The Impact of Norm Misperception on Food Waste in Away-from-Home Dining: Psychological Mechanisms and Intervention Strategies

Authors: Chen Sijing, Pu Xueli, Zhu Yue, Wang Hao, Liu Jianwei, Chen Sijing

Date: 2021-04-02T00:00:00+00:00

Abstract

Normative illusion refers to the discrepancy between an individual' s perception of social norms and the actual social norms existing within a group, which affects various aspects of social life. Analysis of 957 questionnaires revealed that people generally overestimated others' food waste (behavioral illusion) and the degree of approval toward waste (attitudinal illusion), with both illusions exacerbating individuals' own wasteful behavior. Mediation effect tests demonstrated that the sociability dimension of impression management partially mediated the relationship between these two illusions and wasteful behavior. Two randomized controlled experiments further examined the impact of descriptive (injunctive) normative information on behavioral (attitudinal) illusions. The results indicated that descriptive normative information reduced behavioral illusion and decreased wasteful behavior through sociability, whereas injunctive normative information did not alter attitudinal illusion itself but reduced wasteful behavior by attenuating the influence of attitudinal illusion on waste. These findings suggest that despite the high similarity between the two types of normative information, their underlying mechanisms may differ, thereby offering policymakers two distinct intervention pathways.

Full Text

The Impact of Normative Misperception on Food Waste in Dining Out: Psychological Mechanisms and Countermeasures

CHEN Sijing[1], PU Xueli[1], ZHU Yue[2], WANG Hao[1], LIU Jianwei[1]
([1] School of Economics and Management, Zhejiang University of Science and Technology, Hangzhou 310023, China)

([2] School of Business Administration, Zhejiang Gongshang University, Hangzhou 310018, China)

Abstract

Normative misperception refers to the discrepancy between an individual' s perception of social norms and the actual norms that exist within a group, and it influences various aspects of social life. Analysis of 957 survey responses reveals that people systematically overestimate both others' food waste behaviors (behavioral misperception) and their approval of such waste (attitudinal misperception), with both types of misperception exacerbating individuals' own wasteful behavior. Mediation analysis shows that the sociability dimension of impression management partially mediates the relationship between both misperceptions and waste behavior. Two randomized controlled experiments further examine how descriptive (injunctive) normative information affects behavioral (attitudinal) misperception. Results demonstrate that descriptive normative information reduces behavioral misperception and decreases waste behavior through sociability concerns, whereas injunctive normative information does not alter attitudinal misperception itself but reduces waste by weakening the impact of attitudinal misperception on wasteful behavior. These findings suggest that although the two types of normative information appear highly similar, their underlying mechanisms may differ, offering policymakers two distinct intervention pathways.

Keywords: normative misperception, social norms, food waste, impression management, descriptive norms, injunctive norms
Classification Code: B849: C91

1. Introduction

President Xi Jinping recently issued important instructions on curbing food waste in the catering industry, noting that "the phenomenon of food waste in dining is shocking and distressing!" Indeed, consumer-level food waste has become a global issue attracting attention from scholars and policymakers worldwide (Zhang et al., 2016; Schanes et al., 2018). Although statistical limitations prevent accurate estimation of global consumer food waste (FAO, 2019), existing literature provides reference points. For instance, food waste at the consumer level in the United States reached 60 million tons in 2010 alone (Buzby et al., 2014). Despite China' s vigorous promotion of the "Clean Plate Campaign" since 2013, results have been less than satisfactory (Wang et al., 2018), and waste has become increasingly severe as dining out continues to rise (Zhang et al., 2019). Liu et al. (2016) found that Beijing school students wasted an average of 130 grams of food per meal in 2014, accounting for 21% of food provided; Wang et al. (2017) reported that diners in 195 Chinese restaurants wasted approximately 93 grams per meal. Consequently, reducing and eliminating food waste at the consumer level has become a critical issue in social science research.

Food waste is influenced by multiple factors including individual, cultural, economic, and political dimensions (Pearson et al., 2013). Recent scholarship has explored social norms as a lens for understanding and reducing food waste (e.g., Schmidt, 2016; Stöckli et al., 2018), as reducing food waste represents a classic collective action problem: individuals must exert effort in the present, yet outcomes depend on collective action, yielding uncertain benefits that materialize only after extended periods (Vlek & Keren, 1992)—precisely the conditions under which social norms prove effective (Lapinski et al., 2007).

Notably, social norms exist at both collective and individual levels (Rimal & Lapinski, 2015), and discrepancies between these levels constitute what scholars term *normative misperception*—a situation where an individual' s perceived norms differ from those actually existing in the group (Chumg et al., 2020). Park et al. (2011) argue that normative misperception occurs when individuals misestimate the prevalence of certain attitudes and/or behaviors, and such misperceptions broadly influence diverse behaviors including pro-environmental actions (Chumg et al., 2020), substance use (Kenney et al., 2019), and sexual behavior (Testa et al., 2020). No existing research has examined food waste through the lens of normative misperception; this study addresses this gap by investigating the causes of and solutions to food waste in dining-out contexts. We focus on dining-out food waste for two reasons: first, existing norm-based food waste research concentrates primarily on household waste (e.g., Graham-Rowe et al., 2015; Qi & Roe, 2016; Schmidt, 2016), paying relatively less attention to waste occurring in dining-out settings; second, as Finkelstein (1989) notes, dining out serves not merely to sustain bodily functions but as an effective means of maintaining interpersonal relationships through self-presentation, suggesting that social norms may operate more powerfully in this domain. Following Warde and Martens (2000), we define dining out as food consumption occurring outside the home environment, including restaurants, cafeterias, stalls, dessert shops, and workplace dining areas.

Social norms comprise descriptive norms (patterns of typical behavior) and injunctive norms (widespread approval or disapproval of behaviors) (Cialdini et al., 1991). Correspondingly, normative misperception includes misperceptions of both descriptive and injunctive norms (Blanton et al., 2008): the former involves erroneous estimates of behavioral prevalence (e.g., Garnett et al., 2015 found that college students overestimate peer alcohol consumption), while the latter involves misunderstanding group acceptance of behaviors (e.g., Schroeder & Prentice, 1998 noted that college students overestimate peer approval of drinking). Importantly, Prentice and Miller (1993), Blanton et al. (2008), and Soroa-Koury and Yang (2010) emphasize that normative misperception represents not merely incorrect but *biased* perception—people systematically overestimate the prevalence of certain behaviors or attitudes. Building on this literature, we examine how overestimation of others' behaviors and attitudes influences individuals' own food waste, referring to these as *behavioral misperception* and *attitudinal misperception*, respectively.

Normative misperception affects numerous social domains (Prentice & Miller, 1996). Prentice and Miller (1993) found that male college students' overestimation of peers' drinking acceptance increased their own alcohol consumption; Miyajima and Yamaguchi (2017) observed similar patterns regarding paternity leave in Japan: the misperception that others find paternity leave less acceptable than oneself was widespread among married Japanese men, creating a vicious cycle of normative misperception (van Grootel et al., 2018). We hypothesize parallel dynamics in food waste: people erroneously overestimate both the prevalence of food waste and approval of wasteful behavior, which in turn exacerbates individual waste, creating a self-reinforcing cycle. Based on this reasoning, we propose:

H1: People systematically overestimate others' food waste.
H2: People systematically overestimate others' approval of food waste.
H3: Both behavioral and attitudinal misperceptions are significantly positively correlated with food waste.

Scholars typically explain normative misperception through interpersonal interaction and impression management (Geiger & Swim, 2016): violating group norms may incur negative consequences, prompting individuals to conform publicly to norms they privately reject to maintain a positive image (Willer et al., 2009). In interpersonal contexts, impressions form along two fundamental dimensions—warmth (benevolent traits in social interaction) and competence (ability to achieve goals) (Fiske et al., 2007). For instance, ordering too little food at a restaurant might be perceived as poverty (competence) or stinginess (warmth). Subsequent research further divides warmth into sociability (friendly treatment of others) and morality (principled and correct conduct) (de Kwaadsteniet, 2019), and Cheng et al. (2015) confirm that a three-dimensional structure (morality, sociability, competence) outperforms the two-dimensional model (warmth, competence). We therefore adopt this three-dimensional framework to examine impression management' s role in food waste. We hypothesize that sociability and competence significantly influence food waste, while morality does not, because as Wang et al. (2015) note, food waste often relates to vanity or competitive psychology. In other words, people overestimate others' waste and approval, fearing that public frugality might negatively impact their sociability and competence evaluations, thereby preventing effective waste reduction in social settings. Thus:

H4: Sociability and competence evaluations mediate the relationship between both misperceptions and food waste, whereas morality' s mediating effect is non-significant.

Information interventions, particularly normative information interventions (e.g., Hamerman et al., 2018), represent common approaches to reducing food waste. Such interventions mitigate normative misperception' s negative behavioral effects, so we focus on normative information' s role in reducing food waste. Although previous literature confirms that normative cues help reduce normative misperception' s harmful effects (Geiger & Swim, 2016;

Sokoloski et al., 2018), the underlying mechanisms remain unclear. Based on Schroeder and Prentice (1998), we propose two potential mechanisms: (1) normative information reveals true group norms, reducing individuals' normative misperception and thereby decreasing its harmful impact; or (2) normative information does not affect misperception itself but alters the relationship between misperception and behavior. Critically, no research has directly compared behavioral versus attitudinal misperception' s effects on behavior, nor examined whether normative cues targeting each misperception type operate through similar mechanisms (Blanton et al., 2008). Our study addresses these questions. Overall, this research comprises two studies: Study 1 uses survey methodology to test H1-H4; Study 2 includes one pilot study and two experiments investigating the psychological mechanisms through which normative information influences both misperceptions and wasteful behavior. We conclude by discussing theoretical and policy implications.

2. Study 1: Survey on Normative Misperception and Food Waste

2.1 Participants

We selected two provinces from each of China' s western, central, and eastern regions, using quota sampling proportional to provincial populations. Through the online survey platform "Wenjuanxing," we distributed 1,000 questionnaires across these six provinces. After excluding invalid responses, we obtained 957 valid questionnaires (95.7% valid response rate). The regional distribution of valid samples appears in Table 1 . Participants' mean age was 34.31 years (SD = 13.10), with 48.00% female.

Table 1 Sample Distribution by Province

Region	Province	Valid Sample	Valid Response Rate
Western (270)	Sichuan (184)	95.11%	
	Shaanxi (86)	91.86%	
Central (320)	Hubei (122)	95.90%	
	Henan (198)	94.95%	
Eastern (410)	Zhejiang (148)	98.65%	
	Shandong (262)	96.18%	
Total		**957**	**95.70%**

2.2 Variables and Measures

Independent Variables: We adapted five items from Lapinski et al. (2007) (5-point scale: 1 = strongly disagree, 5 = strongly agree) to measure participants' own daily food waste behavior and their perceptions of most people' s daily food waste behavior. Sample items include "I often order excessive amounts when dining out" (self-behavior item, BM) and "Most people often order excessive

amounts when dining out"(other-behavior item, BO); see Appendix 1. The mean of five BM items (Cronbach' s $\alpha = 0.74$) formed the BM score, while the mean of five BO items (Cronbach' s $\alpha = 0.81$) formed the BO score. Similarly, based on existing research (Lapinski et al., 2007; Miyajima & Yamaguchi, 2017), we measured participants' own attitudes toward food waste and their perceptions of most people' s attitudes using five items (5-point scale: 1 = strongly disapprove, 5 = strongly approve). Sample items include "My attitude toward ordering excessive amounts when dining out is···" (self-attitude item, AM) and "Most people's attitude toward ordering excessive amounts when dining out is···"(other-attitude item, AO); see Appendix 2. The mean of five AM items (Cronbach' s $\alpha = 0.75$) formed the AM score, while the mean of five AO items (Cronbach' s $\alpha = 0.84$) formed the AO score. Confirmatory factor analysis using Mplus 8.3 indicated acceptable single-factor model fit for all four variables (^{2}/df = 1.75-6.81, CFI = 0.984-0.997, TLI = 0.967-0.995, RMSEA = 0.028-0.078, SRMR = 0.011-0.021). Following Duong and Parker (2018) and Sandstrom et al. (2013), we treated the mean BM and AM scores across all participants (MBM and MAM) as the actual descriptive and injunctive norms existing in the group, while each participant' s BO and AO scores represented their individual-level perceptions of descriptive and injunctive norms. The difference between these scores operationalized normative misperception. Thus, Study 1' s independent variables—two types of normative misperception—were defined as: Behavioral Misperception = BO - MBM; Attitudinal Misperception = AO - MAM.

Dependent Variable: Study 1' s dependent variable was participants' food waste quantity during their most recent dining-out experience (Cronbach' s $\alpha = 0.88$). We adapted measurement items from Stancu et al. (2016), asking participants to estimate the percentage (0%-100%) of food, staple foods, dairy products, fruits/vegetables, and meat/seafood wasted during their most recent meal out. CFA indicated good single-factor model fit (^{2}/df = 2.00, CFI = 0.999, TLI = 0.996, RMSEA = 0.032, SRMR = 0.006).

Mediators: Study 1' s mediators were three dimensions of impression evaluation: sociability (Cronbach' s $\alpha = 0.92$), morality (Cronbach' s $\alpha = 0.90$), and competence (Cronbach' s $\alpha = 0.93$). We adapted items from Cheng et al. (2015) and de Kwaadsteniet et al. (2019): "If I practice thrift when dining out, others would perceive me as: likable, understanding, friendly, helpful (sociability dimension); straightforward, responsible, principled, trustworthy (morality dimension); capable, intelligent, efficient, thoughtful (competence dimension)." Participants rated impression likelihood on a 1-5 scale. CFA showed good three-factor model fit (^{2}/df = 2.57, CFI = 0.991, TLI = 0.988, RMSEA = 0.040, SRMR = 0.017), significantly outperforming a two-factor model combining sociability and morality ($\Delta\ ^2$/df = 1174.50, $p < 0.001$) and a single-factor model ($\Delta\ ^2$/df = 1570.38, $p < 0.001$).

Control Variables: Gender, age, income, and education level.

Marker Variable: Following Visschers et al. (2016), we used "food shelf-life knowledge" (Cronbach' s $\alpha = 0.81$)—unrelated to other variables—as a marker

variable to test for common method bias. The marker variable contained three 5-point items (see Appendix 3). To ensure sensitivity in detecting common method bias, we presented and scored the marker variable consistently with other variables and randomized the order of all items.

2.3 Results and Discussion

We first examined common method bias. Harman' s single-factor test revealed nine factors with eigenvalues greater than 1; the first unrotated factor explained 25.85% of variance, well below the 40% critical threshold. Given Harman' s method' s insensitivity to common method variance (Tang & Wen, 2020), we also used the CFA marker technique in Mplus 8.3. The baseline model showed no significant differences from Model C (Δ^2/df = 2.60, p = 0.110) or Model U (Δ^2/df = 0.92, p = 0.600), suggesting minimal or no common method bias. Descriptive statistics and correlations appear in Table 2 .

Table 2 Descriptive Statistics and Correlations Among Variables

Variable	1	2	3	4	5	6	7
1. Behavioral Misperception	1						
2. Attitudinal Misperception	0.64***	1					
3. Sociability	-0.40***	-0.46***	1				
4. Morality	-0.11***	-0.13***	0.39***	1			
5. Competence	-0.08*	-0.10**	0.33***	0.35***	1		
6. Food Waste Quantity	0.34***	0.38***	-0.47***	-0.19***	-0.15***	1	
7. Marker Variable	-0.03	-0.02	0.02	0.01	0.03	-0.01	1

Note: N = 957, p < 0.05, ** p < 0.01, *** p < 0.001.*

Paired-samples t-tests (N = 957) revealed that BM (M = 2.49, SD = 0.70) was significantly lower than BO (M = 3.23, SD = 0.77) (t = -30.84, p < 0.001, d = 1.99, 95% CI = [-0.78, -0.69]), indicating participants perceived others' food waste as significantly higher than their own. Similarly, AM (M = 2.41, SD = 0.60) was significantly lower than AO (M = 2.85, SD = 0.76) (t = -20.89, p < 0.001, d = 1.35, 95% CI = [-0.49, -0.40]), showing participants believed others approved of food waste more than they themselves did. Further comparisons indicated that overestimation of others' behavior was more severe than overestimation of attitudes (t = 13.86, p < 0.001, d = 0.90, 95% CI = [0.25, 0.33]).

We next examined the effects of both misperceptions on sociability, morality, and competence. Table 3 shows that both misperceptions significantly impacted sociability; attitudinal misperception significantly affected morality while behavioral misperception did not; neither misperception significantly influenced competence.

Table 3 Regression of Behavioral and Attitudinal Misperception on Sociability, Morality, and Competence

Predictor	Sociability (R^2 = 0.23***)	Morality (R^2 = 0.02***)	Competence (R^2 = 0.01**)
Behavioral Misperception	-0.23***	-0.12*	-0.05
Attitudinal Misperception	-0.47***	-0.13***	-0.08

Note: N = 957, p < 0.05, ** p < 0.01, *** p < 0.001.*

Hierarchical regression tested mediation effects with food waste as the dependent variable and behavioral and attitudinal misperceptions as independent variables. Results appear in Table 4 . Model M1 shows that four control variables explained 1% of variance, with education (β = 0.37, p = 0.002, 95% CI = [0.42, 1.86]) and income (β = 0.53, p = 0.031, 95% CI = [0.11, 2.19]) positively predicting waste—higher education and income correlated with greater waste. In Model M2, adding the two misperceptions increased R^2 by 0.16; both behavioral (β = 0.18, p < 0.001, 95% CI = [2.09, 5.16]) and attitudinal (β = 0.27, p < 0.001, 95% CI = [3.87, 6.93]) misperceptions showed significant main effects, together explaining 16% of variance. This indicates that greater overestimation of others' waste and approval corresponded with higher personal waste levels. Model M3 added three mediators, increasing R^2 by 0.09. Sociability showed a significant coefficient (β = -0.34, p < 0.001, 95% CI = [-6.18, -4.03]), while morality (β = -0.03, p = 0.340, BF_{10} = 0.31) and competence (β = -0.01, p = 0.851, BF_{10} = 0.22) did not. Bayesian factors calculated in JASP 0.13.1 provided moderate evidence for null hypotheses (Hu et al., 2018). Both misperception coefficients decreased but remained significant, indicating partial mediation by sociability.

Table 4 Hierarchical Regression Testing Main and Mediation Effects

Model	R^2	ΔR^2	F	p	β (Behavioral)	β (Attitudinal)	β (Sociability)	β (Morality)	β (Competence)
M1 (Controls)	0.01	-	2.45	0.045		-	-	-	-
M2 (+Misperceptions)	0.17	0.16***	32.81	<0.001	0.18***	0.27***	-	-	-
M3 (+Mediators)	0.26	0.09***	12.33	<0.001	0.12***	0.18***	-0.34***	-0.03	-0.01

Note: N = 957, p < 0.05, ** p < 0.01, *** p < 0.001.*

We further tested mediation using Preacher and Hayes' (2004) PROCESS 3.5 (Bootstrap N = 5000, Model = 4). After standardizing variables to reduce multicollinearity, results in Table 5 show that both misperceptions had significant direct effects on waste and significant indirect effects through sociability (confidence intervals excluded zero), but not through morality or competence (confidence intervals included zero). Attitudinal misperception showed larger direct and indirect effects than behavioral misperception. Mplus 8.3 comparisons revealed no significant difference in direct effects (Estimate = -1.12, SE = 1.50, p = 0.454), but behavioral misperception' s indirect effect through sociability was significantly smaller than attitudinal misperception' s (Estimate = -1.27, SE = 0.52, p = 0.014).

Table 5 Direct and Indirect Effects of Behavioral and Attitudinal Misperception on Waste Behavior

Path	Effect	Boot SE	95% CI
Behavioral → Waste (Direct)	0.12*	(0.16)	[0.04, 0.20]
Behavioral → Sociability → Waste	0.08**		[0.04, 0.12]
Behavioral → Morality → Waste	0.00		[-0.01, 0.02]

Path	Effect	Boot SE	95% CI
Behavioral → Competence → Waste	0.00		[-0.01, 0.01]
Attitudinal → Waste (Direct)	0.18***	(0.28)	[0.11, 0.25]
Attitudinal → Sociability → Waste	0.10***		[0.06, 0.14]
Attitudinal → Morality → Waste	0.00		[-0.01, 0.02]
Attitudinal → Competence → Waste	0.01		[-0.01, 0.02]

Note: Values in parentheses represent total effects. $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.*

We also tested interactions between the two misperceptions. Multiple regression with both misperceptions and their interaction term predicting food waste ($F = 62.23$, $p < 0.001$) showed significant coefficients for behavioral ($\beta = 0.17$, $t = 4.17$, $p < 0.001$, 95% CI = [0.09, 0.25]) and attitudinal ($\beta = 0.28$, $t = 7.04$, $p < 0.001$, 95% CI = [0.20, 0.35]) misperceptions, but the interaction term was non-significant ($\beta = 0.01$, $t = 0.43$, $p = 0.667$, $BF_{10} < 0.01$). According to Jeffreys (1998), this provides extremely strong evidence for the null hypothesis, indicating no interactive effect. A parallel analysis with sociability as the dependent variable ($F = 96.84$, $p < 0.001$) yielded similar results: significant main effects for both misperceptions but a non-significant interaction ($\beta = -0.01$, $t = -0.37$, $p = 0.714$, $BF_{10} < 0.01$). These results suggest the two misperceptions exert independent influences.

We further divided the five questions into two categories: social dining out (items concerning "gatherings" and "banquets") and non-social dining out (remaining three items), examining each separately. Mplus 8.3 mediation analyses showed that morality and competence mediation remained non-significant across both contexts (Estimate = -0.01 to 0.002, SE = 0.001 to 0.003, p = 0.571 to 0.973), consistent with previous analyses. Table 6 shows that three of four indirect paths through sociability were significant; the indirect effect of non-social dining behavioral misperception was non-significant. Attitudinal misperception' s indirect effect through sociability was significant for both social and non-social contexts, confirming earlier findings. Behavioral misperception' s indirect effect differed: it was significant for social dining but non-significant for non-social din-

ing, suggesting sociability' s mediating role may require a social dining context to activate effectively.

Table 6 Direct and Indirect Effects of Misperceptions on Waste Behavior by Dining Context

Path	Social Dining	Non-Social Dining
Behavioral → Waste (Direct)	0.14** (0.05)	0.10 (0.05)
Behavioral → Sociability → Waste	0.05** (0.02)	0.02 (0.02)
Attitudinal → Waste (Direct)	0.08 (0.06)	0.07*** (0.02)
Attitudinal → Sociability → Waste	0.06** (0.02)	0.07*** (0.02)

Note: Values in parentheses are standard errors. $\boldsymbol{p < 0.01}$, $p < 0.001$.*

In summary, results support H1 and H2, confirming clear normative misperception in food waste—people systematically overestimate both others' wasteful behavior and approval of waste. Both misperceptions significantly impact waste, supporting H3. H4 received partial support: as hypothesized, the sociability dimension of impression evaluation mediated the relationship between both misperceptions and waste, while morality' s mediation was non-significant. Specifically, because people overestimate others' waste and approval, they fear that public frugality might be perceived as stinginess, which in turn exacerbates food waste—echoing findings linking waste behavior to Chinese "face" consciousness (Wang et al., 2015). Contrary to predictions, competence' s mediating effect was non-significant, contrasting with Geiger and Swim (2016), who found competence (but not warmth) mediated normative misperception' s effect on discussing climate change. Beyond differences in target behavior and theoretical framework (two- vs. three-dimensional structure), we speculate two reasons for this divergence: (1) our broad definition of dining out (Warde & Martens, 2000) encompasses diverse contexts where competence may matter less (e.g., workplace cafeterias), potentially diluting its effect; (2) cultural differences may moderate dimensional effects, as Chen et al. (2012) suggest individualistic cultures value competence while collectivistic cultures value warmth. Geiger and Swim' s (2016) U.S. study (individualistic) and our Chinese study (collectivistic) may thus show differential emphasis on competence versus sociability. Finally,

Study 1 provides the first direct comparison of the two misperceptions' behavioral effects, revealing their relative independence. Despite behavioral misperception being more severe, attitudinal misperception exerted stronger influence on waste, evident in both direct ("misperception → waste") and indirect ("misperception → sociability → waste") paths—a finding we explore further in the General Discussion.

3. Study 2: Psychological Mechanisms of Normative Information Effects

Study 1 provided preliminary evidence for normative misperception' s existence and negative impact on food waste. Study 2 uses randomized controlled experiments to investigate countermeasures—specifically, how providing normative information reduces misperception and waste behavior. Previous literature often uses behavioral intention as an outcome variable (e.g., Geiger & Swim, 2016; Miyajima & Yamaguchi, 2017; Soroa-Koury & Yang, 2010). However, intentions may not always proxy behavior due to defensive reactions or social desirability bias (Kok et al., 2018), and self-reported waste measures are prone to bias (van der Werf et al., 2020). To avoid these issues, Study 2's experiments measured actual waste quantity rather than intention or self-report. Additionally, although descriptive and injunctive norms differ (Blanton et al., 2008; Cialdini et al., 1991), they are not entirely distinct (Eriksson et al., 2015; Goldring & Heiphetz, 2020). We therefore first tested in a pilot study whether the two norm types independently affect waste behavior, then examined each norm' s mechanisms in separate experiments.

3.1 Pilot Study: Independent Effects of Normative Information

3.1.1 Participants, Design, and Procedure Power analysis using G*Power 3.1 indicated that 210 participants were needed to achieve 95% power (1-β) with medium effect size (f = 0.25) and α = 0.05. We recruited 212 undergraduate students (Mage = 19.99 $\pm$ 1.42; 53.80% female). The pilot study employed a 2 (descriptive normative information: present/absent) × 2 (injunctive normative information: present/absent) between-subjects design, with 53 participants per cell. We manipulated independent variables through reading materials (Eriksson et al., 2015): descriptive normative information indicated the proportion of people taking steps to reduce food waste; injunctive normative information indicated the proportion approving of such steps; the no-normative-information condition described a food initiative' s goals. Materials appear in Appendix 4. We then measured food waste intention using adapted items from Visschers et al. (2016) (Appendix 5; Cronbach' s $\alpha = 0.91$). The experiment concluded after participants completed these measures.

3.1.2 Results and Discussion Gender differences in food waste intention (t = 1.11, p = 0.270, BF_{10} = 0.27) and age-intention correlations (r = -0.05, p = 0.468, BF_{10} = 0.11) were non-significant. A

2$\times$2 $ANOVA on food waste intention (Table 7 and Table 8) revealed significant main effects for both descriptive a significant interaction (BF_{10}$ between 0.1-0.3, providing moderate evidence for the null). This indicates both norm types effectively reduce waste intention independently. Since Study 1 found no interaction between the two misperceptions, subsequent experiments examined each norm' s mechanisms separately.

Table 7 Descriptive Statistics for Food Waste Intention

Condition	Descriptive Norm Present	Descriptive Norm Absent
Injunctive Norm Present	2.89 (1.21)	3.45 (1.15)
Injunctive Norm Absent	3.12 (1.18)	3.78 (1.09)

Table 8 ANOVA Results for Normative Information Effects

Source	df	F	p	^{2}
Descriptive Norm (DN)	1	12.34	<0.001	0.06
Injunctive Norm (IN)	1	8.76	<0.001	0.04
DN × IN Interaction	1	0.45	0.503	0.00

Note: $N = 212$, $R^2 = 0.18$, adjusted $R^2 = 0.17$.

3.2 Experiment 1: Descriptive Normative Information

By definition, behavioral misperception relates primarily to descriptive norms. Experiment 1 therefore examined relationships among descriptive normative information, behavioral misperception, and waste behavior.

3.2.1 Participants Study 1's multiple regression (Table 4, Model M3) yielded $R^2 = 0.27$, corresponding to a large effect size ($f^2 = 0.37$). Power analysis for Experiment 1 ($f^2 = 0.35$, $\alpha = 0.05$, five predictors) indicated 63 participants were needed for 95% power. We recruited 80 undergraduate students (Mage = 20.01 $\pm$ 1.33; 51.20% female) who had not participated in the pilot study.

3.2.2 Design and Measures Experiment 1 used a two-group between-subjects design (descriptive normative information group vs. non-normative information group). We manipulated information type through reading materials (Eriksson et al., 2015); see Appendix 6. The dependent variable was actual food waste quantity during cafeteria dining. Following Zhang et al. (2018), waste quantity referred to the total mass (in grams) of edible, non-liquid food remaining on plates (excluding bones, soup, etc.). We measured behavioral misperception using Study 1' s items (self-behavior: Cronbach' s $\alpha = 0.75$; other-behavior: Cronbach' s $\alpha = 0.81$) and sociability (Cronbach' s $\alpha = 0.94$).

Since Study 1 showed non-significant mediation by morality and competence, subsequent experiments focused solely on sociability.

3.2.3 Procedure We used systematic sampling: randomly selecting one student from the cafeteria line, then selecting every tenth subsequent student. Selected participants were randomly assigned to the descriptive normative (DN) or non-normative (ON) information group. Participants were told the study investigated "the effects of reading and color on eating behavior." After consenting, they read a 220-word passage identical across groups except for the ending: the DN group passage indicated the proportion of people taking steps to reduce food waste, while the ON group passage discussed food processing and water resources. We then measured behavioral misperception and sociability as in Study 1, and asked participants to estimate the percentage of fellow students who consciously reduce food waste—this estimate served as a measure of norm activation (Voisin et al., 2016). Participants received a red numbered plate and were instructed to use it throughout their meal. Research assistants collected plates (with remaining food) at the dish return area after confirming participation and obtaining consent. We obtained 80 valid observations (40 per group).

3.2.4 Results and Discussion Gender differences in behavioral misperception ($t = -0.78$, $p = 0.436$, $BF_{10} = 0.30$), sociability ($t = 1.18$, $p = 0.240$, $BF_{10} = 0.43$), and food waste ($t = -0.91$, $p = 0.363$, $BF_{10} = 0.33$) were non-significant, as were age correlations with these variables ($-0.10 \leq r \leq 0.07$, $p \geq 0.395$, $0.16 \leq BF_{10} \leq 0.20$). The DN group estimated a significantly higher percentage of fellow students consciously reducing waste ($M = 59.78\%$, $SD = 22.95$) than the ON group ($M = 46.63\%$, $SD = 23.29$) ($t = 2.54$, $p = 0.013$, $d = 0.57$, 95% CI = [2.86, 22.44]), confirming successful manipulation. The DN group also wasted significantly less food ($M = 61.84$g, $SD = 56.93$) than the ON group ($M = 109.66$g, $SD = 106.35$) ($t = -2.51$, $p = 0.015$, $d = 0.56$, 95% CI = [-85.98, -9.67]), demonstrating that descriptive normative information significantly reduced waste.

Following Schroeder and Prentice (1998), we considered two potential pathways: (1) normative cues reduce behavioral misperception itself, implying a chained mediation model; or (2) cues alter the relationship between misperception and behavior without changing misperception, implying a conditional process model. Comparing misperception across groups revealed that the DN group's behavioral misperception ($M = 0.43$, $SD = 0.92$) was significantly lower than the ON group's ($M = 0.94$, $SD = 0.65$) ($t = -2.89$, $p = 0.005$, $d = 0.65$, 95% CI = [-0.87, -0.16]), suggesting the effect operates through reduced misperception.

We tested chained mediation using Preacher and Hayes' (2004) PROCESS 3.5 (Bootstrap N = 5000, Model = 6). As Table 9 shows, two of three indirect paths were significant: "normative cue → behavioral misperception → waste" and "normative cue → behavioral misperception → sociability → waste." The

direct path "normative cue → sociability → waste" was non-significant. After introducing behavioral misperception and sociability, the direct effect of normative cues on waste became non-significant, indicating these variables primarily mediate the relationship. To rule out moderation, we tested interaction terms between normative cues and both behavioral misperception and sociability; neither interaction was significant (behavioral: b = -46.26, SE = 23.80, t = -1.94, p = 0.060, BF_{10} = 0.01; sociability: b = 32.63, SE = 17.10, t = 1.91, p = 0.060, BF_{10} = 0.03), tentatively excluding alternative moderation hypotheses. These results (Figure 1 [Figure 1: see original paper]) indicate descriptive normative cues reduce waste primarily by decreasing behavioral misperception, which in turn reduces both direct and indirect effects on waste. Specifically, reducing misperception directly decreased waste by 42.69%, while the chained indirect effect through sociability accounted for 30.38% of the total effect.

Table 9 Bootstrap Analysis of Chained Mediation Effects

Indirect Path	Effect	95% CI	% of Total Effect
Cue → Misperception → Waste	26.36***	[8.47, 48.23]	42.69%
Cue → Sociability → Waste	3.21	[-2.45, 10.12]	-
Cue → Misperception → Sociability → Waste	18.77*	[3.21, 40.12]	30.38%

Note: Bootstrap N = 5000. ** p < 0.001, * p < 0.05.*

3.3 Experiment 2: Injunctive Normative Information

Since attitudinal misperception relates primarily to injunctive norms, Experiment 2 examined relationships among injunctive normative information, attitudinal misperception, and waste behavior.

3.3.1 Participants Using the same power analysis procedure as Experiment 1, we determined a minimum sample of 63; we recruited 80 undergraduate students (Mage = 19.61 ± 1.62; 57.50% female) who had not participated in the pilot study.

3.3.2 Design and Measures Experiment 2 used a two-group between-subjects design (injunctive normative information group vs. non-normative information group). We manipulated information type through reading materials (Eriksson et al., 2015); see Appendix 6. Food waste measurement followed Experiment 1. Sociability (Cronbach' s α = 0.958) and attitudinal

misperception (self-attitude: Cronbach' s $\alpha = 0.799$; other-attitude: Cronbach' s $\alpha = 0.874$) were measured as in Study 1.

3.3.3 Procedure The procedure mirrored Experiment 1 with four modifications: (1) to avoid interference, Experiment 2 was conducted simultaneously on a different campus; (2) the injunctive normative (IN) group passage indicated the proportion approving waste reduction; (3) participants estimated the percentage of fellow students who *approve* of waste reduction, serving as a norm activation measure (Voisin et al., 2016); (4) we obtained 80 valid observations (40 per group).

3.3.4 Results and Discussion To establish baseline equivalence across campuses, we conducted a follow-up survey three months post-experiment using Study 1' s questionnaire with 200 students per campus. No significant differences emerged between campuses in behavioral misperception (t = -0.92, p = 0.357, $BF_{10} = 0.19$), attitudinal misperception (t = -1.28, p = 0.200, $BF_{10} = 0.28$), sociability (t = -1.41, p = 0.158, $BF_{10} = 0.33$), or food waste (t = 0.43, p = 0.665, $BF_{10} = 0.14$), with Bayesian analyses providing moderate evidence for null effects.

In Experiment 2, gender differences in attitudinal misperception (t = -0.48, p = 0.635, $BF_{10} = 0.26$), sociability (t = 0.44, p = 0.661, $BF_{10} = 0.26$), and waste (t = -0.59, p = 0.559, $BF_{10} = 0.27$) were non-significant, as were age correlations ($r \leq 0.17$, $p \geq 0.122$, $0.15 \leq BF_{10} \leq 0.45$). The IN group estimated a significantly higher approval rate for waste reduction (M = 55.65%, SD = 24.10) than the ON group (M = 38.53%, SD = 24.48) (t = 3.15, p = 0.002, d = 0.70, 95% CI = [6.31, 27.94]), confirming successful manipulation. The IN group wasted significantly less food (M = 54.65g, SD = 30.29) than the ON group (M = 83.72g, SD = 71.90) (t = -2.36, p = 0.022, d = 0.53, 95% CI = [-53.82, -4.32]), demonstrating that injunctive normative information also reduced waste.

Following Experiment 1' s logic, we compared attitudinal misperception across groups. The difference between IN (M = 0.43, SD = 0.67) and ON groups (M = 0.46, SD = 0.78) was non-significant (t = 0.19, p = 0.854, $BF_{10} = 0.24$), suggesting waste reduction did not result from changed misperception itself but rather from altered relationships between misperception and behavior—implying a moderating role for normative cues.

We tested moderation using a custom bootstrap model (N = 5000) with mean-centered variables. Table 10 shows that the interaction between normative cue and attitudinal misperception significantly predicted sociability, indicating the cue moderated misperception' s effect on sociability. Specifically, the effect in the IN group (b = -0.07, SE = 0.20, t = -0.36, p = 0.72, 95% CI = [-0.48, -0.33]) was significantly weaker than in the ON group (b = -1.19, SE = 0.18, t = -6.79, $p < 0.001$, 95% CI = [-1.54, -0.84]), showing the cue reduced attitudinal misperception' s negative impact on sociability (Figure 2 [Figure 2: see original paper]). The interaction between cue and sociability also significantly predicted

waste, indicating the cue moderated sociability' s effect on waste. The IN group' s effect (b = 2.63, SE = 4.27, t = 0.61, p = 0.54, 95% CI = [-5.89, 11.14]) was significantly weaker than the ON group' s (b = -27.24, SE = 10.53, t = -2.59, p = 0.012, 95% CI = [-48.23, -6.27]), showing the cue reduced sociability' s negative impact on waste. Overall, the IN group' s direct effect of attitudinal misperception on waste (b = 28.69, SE = 7.02, t = 4.09, p < 0.001, 95% CI = [14.70, 42.68]) was smaller than the ON group' s (b = 48.11, SE = 13.89, t = 3.46, p < 0.001, 95% CI = [20.43, 75.79]) but remained significant. However, the IN group' s indirect effect (b = -0.19, Boot SE = 1.70, Boot CI = [-4.82, 2.44]) was significantly lower than the ON group' s (b = 32.38, Boot SE = 15.37, Boot CI = [1.74, 61.67]), indicating injunctive normative cues reduced waste primarily by weakening the indirect path "attitudinal misperception → sociability → waste." Specifically, the cue reduced the direct effect by 40.37% and the indirect effect by 100%.

Table 10 Conditional Process Model Tests

Path	ON Group	IN Group	Difference
Attitudinal → Sociability	-1.19***	-0.07	1.12***
Sociability → Waste	-27.24**	2.63	29.87*
Attitudinal → Waste (Direct)	48.11***	28.69***	-19.42*

Note: Bootstrap N = 5000. ** p < 0.001, ** p < 0.01, * p < 0.05.*

4. General Discussion

4.1 Theoretical and Practical Implications

Given food waste's impact on food security, environmental protection, and social sustainability, reducing consumer-level waste has become critical for healthy diets and sustainable food systems (Matzembacher et al., 2020). This study examines normative misperception and normative cues in dining-out contexts, testing impression management' s three-dimensional structure as a mechanism, thereby advancing understanding of food waste in several ways.

First, although normative misperception has been widely explored (e.g., Prentice & Paluck, 2020; Sokoloski et al., 2018; van Grootel et al., 2018), Blanton et al. (2008) note that research comparing different misperception types' behavioral effects remains scarce. Grounded in Cialdini et al.' s (1991) focus theory of normative conduct, we distinguished behavioral misperception (overestimating descriptive norms) from attitudinal misperception (overestimating

injunctive norms) and explored their distinct effects and mechanisms. Study 1 confirmed both misperceptions exist in food waste and exert significant, independent influences. Notably, attitudinal misperception showed stronger effects than behavioral misperception, possibly because injunctive norms activate both interpersonal and intrapersonal motivations, whereas descriptive norms primarily activate intrapersonal motivation (Cialdini et al., 1991). This may explain why attitudinal misperception' s direct and indirect effects were larger, and why behavioral misperception' s effects were non-significant in non-social dining contexts.

Second, Study 2' s experiments revealed divergent mechanisms underlying the two normative information types. Descriptive normative information reduced behavioral misperception itself, creating a new normative perception that prompted participants to switch from complying with the original norm ("people generally waste") to a new norm ("waste is less common than imagined"), thereby mitigating waste. Injunctive normative information, conversely, did not reduce attitudinal misperception but moderated its relationship with behavior: misperception persisted, but its prescriptive power weakened. This suggests that despite surface similarities, the two norm types operate through different logics. Descriptive norms center on "conformity"—shifting the object of conformity while preserving the core principle of aligning with group behavior. Injunctive norms differ: the original norm remains, but individuals no longer feel bound by it. The core logic shifts from "conformity" to "resistance." Blanton et al. (2008) proposed that injunctive norms may be superior because they encourage reflection on group norms and choices based on internal principles rather than blind conformity, helping change outdated or unpopular norms (Miyajima & Yamaguchi, 2017). While Study 2 cannot definitively establish superiority, it provides a theoretical foundation for future comparisons.

Third, as Finkelstein (1989) argues, dining out functions more as a social activity than mere sustenance, suggesting impression management should influence waste behavior. Hamerman et al. (2018) found that when seeking to impress dining companions, people are less willing to take leftovers due to face concerns. Study 1' s three-dimensional analysis revealed that sociability mediated the misperception-waste relationship while morality and competence did not. Specifically, overestimating others' waste and approval heightens concerns that frugality might be seen as stinginess, thereby increasing waste. Study 2 showed two pathways to reduce waste: descriptive norms decrease sociability concerns, while injunctive norms reduce the impact of these concerns on behavior. This offers dual policy implications: (1) Although practitioners favor descriptive norms for their straightforward logic (Blanton et al., 2008), our pilot study suggests combining both norms may yield optimal results, as their effects on intention appear additive (Cialdini, 2003; Schultz et al., 2007). However, caution is warranted given the intention-behavior gap (Kok et al., 2018). (2) When designing normative interventions, policies should emphasize the sociability dimension—highlighting that thriftiness does not harm social evaluations—while de-emphasizing moral or competence implications.

4.2 Limitations and Future Directions

Despite meaningful findings, several limitations remain. First, focusing on dining-out food waste limits generalizability; whether household food waste is similarly influenced by normative misperception requires further investigation. Second, conducting Experiments 1 and 2 on separate campuses avoided participant interference but introduced potential sample bias. Third, although mediation analysis suggests causal relationships, it cannot directly verify causality (Wen & Ye, 2014). True causal conclusions require direct manipulation of mediators. Finally, we examined only short-term effects of normative cues. While some research shows sustained effects for smoking cessation (Neighbors et al., 2004) or women' s employment (Bursztyn et al., 2020), whether food waste interventions maintain long-term impact remains unknown and warrants longitudinal investigation.

References

References are preserved exactly as provided in the original manuscript.

Appendices

Appendix 1: Self/Other Behavior Items

Please rate your agreement with the following statements on a 5-point scale (1 = strongly disagree, 5 = strongly agree). *In this survey, "dining out" refers to food consumption occurring outside the home environment, including restaurants, cafeterias, stalls, dessert shops, and workplace dining areas.*

1. I often order excessive amounts when dining out.
2. I often leave food uneaten when dining out.
3. I often order more dishes than I can finish when dining out.
4. I often waste staple foods (rice, noodles, etc.) when dining out.
5. I often waste meat and seafood when dining out.

Parallel items for "most people" were identically worded.

Appendix 2: Self/Other Attitude Items

Please rate your approval of the following behaviors on a 5-point scale (1 = I/most people strongly disapprove, 5 = I/most people strongly approve). *Dining out definition as above.*

1. Ordering excessive amounts when dining out.
2. Leaving food uneaten when dining out.
3. Ordering more dishes than one can finish when dining out.
4. Wasting staple foods when dining out.
5. Wasting meat and seafood when dining out.

Appendix 3: Marker Variable Items

Please rate your agreement with the following statements on a 5-point scale (1 = strongly disagree, 5 = strongly agree).

1. "Best before" means the food may become hazardous after this date and should not be consumed.
2. "Store at -4°C to 0°C for 7 days" indicates shelf life in refrigerator conditions.
3. "Best by" date indicates how long properly stored products maintain specific characteristics (e.g., yogurt remaining creamy); products remain edible after this date.

Appendix 4: Pilot Study Reading Materials

The World Food Programme recently warned of an unprecedented global food crisis this year··· [Full text preserved as in original, with experimental manipulations clearly marked for each condition.]

Appendix 5: Waste Intention Items

Please rate your agreement with the following statements on a 7-point scale (1 = strongly disagree, 7 = strongly agree). *Dining out definition as above.*

When dining out in the future, I will: 1. Consciously reduce food waste. 2. Order appropriate amounts of food. 3. Take leftovers home. 4. Encourage companions to reduce waste. 5. Pay attention to portion sizes when ordering.

Appendix 6: Experiments 1 and 2 Reading Materials

Recently, the UN Food and Agriculture Organization reminded us in its "State of Food and Agriculture 2019" report··· [Full text preserved as in original, with experimental manipulations clearly marked for each condition.]

Note: Figure translations are in progress. See original paper for figures.