaging survey (EPPS) was used to assess consumers' perceptions of packaging. The EPPS is a consumer survey instrument, and it was based on research originally carried out by the Industry Council for Packaging and the Environment and the Waste & Resources Action Programme [43] in the United Kingdom. Adjustments and additions for the Australian context and the research objectives were made to the base questionnaire.

In addition, for the current study, the EPPS aimed to build on results from the Australian National Benchmark Survey (NBS) [44]. The EPPS was conducted online and comprised questions on participants' demographics, household food shopping habits, perceptions of food issues and packaging, food preparation, storage, and disposal habits, knowledge of labels and motivations to reduce household food waste. Questions within the

survey used one of three formats: (i) 'select the most relevant' multiple-choice questions; (ii) 'select all that apply' questions; (iii) ordinal scaled matrix questions, consisting of a five-point Likert-type scale [from 'strongly disagree/dislike' (1) to 'strongly agree/like' (5)]. The project was approved by RMIT's Human Research Ethics Committee in 2019. Before completing the survey, participants were directed to a Plain Language and Consent Statement. For a copy of the EPPS instrument, please email the corresponding author.

2.2. Survey Sample

A total of 1015 participants were surveyed between March and April 2020. Recruitment occurred via an online market research agency using Australian panellists. Criteria were applied to ensure individuals with the following characteristics were included: Australian residents aged 18 years or older, proficient in English, and who identified as the primary food purchaser or preparer in their household. Individuals also needed to be familiar with the five food categories assessed and had to have purchased these once or more within the week prior to survey completion. These categories were meat and seafood, bakery, packaged and processed foods, dairy and eggs and fresh fruit and vegetables. The categories were selected based on industry research in which consumers indicated these to be the most wasted foods in household settings [5,45].

Geolocation quotas were applied to the selection criteria to ensure a representational ratio of the population within each state and territory based on Australian demographic statistics [46]. No additional quota filters were applied (e.g., gender, age or education levels). Fifty cases were excluded because they were incomplete, did not meet the inclusion criteria or did not provide consent. This resulted in a final sample of n = 965 Australian representative consumers.

2.3. Analysis

Statistical analyses were performed to test the four hypotheses (see Supplementary File S1 for detailed information regarding hypothesis testing) using Minitab® 19.1 software (Minitab, Inc., State College, PA, USA). Descriptive statistics were calculated and demographic data were examined using frequencies and percentages. Multiple statistical tests were used to cross-examine the identified key factors, consumer clusters and significant findings [47]. Data were assessed for normality of distribution using a Shapiro–Wilk test. Missing entries were omitted, but identified outliers were retained. Assumptions were satisfied for the statistical tests that their data were independent, randomised, had equal variances and normality due to the large sample size of n = 965 based on the central limit theorem (CLT).

Three key sociodemographic variables, i.e., living arrangements, income and education, were recoded into quintiles. Living arrangements were based on whether participants lived alone, as a couple, with children or with others. Income was aligned to Australia's household income wealth distribution bands [48]. Education ranged from partially completed secondary school to diplomas and higher degrees. Consumers' motivation to reduce food waste was recoded to a 5-point Likert-type scale ranging from 'extremely unmotivated' (1) to 'extremely motivated' (5). Statistical test assumptions were met using a Levene's test for equal variances.

Multivariate and general linear model studies were selected to investigate the key questions of consumers' existing perceptions of packaging and their role in fighting food waste. Principal component analysis (PCA) was used to identify distinct consumer perception clusters from the multivariate dataset, which were then named by the authors based on their key characteristics. Further to this, an ANOVA general linear model (GLM) and a Tukey's difference of means test were used to compare the differences in population means between the three identified consumer groups with perceptions of negative, neutral and positive responses towards packaging reducing food waste against the variables of interest. More specifically, a one-way ANOVA and an ANOVA general linear model (GLM) were selected using a 0.05 alpha for a 2-sided hypothesis tested between the three identified

consumer propensities (for and against food packaging, motivational differences to reduce food waste and concern for environmental impact) with these compared over their resulting fitted means. A Tukey's difference of means (DOM) test compared shifts between the sample using a Fisher's least significant difference (LSD) approach. For ease of reading, we report only the main statistics and effects.

3. Results

The descriptive statistics are reported (Table 1) with a total sample size of 965 participants. The proportion of female participants was 65% (n = 627). Age was distributed across the population, with the largest category of responses being 26–35 (n = 216; 22.4%). Many participants (n = 416; 43%) had completed a diploma, degree or higher level of education, lived as a couple with children (n = 366; 37.9%), and earned an annual combined household gross income that placed them in the $50,000–$100,000 income band, therefore aligning with the national average household income band as defined by the Australian Bureau of Statistics [48,49]. Many participants were from New South Wales (n = 318; 33%), which is consistent with the population distribution in Australia. Regarding the participants' propensity to reduce food waste, much of the sample (n = 407; 42.2%) agreed or strongly agreed that packaging helps reduce food waste, whereas 24.2% (n = 234) participants expressed being highly motivated to reduce food waste.

Table 1. Participant demographics.

Variables	*n* (%)
Gender	
Female	627 (64.97)
Male	338 (35.03)
Age category	
18–25	119 (12.33)
26–35	216 (22.38)
36–45	206 (21.35)
46–55	149 (15.44)
56–65	139 (14.40)
66+	136 (14.10)
Education level	
Did not complete secondary school	84 (8.71)
Completed secondary school	198 (20.52)
Trade qualification	67 (6.94)
Certificate qualification	200 (20.72)
Diploma, degree or higher	416 (43.11)
Living arrangements	
Single person	205 (21.24)
Single parent with children, w/wo others	113 (11.71)
Couple, w/wo others	181 (18.76)
Couple with children, w/wo others	366 (37.93)
Other family household	100 (10.36)
Income	
Under $25,000	110 (11.40)
$25,000–$50,000	258 (26.74)
$50,000–$100,000	335 (34.71)
$100,000–$150,000	176 (18.24)
Over $150,000	86 (8.91)

Table 1. *Cont.*

Variables	*n* (%)
Australian residence (State or Territory)	
New South Wales	318 (32.95)
Victoria	229 (23.73)
Queensland	194 (20.10)
South Australia	50 (5.18)
Western Australia	87 (9.01)
Tasmania	29 (3.01)
Northern Territory	29 (3.01)
Australian Capital Territory	29 (3.01)
Packaging helps to reduce food waste (current propensity)	
Disagree to Strongly Disagree	223 (23.10)
Unsure (neutral)	335 (34.70)
Agree to Strongly Agree	407 (42.20)
Motivation to reduce food waste (future propensity)	
Extremely unmotivated	131 (13.57)
Unmotivated	213 (22.07)
Unsure	214 (22.18)
Motivated	173 (17.93)
Extremely motivated	234 (24.25)

Note: Income amounts shown in Australian Dollars; n = 965.

3.1. Grouping Consumers according to Packaging Perceptions

H1 was explored using Principal Component Analysis (PCA) to investigate differences between consumer perceptions when considering packaging and its role in reducing food waste across demographic profiles of gender, age, residential state, living arrangements, education and income (H1; see Supplementary File S2 for a full breakdown of the PCA). Eigenvalues cumulated proportions of four main components, contributing approximately 69% of the overall variance. The PCA established that the first and largest contributor to variance (36%) described a cluster of consumers concerned with selecting biodegradable, recyclable packaging and preferring to avoid all unnecessary packaging. This component primarily measured the consumer group that is conscious of minimising packaging waste (the environmentalists). The second-largest component (17% contributing variance) had large positive associations with fresh food in packaging and packaging that reduces food waste, thus designated as the food waste-conscious consumer group (food waste-conscious consumers). The third component (8% contributing variance) grouped participants according to their interests in bringing their own packaging (the packaging reducers). The fourth principal component (8% contributing variance) identified consumers who perceived that packaging played a positive role in reducing food waste and required packaging to meet their needs in reducing packaging waste together (the pro-packaging consumers).

The PCA supports H1, hence there are differences between consumer perceptions on food packaging's role in reducing food waste with four major distinct consumer clusters identified. Figure 1 visually summarises the PCA consumer clusters on a four-quadrant matrix comparing consumers' concern for food waste against their concern for packaging waste. The four groups are indicated by a circle's plotted location and size that approximates the PCA portion contribution to variance percentage and proportion of group.

3.2. Perceived Environmental Impact of Food and Packaging Waste

In order to test whether there are differences between consumers' rating of food waste and food packaging's perceived environmental impact (H2), an interval plot was derived from the one-way ANOVA with Tukey post-hoc comparisons (see Supplementary File S3 for statistical output) and used to examine consumers' ratings of the perceived environmental impact of food waste and food packaging (H2). The interval plot visualises the

gap between the two consumer groups identified from the PCA (those pro-packaging, and those against) and shows that there were no reportable differences between the two groups, which had similar interval rankings crossing at means of 3.4 and 4.1 (Figure 2). However, the two populations of consumers both perceived packaging waste as a statistically significantly greater environmental issue than food waste. Interestingly, both groups considered food waste as a 'moderate' environmental issue over packaging waste, which was seen as an 'extreme' issue. This clearly shows society's perceptions of food waste. Thus, H2 is supported. The analysis shows that consumers who are pro-packaging and also those critical of packaging both underestimate food waste as an environmental issue. In contrast, packaging waste was shown to be a significantly greater environmental concern to consumers than food waste.

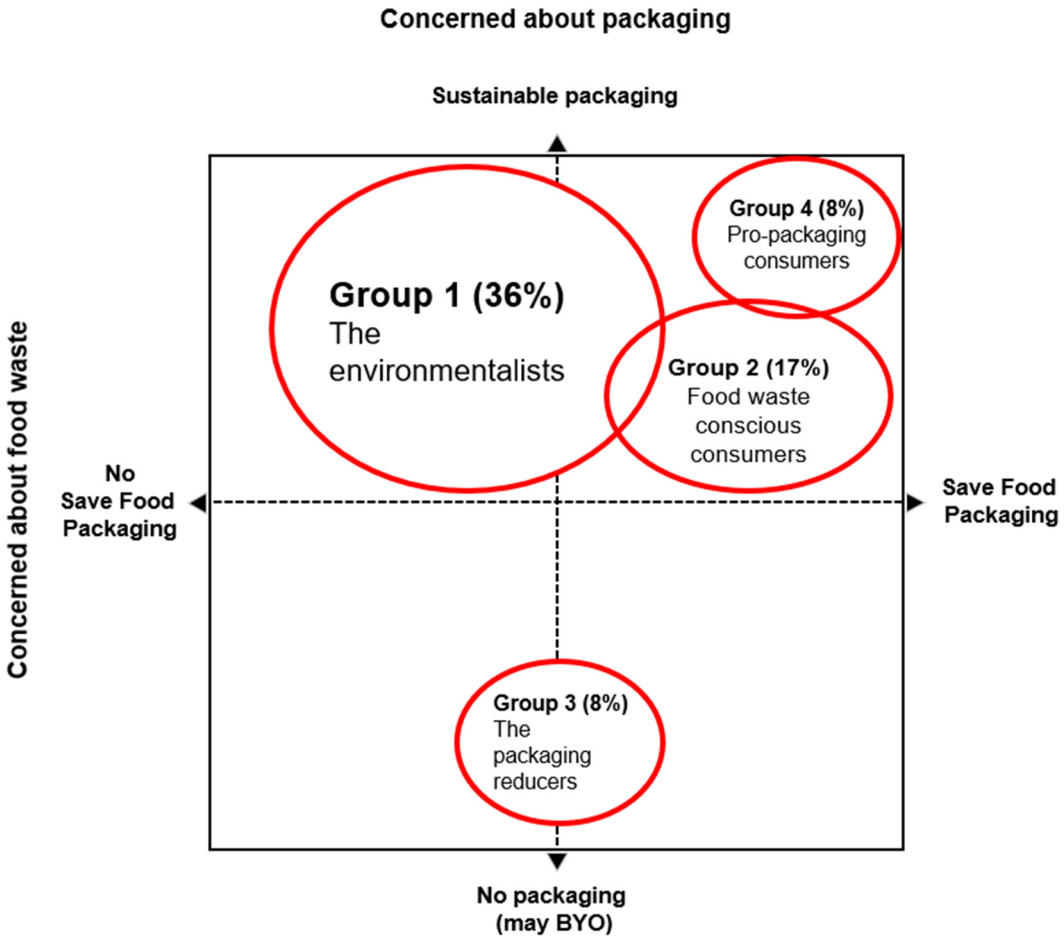

Figure 1. Four consumer groups mapped across food waste and packaging perceptions showing PCA contribution to variance percentages.

3.3. Consumers' Motivations to Reduce Food Waste

For H3, a plot of fitted means taken from the ANOVA general linear model was used to explore the consumers' motivation to reduce food waste (H3) across demographic profiles in terms of gender, age, state, living arrangements, education, income and the consumers' opinions on whether packaging reduces food waste (see Supplementary File S4 for the detailed statistical output). The purpose of the fitted means analysis was to examine differences in motivational levels and not directly compare them. As such, contrasts for statistical significance of the differences are beyond the scope of H3 and were not investigated in the current study.

Figure 3 describes the main effects for the fitted means of consumers' motivations to reduce food waste. Differences in means for the motivational levels were found across the

sociodemographic variables and for those who agreed compared to those who disagreed on whether packaging reduces food waste. Women were significantly more motivated to reduce food waste than men. Younger consumers (aged 18–25) reported higher motivational levels to reduce food waste than those aged 26–35. The plot also portrays a steep ascendant trend showing that the older the participants were (those aged 46 and older), the higher their motivational levels were to act on reducing food waste.

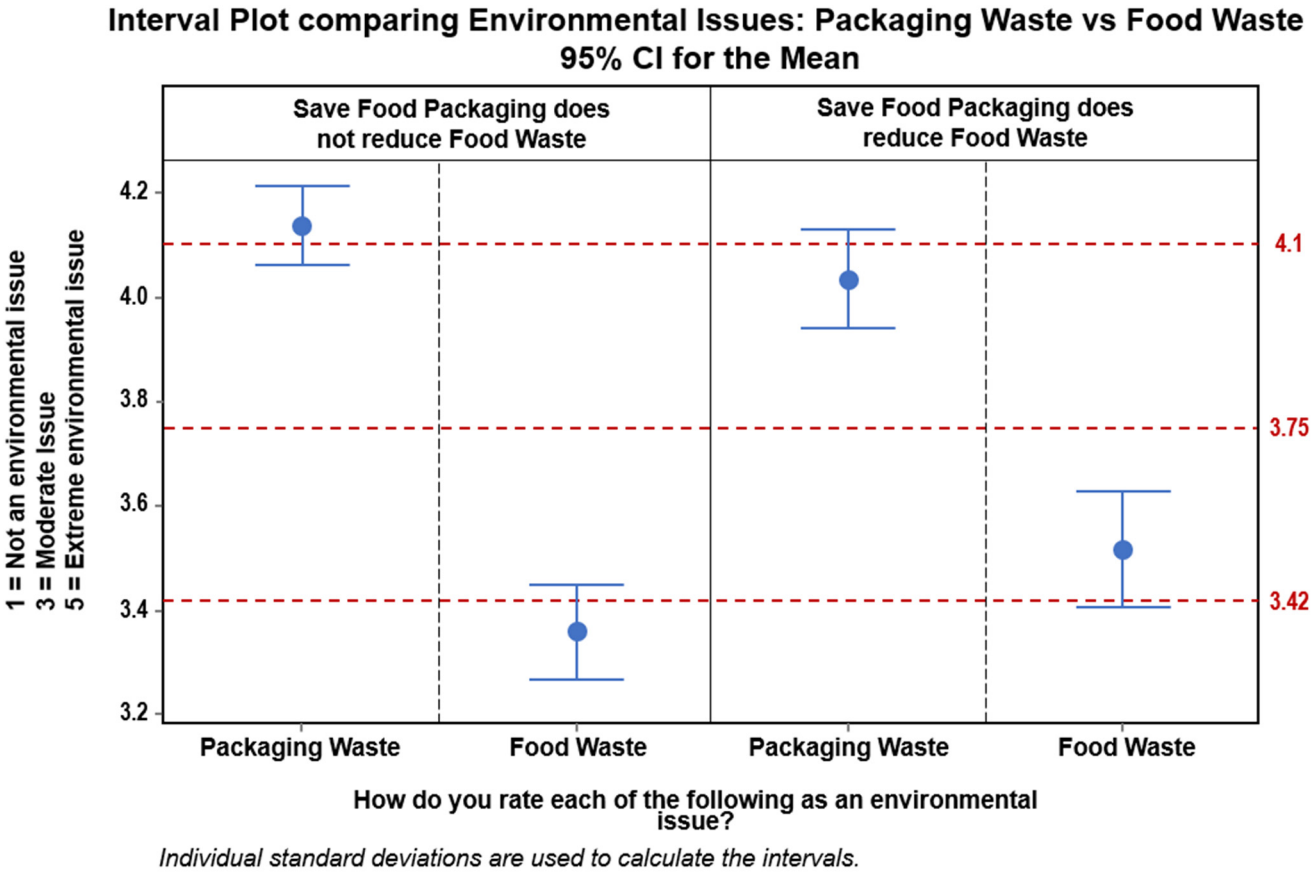

Figure 2. Interval plot showing consumers' environmental impact ratings between packaging waste and food waste.

There were no major differences regarding motivation to reduce food waste across Australian states except South Australia (higher scores) and Tasmania (lower scores). Living arrangements did not exhibit a substantial impact on motivational patterns. However, differences were evident in terms of income and motivation to reduce food waste. Consumers in the most disadvantaged income bracket were less motivated to care about food waste reduction compared to the most affluent consumers. The latter had heightened motivation to reduce food waste. Higher motivational levels were also observed for consumers with a higher education diploma or degree. Finally, consumers were asked whether they agreed or disagreed with the statement "Packaging plays a role in reducing food waste". Those that disagreed with this statement were significantly more motivated to reduce food waste. In contrast, those who agreed were significantly less motivated to reduce food waste. In summary, the Hypothesis 3 (H3) test for differences between consumer motivational levels to reduce food waste was supported for gender, age, income and the perceptions of packaging that reduces food waste. No statistical differences were found for state, living arrangement or education of the participants.

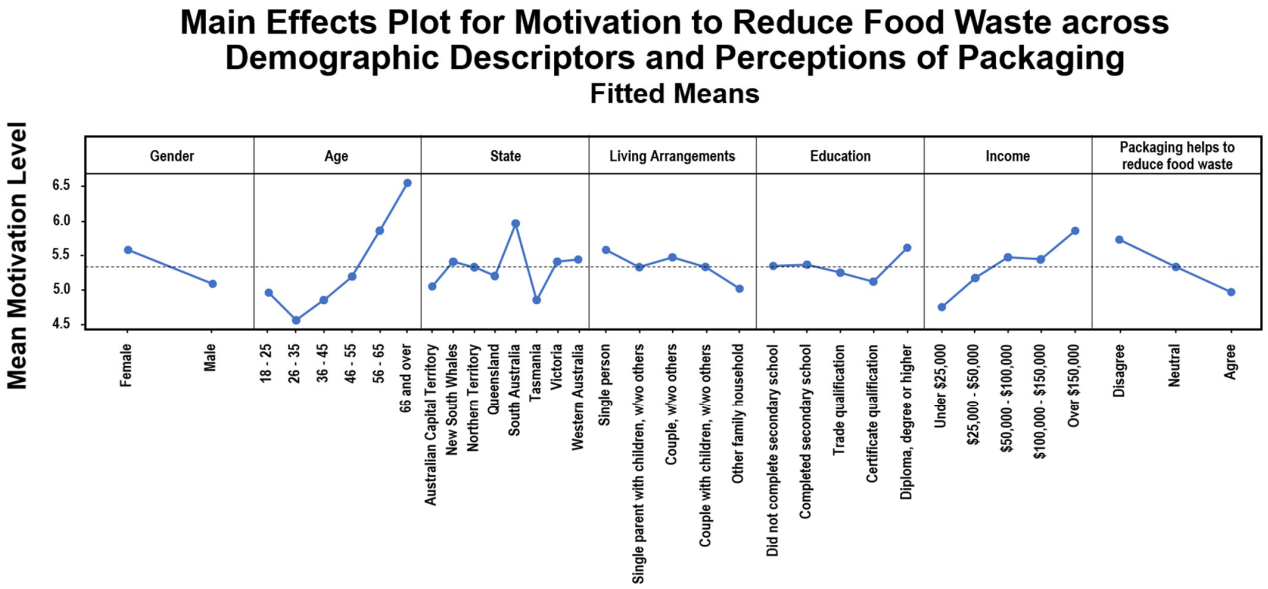

Figure 3. Consumer's motivation levels to reduce food waste.

3.4. Consumers' Concern for Food Waste as an Environmental Concern and the Perceived Value of SFP

For H4, the final stage of the analysis includes the ANOVA general linear model results (see Supplementary File S4 for detailed statistical output) using the means of consumers' ranking of food waste as an environmental issue across food waste reduction motivations and perceptions of packaging. The detailed breakdown of effects is presented in Table 2.

Table 2. Perceptions of food waste's environmental impact across food waste reduction motivations, packaging's role, benefits, efficiency and waste.

Factor	Variance Levels	*n*	Fittedmean	SEM	95% Confidence Interval	DOM	*p*-Value	ANOVA Factor: F(df, Error) F-Value, *p*-Value
How motivated are you to reduce your household's food waste?	1 = Not motivated							
	1	234	2.70	0.24	(2.23, 3.17)	a	0.762	$F_{(4, 919)} = 5.86$, p-value < 0.001
	2	173	2.77	0.24	(2.30, 3.23)	a	0.470	
	3	214	2.44	0.24	(1.97, 2.90)	a	0.001 ***	
	4	213	2.83	0.24	(2.36, 3.30)	ab	0.110	
	5	131	2.88	0.23	(2.42, 3.34)	b	0.012 *	
	5 = Highly motivated							
Packaging helps to reduce food waste	1 = Strongly disagree							
	1	126	2.85	0.27	(2.33, 3.37)	a	0.283	$F_{(4, 919)} = 4.15$, p-value = 0.002
	2	281	2.54	0.24	(2.07, 3.00)	ab	0.008 **	
	3	335	2.59	0.23	(2.13, 3.04)	ab	0.018 *	
	4	174	2.69	0.23	(2.24, 3.15)	b	0.631	
	5	49	2.95	0.24	(2.47, 3.43)	b	0.005 **	
	5 = Strongly agree							
Rate the benefits of the combined 13 packaging functions †	1 = Not beneficial							
	1	7	2.69	0.43	(1.85, 3.53)	a	0.913	$F_{(4, 919)} = 0.19$, p-value =0.944
	2	107	2.74	0.24	(2.26, 3.21)	a	0.911	
	3	381	2.70	0.23	(2.25, 3.14)	a	0.755	
	4	396	2.70	0.23	(2.26, 3.14)	a	0.778	
	5	70	2.80	0.24	(2.34, 3.26)	a	0.564	
	5 = Highly beneficial							

Table 2. *Cont.*

Factor	Variance Levels	*n*	Fittedmean	SEM	95% Confidence Interval	DOM	*p*-Value	ANOVA Factor: F(df, Error) F-Value, *p*-Value
To what extent do the following combined nine food packaging features have the ability to reduce food waste? ¶	1 = Greatly reduces food waste							
	1	174	2.22	1.02	(0.22, 4.22)	a	0.543	$F_{(4, 919)} = 0.51$, *p*-value = 0.732
	2	503	2.83	0.36	(2.13, 3.54)	a	0.754	
	3	279	2.84	0.13	(2.59, 3.09)	a	0.600	
	4	8	2.81	0.13	(2.55, 3.06)	a	0.717	
	5	1	2.92	0.15	(2.64, 3.21)	a	0.383	
	5 = Greatly increases food waste							
How do you rate the environmental issue of packaging waste?	1 = Not an issue							
	1	9	1.52	0.36	(0.81, 2.22)	a	0.001 ***	$F_{(4, 919)} = 42.22$, *p*-value < 0.001
	2	51	2.21	0.28	(1.66, 2.75)	b	0.001 ***	
	3	189	2.93	0.25	(2.44, 3.42)	c	0.033 *	
	4	308	3.24	0.25	(2.76, 3.72)	d	0.001 ***	
	5	408	3.73	0.24	(3.25, 4.20)	d	0.001 ***	
	5 = Extreme issue							

Note: Statistical significance rating * denotes *p*-value < 0.05, ** <0.01, *** <0.001; SEM = standard error mean; DOM = difference of means according to Tukey's pairwise grouping method; means that do not share a letter (a,b,c,d) are significantly different; *n* = 965. † = Combined 13 packaging functions (1. Protects the food; 2. Protects the food in the home; 3. Helps extend the shelf life of the product; 4. Keeps products safe and hygienic; 5. Makes it easy to transport products home; 6. Makes it easy to use/reuse products at home; 7. Gives important information on the labels; 8. Allows out of season food to be purchased all year round; 9. Helps reduce food waste; 10. Makes it easier to buy several of the same item; 11. Makes it easier to buy the right quantity; 12. Makes the product more attractive; 13. Makes portioning easy). ¶ = Combined 9 food packaging features (1. Packaging that keeps the product fresher for longer; 2. Resealable/Reclosable; 3. Refillable/Reusable; 4. Smaller pack sizes; 5. Split packs; 6. Packaging that indicates product freshness; 7. Packaging design is easy to empty; 8. Clearer storage info on the label; 9. Buying in bulk and packaging into portion sizes).

Consumers' motivations to reduce food waste positively predicted their perception of food waste as an environmental issue [F(4, 919) = 5.85, *p*-value < 0.001]. Similar effects were found for the consumers' perceptions of packaging as a way to reduce food waste [F(4, 919) = 4.15, *p*-value = 0.002] and packaging waste as an environmental issue [F(4, 919) = 42.22, *p*-value < 0.001]. No effects were found for the consumers' rate (*p*-value = 0.944) and efficiency (*p*-value = 0.73) of packaging for reducing food waste. The results partially support H4, indicating that the consumers' level of concern over food waste and its environmental impact relates to their perceived value of packaging as a strategy to reduce food waste. However, these motivations do not outweigh the concerns about food packaging per se.

4. Discussion

The insights into consumers' perceptions of food packaging and waste identified through this study have implications for both packaging designers and producers as well as those seeking to reduce food waste through consumer behaviour change. Together, these insights provide a more detailed understanding of consumers' perceptions of packaging and enable designers and decision-makers to leverage differing attitudes towards food and packaging waste.

This study confirmed that it is possible to segment or cluster consumers according to demographic descriptors and their attitudes towards food waste, packaging and environmental concerns [4]. In particular, the current research identifies four distinct Australian consumer groups driven by perceptions of food packaging. These groups are (a) the environmentalists (avoiding all unnecessary packaging or, if unavoidable, biodegradable, recyclable packaging only), (b) the food waste-conscious consumers (only seeking out packaging if it reduces food waste), (c) the packaging reducers (BYO packaging or nothing at all) and (d) the pro-packaging consumers (preferencing packaged products that will

reduce food waste). Between these groups, consumer perceptions of the role of packaging in reducing food waste showed significant variation from those concerned with all waste to those concerned more with food or packaging waste. Although food waste is one of the largest environmental and societal issues of our day, our findings reported that consumers perceive packaging waste as a more serious environmental issue than food waste, with food waste neutrally considered as an environmental issue. Societal awareness of the environmental impact food waste has is clearly low and requires further work.

Consumers' motivation to reduce food waste was also found to differ according to gender, age and income. The motivation to reduce food waste contrasts with earlier research about actual or self-reported consumer behaviour around food waste. For instance, whereas a study found that women were more motivated to reduce food waste than men, earlier studies have found that female respondents were more likely to report generating food waste [28], whereas other studies have found that men waste more than women [45]. Similarly, whereas this study found that the youngest age group (i.e., those aged 18–25) were more motivated to reduce food waste than those aged 26–45, previous research has found that young people are also more likely to waste food [28]. The present study also found that those aged 46 and above had higher motivation to reduce food waste than their younger counterparts; this is in line with previous research which found that older consumers are less likely to waste food [23,45].

The present study's findings contribute to a complex and sometimes contradictory array of existing research about the impact of income level on consumer behaviour around food waste. Although the results indicate that higher-income households were more likely to be motivated to reduce food waste than lower-income households, several previous studies have found that higher-income households waste more food than low-income households [50], which is possibly because of an association between wasting food and wasting money [51]. However, some previous research has suggested that low-income households may end up wasting more food because they are using purchasing strategies that aim to save money, such as bulk buying and cooking from scratch, or because they are striving for an appearance of abundance [51].

These findings, seen within the context of existing research about consumer behaviour around food waste across different demographics, suggest that more understanding is needed about the relationship between motivation to reduce food waste and actual or self-reported behaviours. This may indicate that consumers' perceptions of food waste as an issue do not necessarily align with actual behaviour, which may further suggest that there are other drivers of food waste in their households, such as their values [10,25], the challenges of everyday life [11,12,14,15,21,23–25,28,45,52,53], issues of managing stock in households [11,12,15,16,22] and material factors [8,9,12,14,15,21,22,54,55] identified in the existing literature that are difficult to overcome despite a willingness and desire to avoid food waste. Food packaging designers should consider whether packaging designs can and do directly address these drivers of consumer food waste and the tensions that can arise between them. For instance, consumers may be highly motivated to reduce food waste, but the food they buy may only come in a portion size that is too large for the size and makeup of their household, or the portion size available may not suit the frequency at which the household shops, thus they may purchase more than they need to cover the difference [5]. These findings may also mean that those who perceive food waste as an issue are more aware of their own food waste. The relationship between consumer perceptions and actual or intended behaviour must also be considered in relation to packaging design.

Polarisation between those who agree and disagree on whether packaging reduces food waste was also evident. Consumers who were critical of food packaging had a stronger motivation to reduce food waste. The findings contribute to the literature by corroborating with past research that identifies that consumers could be looking to reduce waste in general, whether that is food waste or packaging waste [41]. In contrast, the current findings indicate that consumers who were pro-food packaging were less motivated to act on food waste reduction strategies, suggesting that this consumer group heavily relies

on food packaging designs to extend food shelf life and maintain its integrity, offering greater convenience and reducing their need to consider food waste. Further research could consider overlaying more detailed variables such as shopping missions (those who shop every day to those who shop once a week) and how this impacts the need and willingness to adopt packaging. As such, research should extend the current findings to understand how individualistic and collectivistic cultures and societies perceive the relationship between food waste and packaging. The literature has evidenced that cultural differences are a strong driver of behaviour [56], which, in turn, requires different packaging and marketing communication strategies.

Furthermore, the current study revealed that there were no differences in motivation to reduce food waste between consumers' residence, living arrangements and education. These results provide insights into how consumer groups differ regarding their motivation and perception of food and packaging waste for packaging designers and policymakers. They similarly offer a powerful reminder that consumers should not be treated homogenously regarding their attitudes and perceptions of food and packaging waste. For example, it may be more effective to target different messaging and packaging designs based on attitudes toward food waste rather than consumers' education levels.

Regarding SFP as a way to reduce food waste, the present study supports the idea that packaging is largely undervalued by consumers considering its role in reducing food waste. In line with findings of earlier research [43], packaging waste was shown to be a greater environmental concern to consumers than food waste. Consumers were more critical and apathetic towards SFP, as currently it is not valued for its functions and efficiencies but is instead perceived as a contributor to waste.

Combined with the results of earlier qualitative studies [5], the current study suggests there is both an opportunity and challenge for the industry, packaging designers and decision-makers to reposition SFP as helping to reduce food waste. However, doing so in isolation is likely to be challenging, owing to the criticism of (especially plastic) packaging in the public domain [5]. Despite the tension around plastic packaging, there is evidence that a significant number of consumers do support some measures to reduce food waste, especially through date label changes and making food donations [33,57]. A broader response involving consumer awareness of food waste as an issue, education and continued packaging innovation and building on measures that garner some consumers' support warrants further investigation.

Increasing consumers' awareness and understanding of food waste as an environmental issue could also be paired with the continued development of packaging innovations that reduce food waste without expecting consumers to demand SFP, especially when they perceive all packaging as wasteful. This is essential to halve global food loss and waste by 2030 and substantially reduce waste generation, as outlined in Sustainable Development Goal 12 (Responsible consumption and production) [7]. The packaging industry plays a central role in ensuring these targets are met. Focus should be given to designs that are intuitively easy to understand, easy to open and reseal, able to extend product shelf life, and reduce food waste. These issues have been identified in earlier research as causes of household food waste that could be overcome by improving packaging [58]. Built-in functions to save food would not rely on consumers' awareness, as these features could be communicated on the pack. The latter approach would complement concurrent consumer education about the benefits of SFP to address the gap between consumers' concerns about the environment and their attitude and behaviours towards packaging. Similarly, because consumers have previously shown acceptance and awareness of the benefits of some types of packaging [37], the focus should also be given to types of packaging that consumers might already see as valuable, e.g., zip lock resealing functions. The long-term goal would be to increase the perceived value of SFP among consumers from something unnecessary and wasteful to a helpful and environmentally aware feature so that the benefits of SFP are not lost to a lack of consumer understanding.

Research has also evidenced that policy-makers are willing to engage with consumers in health- and sustainability-related behaviours [59]. Public policy-makers have a key role in creating policies that will drive industries to waste less and use packaging designs that are designed to save food; this will be necessary if the profit motive supports the status quo (i.e., it is probably cheaper to stay the same). Innovation in packaging is also expensive, and governments can also promote SFP innovation through policy and incentives designed to reduce food waste [60]. Overturning consumer perceptions of the relative merits of packaging versus food waste may also require some behavioural infrastructures to be built. For example, policy guidelines could be created for portion sizes suitable for the average household, or in another example, the sale of large quantities of perishable foods without SFP options could be forbidden. Policy interventions are necessary where there is a clash between consumer desires, industry profit-seeking and societal and environmental wellbeing.

Although carefully designed and conducted, there are limitations associated with this study. First, this study used a sample limited to a single country. Further studies could extend the findings to different populations. Research has demonstrated that patterns of consumerism differ across countries and cultures [61], consequently limiting the generalisability of the findings. Second, it was beyond the study's scope to ask consumers about packaging for different types of foods. This would be a valuable direction for future research, as the literature suggests that consumers' perceptions of packaging and labelling are not consistent across product categories and types of foods [4,61]. Thirdly, it was not possible to control for the influence of every variable that could affect packaging and food waste perceptions. However, we have created a model with key factors that influence consumers to provide valuable insight into consumers' perceptions of packaging. This study has also shown that there may be a considerable gap between consumers' motivations and their reported or actual behaviour around food waste. Further research could also be considered to better guide SFP designs. Furthermore, to reduce food waste, the authors encourage further research into consumers' attitudes toward food waste, packaging and packaging's potential role in reducing and preventing food waste. Further research should consider additional forms of analysis, such as meta-analysis and a many analysts approach [62], and explore why motivation levels to reduce food waste differ between groups such as men and women, cultures, ages and those with different income levels.

5. Conclusions

Despite being a considerable contributor to food waste, consumers' perceptions of food packaging designed to reduce waste are relatively under-reported in the scholarly literature. This paper distinguished between consumer groups that present propensities of anti- or pro-SFP sentiments. It identified societal subclusters through sampling and statistical interrogation, which is unique to this field of research, that is often founded on qualitative results alone. The research identified four clustered consumer groups defined on their perceptions of food packaging as submarkets. Consumers' perceptions of the seriousness of food waste also influence their perceptions and buying behaviours of packaging that can reduce food waste. Significant differences regarding motivation levels to reduce household food waste showed women, older generations and more affluent consumers were more motivated than their counterparts. Interestingly, those who agreed that packaging supports food waste reduction reported that they were less motivated to reduce food waste overall, and those who were critical of food packaging were more active in food waste mitigation. This suggests consumers are either anti-waste and will work hard to reduce both packaging and food waste together, or, in contrast, they rely on food packaging benefits for mitigating food waste more so for the convenience and economic factors rather than their desire to be an advocate for the environment.

The consumer populations and their respective perceptions identified in this paper can inform businesses, packaging designers and decision-makers who require a greater understanding of the Australian consumer landscape. The current state of consumer sub-

markets is distinct and requires unique education initiatives and on-pack communication designs. This research acts as a benchmark for consumer perceptions of packaging and its role of reducing food waste within the household. Promotion of the role of sustainable SFP is required to shift negative perceptions and move society towards a united and motivated practice of fighting food waste.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su15031917/s1, Supplementary File S1: Alternative hypotheses and their corresponding statistical tests conducted in Minitab 19. Supplementary File S2: Minitab 19: Multivariate principal component analysis (PCA) output results (n = 965) showing 10 factors and their corresponding definitions. Supplementary File S3: Minitab 19: One-way ANOVA output results (n = 965) with Tukey's post-hoc comparisons. Supplementary File S4: Minitab 19: ANOVA general linear model results (n = 965), consumer perceptions of food waste environmental issue impacting their perceived value of save food packaging.

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