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Communicating supply chain sustainability: transparency and framing effects

Yanji Duan
Department of Marketing and Logistics, University of North Florida, Jacksonville, Florida, USA
John A. Aloysius
Department of Supply Chain Management, University of Arkansas, Fayetteville, Arkansas, USA, and
Diane A. Mollenkopf
Management, Marketing and Entrepreneurship, University of Canterbury, Christchurch, New Zealand

Abstract

Purpose – Firms employ various forms of disclosure to demonstrate commitment to and involvement in sustainable supply chain management (SSCM) practices. This research provides guidance to firms employing framing strategies when communicating their SSCM with external stakeholders like consumers as part of their supply chain transparency efforts.

Design/methodology/approach – The authors employed a middle-range theorizing approach to understand the context of SSCM practices and mechanisms of variously framed communication methods to disclose sustainability information to consumers. The authors conducted two experiments in an e-waste recycling context, studying how sustainable information disclosed to consumers using attribute framing and goal framing can affect consumers' attitudes. The authors also examined the moderating role of consumers' environmental involvement.

Findings – Results suggest that when attribute framing is used, firms should avoid framing the attribute from a negative valence. When goal framing is used, messages with consequences stated as "avoid loss" yield the most substantial effect. Additionally, framing effects are more significant for consumers with higher-than-average environmental involvement.

Originality/value – The authors' results contribute to the ongoing theorization of SSCM by providing contextual understanding of how to communicate sustainability information. Corroborating evidence from marketing, framing effects are found to be context specific, thereby elucidating the framing literature more fully to the SSCM context. The authors extend this literature by studying attribute framing and comparing the effectiveness of all possible goal framing combinations of valence and gain/loss perspective in the SSCM communication context.

Keywords Supply chain transparency, Framing effect, Environmental involvement, Sustainability, Middle-range theorizing

Paper type Research paper

Introduction

Consumers increasingly care about the sustainability actions of companies and their supply chains. Consumer perceptions of product quality and willingness to buy can be quickly eroded when upstream supply chain news reveals unsustainable or unethical actions (Subramaniam *et al.*, 2019). Thus, firms attempt to communicate with their stakeholders about their sustainability efforts through increased prevalence and scope of annual corporate social responsibility reports (Piecyk and Björklund, 2015). A key facet of sustainable supply chain management (SSCM) is the notion of transparency, the means by which firms proactively disclose information to their stakeholders about products and processes that would not necessarily be available to them otherwise (Carter and Rogers, 2008; Carter and

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Easton, 2011; Carter *et al.*, 2019). The emerging concept of supply chain transparency reflects the notion of enhanced trust between organizations and their stakeholders (Busse *et al.*, 2017; Sodhi and Tang, 2019). Yet, little is known about the impact of disclosing SSCM information to consumer stakeholders (Bell *et al.*, 2016). It is important to address this gap because intentional disclosure of sustainable supply chain practices could enable firms to signal their integrity (Castillo *et al.*, 2018), build trust with consumers (Cailleba and Casteran, 2010), and ultimately, influence firm performance (Duan *et al.*, 2021).

One approach to disclosing information to consumers is through framing, using "different but objectively equivalent descriptions of the same problem," (Levin *et al.*, 1998, p. 150). Framing effects have been well-established in contexts such as healthcare (Agrawal and Duhachek, 2010) and operations management (Dilts and Pence, 2006). However, limited research has investigated framing effects in the context of sustainable supply chain communication with consumers (Amatulli *et al.*, 2017). The current research focuses specifically on two types of framing by which firms can disclose their sustainability practices: attribute framing and goal framing.

Attribute framing focuses on describing the positive or negative attributes such as the success or failure rate of an event, while goal framing focuses on stating an outcome in either a positive or negative frame when there is an "act" involved. Attribute framing of SSCM communication is important to study because prior studies have focused on contexts where consumers' personal outcomes are impacted. It is unclear whether such effects will apply in a supply chain context in which sustainability efforts would have no direct, immediate impact on consumers. Regarding goal framing, researchers have yet to compare the effectiveness of all possible variations of valence and perspective in a sustainable communication context. Therefore, the purpose of this research is to investigate consumers' attitudes toward the firm, based on different types of sustainable supply chain disclosure efforts, in the particular context of environmental e-waste recycling.

We experimentally examine the effects of different framing approaches firms can employ when disclosing supply chain sustainability practices to consumers. This represents a middle-range theorizing (MRT) effort, in that while the domain of knowledge regarding framing effects is well-established, the current research focuses more narrowly on framing effects within the specific context of SSCM initiatives. Consistent with MRT (Stank *et al.*, 2017), the generated hypotheses pose theoretical statements aimed at explaining *how* to communicate to consumers about a firm's sustainability efforts. Thus, we build on established knowledge within the domain of framing effects, while focusing specifically on causal mechanisms within the SSCM context to understand the outcomes of variously-framed transparency efforts (Pawson and Tilley, 1997).

This research makes several contributions to the literature. As an MRT effort, the results contribute to evolving efforts toward SSCM theorizing, based on Carter and Rogers' (2008) framework. Likewise, the results contribute to the framing literature by providing contextual relevance by which the mechanisms of framing approaches impact consumer responses. While some of our findings seem to contradict established knowledge, an MRT interpretation provides for contextual variations, providing robustness and/or boundary condition findings (Busse *et al.*, 2017) that constitute an evolving theoretical understanding.

Literature review

Supply chain transparency and external stakeholders

Researchers have been slow to coalesce around an agreed definition of the term *supply chain transparency* (referred to henceforth as transparency). *Transparency* is closely related to *visibility* and *traceability* (Richey *et al.*, 2016; Morgan *et al.*, 2018), which may partially explain inconsistent terminology. Sodhi and Tang (2019) have recently clarified that *visibility* refers to

internal information sharing about operations (within the firm or among supply chain partners) and *traceability* refers specifically to a form of visibility related to provenance, whereas *transparency* refers to disclosure of information to external stakeholders. Disclosure to external stakeholders implies an intended target audience, such as consumers, shareholders, governments and/or other agencies (Mol, 2015). While consumers often have been relegated to passive roles as recipients of supply chain services (Ta *et al.*, 2015), scholars increasingly acknowledge the important and active role that consumers play in supply chain processes and services (Wang *et al.*, 2019).

Yet, little academic guidance for firms currently exists regarding how to disclose SSCM information. The few papers that have examined the effects of disclosing SSCM information to stakeholders provide mixed results (Birkey *et al.*, 2018). In the consumer realm, researchers have found that transparency about refurbished products affects consumers' attitude and willingness to pay a premium (Duan and Aloysius, 2019). Important strides have been made in understanding how transparency can be effectively achieved, and how transparency, in general, can influence external stakeholders. However, little is known about the most effective way of communicating supply chain transparency to consumers.

Framing effects and sustainable communication

Levin *et al.* (1998) first distinguished three types of framing according to underlying mechanisms and consequences: risky-choice framing, attribute framing and goal framing [1]. Attribute framing pertains to the description of characteristics of an object or event. Two components of such a description can be consequential: valence and probability. The combinations of the two attribute framing components yield four different attribute framing messages (Table 1, panel A). Goal framing pertains to the description of outcomes of an act. Two components can be manipulated: valence and perspective [2]. Combining the two different goal framing components results in four goal framing messages that emphasize different consequences (Table 1, panel B). Table 2 provides a supplemental review of framing literature in the context of sustainable communication, demonstrating that attribute framing has been neglected. Those studies exploring the effects of goal framing have focused on one (either valence or perspective) rather than both aspects, resulting in the effectiveness of only two consequences being compared. Thus, it is critical to incorporate attribute framing and compare all possible goal framing combinations to fully understand framing effects in sustainable supply chain communication.

Hypothesis development

Theorizing at the middle range allows researchers to address causal connections within an established domain (Merton, 1968; Stank *et al.*, 2017), with the aim of predicting phenomena

	Intermediate probability	Extreme probability
Panel A: The attribute framing paradigm		
Positive attribute framing	*60% success rate*	*90% success rate*
Negative attribute framing	*40% failure rate*	*10% failure rate*
	Gain perspective	Loss perspective
Panel B: The goal framing paradigm		
Positive goal framing	*Consequence A*: Obtain gain	*Consequence B*: Avoid loss
Negative goal framing	*Consequence C*: Forego gain	*Consequence D*: Suffer loss

Table 1.
Summary of two framing typologies

Paper	Context	Type of framing	Findings
White *et al.* (2011)	Recycling program	Perspective (suffer loss vs obtain gain)	(1) Loss frames are more efficacious when paired with low-level, concrete mind-sets, whereas gain frames are more effective when paired with high-level, abstract mind-sets (2) Do not find support for the framing valance on consumer attitude
Olsen *et al.* (2014)	Launch of green products	Valance	(1) The quantity of green messages, the product type and their source credibility influence brand attitude
Chang and Wu (2015)	Organic farming	Valance (obtain gain vs forgo gain)	(1) Negative goal framing is more effective (2) Environmental motivation and knowledge moderate the relationship between framing and intention
Cucchiara *et al.* (2015)	Organic seafood	Perspective (suffer loss vs. obtain gain)	(1) A message features a gain perspective is more persuasive (2) Organic food involvement and PCE moderate the relationship
Segev *et al.* (2015)	Washing machine	Perspective	(1) Gain frames and self-appeals elicit more favorable responses than loss frames and environment appeals (2) Framing from a gain perspective has a stronger effect
Mir *et al.* (2016)	Air pollution	Perspective (suffer loss vs avoid loss)	(1) Psychological distance moderates the relationship between framing and willingness in behaving environmentally friendly (2) Negatively framed educational message is more effective
Moon *et al.* (2016)	Biofuel adoption	Valance	(1) Consumers' environmental consciousness, prosocial behavior, and openness to new experiences positively affect their intention to adopt biofuel
Amatulli *et al.* (2017)	Battery; Apparel	Valence (suffer loss vs obtain gain)	(1) Negatively framed messages are more effective (2) Environmental concern and the type of product promoted serve as moderators
Oh and Ki (2019)	CSR communication	Perspective (suffer loss vs obtain gain)	(1) Publics' intention to generate positive word-of-mouth was highest when the gain-focused message is used

Table 2.
Framing literature in sustainable communication

"by focusing on the specific generative causes (or mechanisms) that produce outcomes within a particular context," (Stank *et al.*, 2017, p. 7). Essentially, MRT aims to "unpack" the black box between traditionally established "*x*" and "*y*" variables (Pawson and Tilley, 1997; Pellathy *et al.*, 2018; Wowack *et al.*, 2021). Our approach follows the realist framework of *context* + *mechanisms* to understand outcomes, as previously exemplified by other supply chain scholars (Stank *et al.*, 2017; Pellathy *et al.*, 2018).

Hypotheses developed in this section explore the effectiveness of communicating a firm's supply chain initiatives to consumers, using attribute framing and goal framing. Theoretically established relationships between framing efforts and respondents are well-documented in management and marketing literature (Putrevu, 2010; White *et al.*, 2011) and have begun to be applied within the supply chain management literature (Tokar *et al.*, 2016). The MRT approach applied here emphasizes the specific context of SSCM, exploring the

mechanisms by which attribute and goal framing might impact consumer responses. This context specificity should provide insights to help bridge practice and theory in the evolving domain of SSCM.

Attribute framing

As the simplest form of framing, attribute framing manipulates a single attribute of an object/event. Attribute framing is fundamentally about "describing the situation in terms of success versus failure rate" (Levin *et al.*, 1998, p. 159). Valence refers to whether or not the key attribute is presented to the decisionmaker in a favorable way (Tversky and Kahneman, 1981), while probability pertains to the magnitude attached to an attribute.

Valence effects. In the context of attribute framing, a positive frame (success rate) has a stronger influence than a negative frame (failure rate) on people's behavioral intention and perceptions (Krishnamurthy *et al.*, 2001). Consistently observed outcomes are attributed to a "valence-consistent shift," which suggests that positive framing leads to a positive association in memory, while negative framing evokes an unfavorable impression. Such associations and impressions are thought to be influential in leading to framing congruency in cognitive tasks such as attention, learning and evaluation (Putrevu, 2010).

Literature from multiple fields supports this argument. In operations management, evaluation of an inventory replenishment policy was higher when the statement was positively-framed (e.g. achieving 90% in-stock rate vs achieving a 10% out-of-stock rate) (Tokar *et al.*, 2016). When disclosing their SSCM initiatives to stakeholders, firms can present their sustainability initiatives by stressing the success rate for an initiative, or disclosing the same attribute unfavorably in terms of failure rate. Consistent with previous literature, we predict that customers will be more affected when SSCM information is framed positively than negatively. As illustration, a message stating that there is 60% probability that a firm *can* achieve the specific target of an e-waste recycling program will be more influential than a message stating there is 40% probability that the firm *cannot* achieve the specific target.

H1a. A message featuring a positively framed attribute of a SSCM practice will generate higher attitude ratings for a firm than a message featuring the same attribute framed negatively.

Probability effects. A specific attribute is often paired with a probability. For instance, if firms communicate a sustainable initiative in the form of success rate, another important characteristic that can be manipulated is the magnitude of the probability related to the attribute, either as intermediate or extreme (e.g. 60% success vs 90% success). Prior literature suggests that probability influences the valence effect due to ceiling and floor effects [those points at which an independent variable ceases to affect a dependent variable due to saturation being reached (ceiling), or yet to take hold (floor) (Garin, 2014)]. For example, Levin *et al.* (1998) found that when presenting gambling evaluations with different probabilities combinations, the framing effects were stronger when participants were presented with intermediate rather than extreme probabilities, concluding that such effects might be due to ceiling/floor effects.

For robustness, we incorporate probability into the attribute framing statements and argue for an interaction between attribute framing valence and probability. If floor or ceiling effects are operational, the effect of attribute framing valence for participants exposed to intermediate probability scenarios of supply chain sustainability should be stronger than for those exposed to extreme probability scenarios. Therefore, we include both intermediate (40% failure and 60% success) and extreme probabilities (10% failure and 90% success) in our study to capture the interaction of probability and valence, hypothesizing:

H1b. The valence effect of framing a SSCM practice will be stronger when such attribute features an intermediate probability compared to an extreme probability.

Goal framing

Goal framing states an *outcome* in either a positive or negative frame when there is an "*act*" involved, by manipulating valence and perspective. Positive valence goal framing messages stress the positive consequences of performing an act, while negative valence goal framing messages emphasize the negative consequences of *not* performing an act. Perspective refers to whether the consequence is described as a gain or a loss (Levin *et al.*, 1998).

Valence effects. The valence of a goal framing statement can generate different effects (Piñon and Gambara, 2005), with negative goal framing generally having a stronger effect than a positive goal framing on people's evaluation and judgments (Haydarov and Gordon, 2015). The underlying reason may be the intensified effect of framing on the outcome, together with a negativity bias (negative information is more influential than positive information) such that people tend to emphasize the negative consequence (Moon *et al.*, 2016). However, other researchers have observed non-significant or opposite results (Levin *et al.*, 2002; Segev *et al.*, 2015). Hence, it is important to explore the nuances of goal framing under specific situations. Consistent with prior findings that negative valence tends to be more influential, we argue that negative valence will have stronger effect than positive valence on consumer attitude. Using the previous e-waste recycling example, we argue that stating the negative consequence (e.g. 2 bn more pounds of used electronics will be sent to landfill) of *not* conducting the e-waste recycling program would be more influential than stating the positive consequence (e.g. avoiding 2 bn more pounds of used electronics sent to landfill) of conducting such a program. Therefore, we hypothesize:

H2a. A message about a SSCM goal framed negatively will generate higher attitude ratings for a firm than the same goal framed positively.

Gain/loss perspective. The gain/loss perspective adds more complexity to goal framing (Levin *et al.*, 1998). For instance, two different consequences can be argued under a positive frame: by *doing* [something. . .], the consequence can either be the attainment of a goal or the avoidance of a loss. Conversely, a negatively framed approach of *not doing* [something. . ..] results in a foregone gain or a suffered loss (Segev *et al.*, 2015).

Due to loss aversion (Levin *et al.*, 2002), loss-perspective goal framing messages have greater impact than obtaining a gain of equal magnitude (Tversky and Kahneman, 1981). Essentially, people are more motivated to do something to avoid losses than to gain benefits. When comparing consumers' purchase intention after exposure to a message emphasizing the gain of buying green products vs the loss of not buying them, Amatulli *et al.* (2017) found that people who received the loss-focused message tended to have significantly higher purchase intention than those who received the gain-focused message. However, such effect might be contextual, especially in the context of green communication. Unlike other contexts, there is no or little direct gain/loss for the consumers in the green communication context. Rather, the consequences affect the natural environment. Loss aversion might become more prominent if consumers do not consider creating gains for the environment to be possible or critical. Similarly, firms can communicate the consequences of an SSCM initiative from either the gain or loss perspective. Stating that "*Our recycling program can help to avoid diverting 2 bn pounds of e-waste into landfill*" (avoid loss) or "*Without our e-waste recycling program, 2 bn more pounds of e-waste will be diverted into landfill*" (suffer loss) will be more favorable than stating that "*Our recycling program can help to recover 2 bn pounds of e-waste*" (obtain gain) or "*Without our e-waste recycling program, we will not be able to recover 2 bn pounds of e-waste*" (forego gain).

H2b. A message about an SSCM goal (positively or negatively framed) presented from a loss perspective will generate higher attitude ratings for a firm than the same goal presented from a gain perspective.

Issue involvement and perceived information persuasiveness

Defined as "the extent to which the attitudinal issue under consideration is of personal importance," (Petty and Cacioppo, 1979, p. 1915), individuals' issue involvement has long been established as a moderator that influences people's information processing procedures, and results in different perceived persuasiveness (Cho, 2015). For those exhibiting a low involvement level for a specific issue, cognitive processing seems to rely more on superficial cues such as the length of the message (Cho, 2015). However, people with a high-level involvement usually incur extensive cognitive elaborations of the information (Petty and Cacioppo, 1979). In the context of transparency, we focus on environmental involvement (EI): an individual's "degree of personal relevance and importance associated with the environment," (Cho, 2015, p. 75).

Evidence suggests that involvement moderates the framing effect on perceived information persuasiveness; however, results are mixed pertaining to the direction. Some researchers found that framing effects tend to diminish for people with high involvement because they put forth the effort to carefully evaluate the persuasive message and are therefore less susceptible to framing effects (Newman *et al.*, 2012). However, others found that that high involvement strengthens the framing effect because people are more likely to be sensitive to the positive and negative implications of health information which amplifies sensitivity to valence information, and thus the valence effect (McCormick and Seta, 2016). Therefore, we test whether people's EI will interact with the SSCM messages they receive, and thus affect their evaluation ratings of the company that presents those messages. We build on our previous hypotheses which focused on positive attribute framing, negative goal framing and loss perspective goal framing, but do not hypothesize a direction in this exploratory hypothesis.

H3. The effect of [3a, 3b, 3c] of the sustainability transparency message will either be amplified or weakened for consumers with a higher EI than those with a lower EI level.

H3a. Positive attribute framing.

H3b. Negative goal framing.

H3c. Loss perspective goal framing.

Overview of studies

To test the hypotheses about firms' disclosure of their SSCM efforts, we conduct two experiments focused on attribute framing and goal framing, respectively. Both experiments are built on a common scenario of an electronics firm's reverse supply chain activities of reclaiming e-waste and diverting it from landfills. The electronics firm is depicted as disclosing information in its annual corporate social responsibility (CSR) report about its sustainability effort. Such information represents the firm's SSCM efforts to its stakeholders, which would include those consumers considering purchasing the firm's products. In both studies, we recruited participants from Amazon MTurk, in line with other researchers across disciplines (Kees *et al.*, 2017). To minimize concerns regarding MTurk, we adopted approaches recommended by Paolacci *et al.* (2010) and Sharpe Wessling *et al.* (2017). Our samples included 398 participants for study 1 and 404 participants for study 2.

Study 1: attribute framing

The scenario-based, role-playing experiment used a 2 (Valence: positive vs negative) × 2 (Probability: intermediate vs extreme) between-subject design (Rungtusanatham *et al.*, 2011). Excerpts about firms' e-waste recycling programs were drawn from actual CSR reports and rephrased into differently framed messages about the focal firm's e-waste program. The attribute being framed was a specific target (i.e. to recover 2 bn pounds of e-waste) related to the firm's e-waste recycling program. Participants were asked to imagine they were customers wanting to buy a computer online and saw the excerpt from the CSR report, which presented the manipulation of the study. Our goal was to study the effect of attribute framing of SSCM communication under four different scenarios. According to our predictions, positively stated attribute framing messages (e.g. we *can* achieve our target) would be more influential than negatively stated messages (e.g. we *cannot* achieve our target). Also, a statement containing an intermediate probability (e.g. a 60% probability of achieving the target to recover 2 bn pounds of e-waste) would elicit a more pronounced valence effect than a statement presented with an extreme probability (e.g. a 90% probability of achieving the target). Each participant was randomly assigned to one of the four scenarios. Table 3, panel A provides a summary of the experimental design.

Measures

To test H1a and H1b, the two main independent variables were manipulated: attribute framing valence and attribute framing probability. EI was included as a moderator to test H3a. The EI measure captured participants' concerns regarding different environmental issues. We used the participant's attitude toward the firm as a proxy for consumers' evaluation of the company (Burton *et al.*, 1994). Appendix provides the measures and technical details for each study.

Results

We first analyzed the main effect of attribute framing valence. Table 4, panel A presents the descriptive information for each variable. The one-way analysis of variance (ANOVA) results support H1a. Participants who were presented with positive messages rated significantly

	Probability (extreme)	Probability (intermediate)
Panel A: Study 1-attribute framing scenarios		
Negative valence	There is *10%* probability that we *cannot achieve* our goal in 2020 to recover 2 bn pounds of e-waste	There is *40%* probability that we *cannot achieve* our goal in 2020 to recover 2 bn pounds of e-waste
Positive valence	There is *90%* probability that we *can achieve* our goal in 2020 to recover 2 bn pounds of e-waste	There is *60%* probability that we *can achieve* our goal in 2020 to recover 2 bn pounds of e-waste
	Perspective (Gain)	Perspective (Loss)
Panel B: Study 2 - Goal framing scenarios		
Negative valence	*Without* our robust infrastructure to leverage, we will *not be able to recover* 2 bn pounds of used electronics	*Without* our robust infrastructure to leverage, 2 bn more pounds of used electronics will be diverted into landfill
Positive valence	*With* our robust infrastructure to leverage, we will *be able to recover* 2 bn pounds of used electronics	*With* our robust infrastructure to leverage, we will *be able to avoid* diverting 2 bn more pounds of used electronics into landfill

Table 3.
Experiment scenarios

	Min	Max	M	SD	1	2	3	4
Panel A: Study 1								
1. Attitude toward the firm	1	7	5.61	1.13	1			
2. Valence	0	1	0.51	0.50	25***	1		
3. Probability	0	1	0.52	0.50	21***	0.004	1	
4. EI	1	7	5.29	1.31	0.33***	0.10*	0.01	1
Panel B: Study 2								
1. Attitude toward	1	7	5.93	1.07	1			
2. Valence	0	1	0.55	0.50	0.01	1		
3. Perspective	0	1	0.51	0.50	(0.11)**	(0.04)	1	
4. EI	1	7	5.32	1.28	0.45***	0.06	(0.05)	1

Table 4.
Descriptive statistics

Note(s): ***$p < 0.01$, **$p < 0.05$

higher in attitude toward the firm than those who received negative messages ($M_{positive} = 5.88$, SD = 0.92, $M_{negative} = 5.32$, SD = 1.25, $F(1, 396) = 25.89$, $p < 0.01$). In addition, we compared the communication effectiveness of the four different attribute framing messages. Results of a one-way ANOVA show that different attribute framing messages affect participants' attitude ratings differently ($F(3, 394) = 17.17$, $p < 0.01$). A Tukey HSD post-hoc test of the four attribute framing messages revealed that when the attribute is framed negatively with intermediate probability, participants had a significantly lower attitude rating than the alternatives ($M_{negative\_intermediate} = 4.95$, $M_{positive\_intermediate} = 5.77$, $M_{negative\_extreme} = 5.67$, $M_{positive\_extreme} = 5.98$, $p < 0.01$), with no significant difference among the other three alternatives.

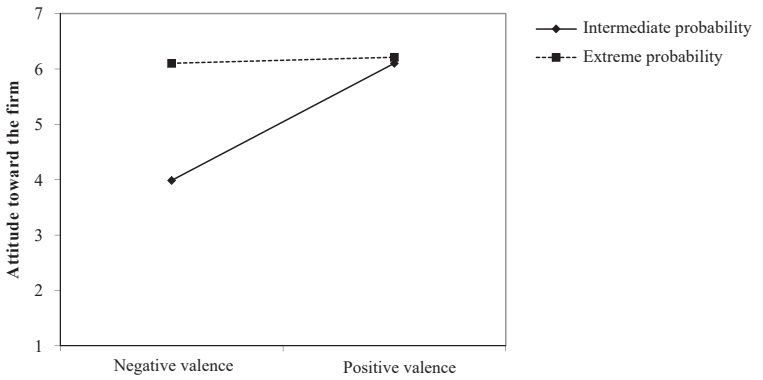
Interaction effect of attribute framing valence and attribute framing probability. H1b predicts an interaction effect between attribute framing probability and attribute framing valence on participants' attitude: messages with intermediate probabilities would enhance the effect of positively framing an attribute more than for messages with extreme probabilities. We ran regressions with the valence of the message (positive vs. negative) as the independent variable, the probability of the message (intermediate vs. extreme) as a moderator and attitude toward the firm as the dependent variable, using PROCESS model 1 (Hayes, 2013) (mean-centered for all constructs; 95% bias-corrected CI; bootstrap sample of $n = 10{,}000$).

Results indicated significant interaction of attribute framing valence and probability ($F(1, 394) = 17.17$, $\beta = -0.50$, SE = 0.21, $t = -2.35$, $p < 0.05$, 95% CI [−0.92, −0.08]) in predicting attitude toward the firm, supporting H1b. When the message features an intermediate probability, the positively framed message generates a significantly higher attitude rating than the negatively framed message (Figure 1, panel A). However, when the message features an extreme probability, there is no difference between positively and negatively framed messages in attitude rating. This result also provides evidence of ceiling effects in which attribute framing ceases to affect the dependent variable when paired with an extreme probability.

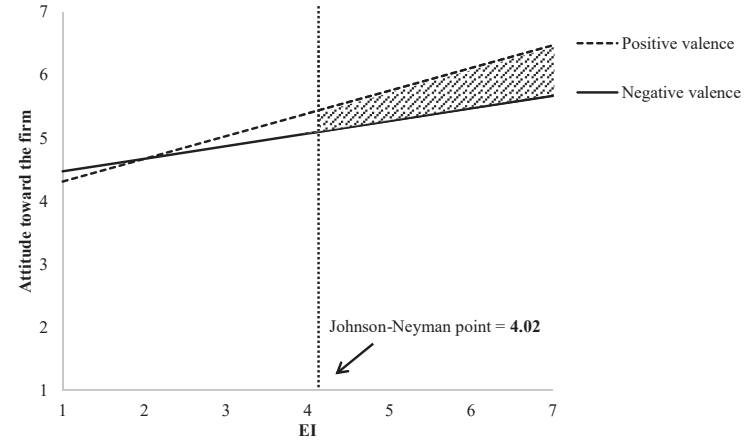
Interaction effect of EI and attribute framing valence. H3a predicts that participants' EI interacts with attribute framing valence to affect their attitude. We ran regressions with the message valence as the independent variable, the EI as a moderator, and attitude toward the firm as the dependent variable by using PROCESS model 1 (Hayes, 2013) (mean-centered for all constructs; 95% bias-corrected CI; bootstrap sample of $n = 10{,}000$).

The interaction of EI and valence was marginally significant in predicting attitude toward the firm ($F(1, 394) = 3.58$, $\beta = 0.15$, SE = 0.08, $t = 1.89$, $p < 0.10$, 95% CI [0.00, 0.31]). Figure 1, panel B displays this effect using the Johnson-Neyman (JN) technique, which allows

Panel A (Study 1): Moderating effect of probability and attribute framing valence on attitude toward the firm



Panel B (Study 1): Conditional moderation of attribute framing valence and EI on attitude toward the firm



Panel C (Study 2): Conditional moderation of goal framing perspective and EI on attitude toward the firm

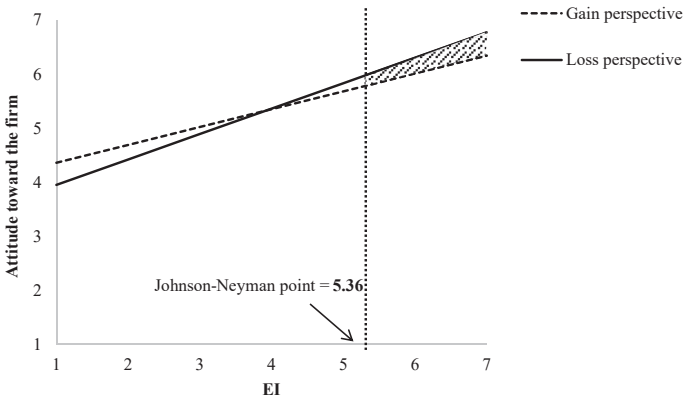


Figure 1.
Moderating effect in study 1 and study 2

identification of regions in the moderator's (EI) range in which the effect of the attribute framing valence on attitude toward the firm is significant (Johnson and Neyman, 1936; Spiller *et al.*, 2013). The JN point ($p < 0.05$) for the valence moderator occurred at an EI value of 4.02, which was 0.96 standard deviations below the mean. The result indicates that for participants with an EI value above 4.02 (95% CI: 0.00 to 0.58), messages featuring positive attribute framing valence generate significantly higher attitude toward the firm than messages with negative valence. Therefore, H3a is partially supported, when EI is higher than 4.02.

Study 2: goal framing

This experiment used a 2 (Valence: negative vs. positive) × 2 (Perspective: gain vs. loss) between-subject design. The contextual information in the simulated CSR report was the same as Study 1. We expected that a negatively-stated goal framing message (i.e. without our robust infrastructure to leverage, we will not be able to. . .) would be more influential than the positively-stated goal framing (i.e. with our robust infrastructure to leverage, we will be able to. . .). Also, we expected goal framing messages stated from a loss perspective (i.e. we will be able to avoid the loss. . .) would be more influential than messages stated from a gain perspective (i.e. we will be able to achieve the gain. . .). A summary of the experimental design can be found in Table 3, panel B.

Measures

To test H2a and H2b, two main independent variables were included: goal framing valence and goal framing perspective. Similar to Study 1, we included EI as a moderator to test H3b and H3c and attitude toward the firm as the dependent variable.

Results

Table 4, panel B presents the descriptive information for each variable. H2a predicted that negative goal framing would be more persuasive than positive goal framing, leading to higher ratings in attitude. The one-way ANOVA results showed no significant difference on attitude toward the firm ($M_{negative} = 5.89$, SD = 1.10, $M_{positive} = 5.89$, SD = 1.03, $F(1, 403) = 0.66$, p = NS) when participants were presented messages with different goal framing valence. Hence, H2a was not supported. An examination of the research on goal framing reveals that other studies have also identified similar results (e.g. Block and Keller, 1995). We speculate that the unique context of disclosing SSCM information to consumers is the reason for rejecting the hypothesis (Amatulli *et al.*, 2017). The framed events do not have direct consequences on consumers' personal benefits, resulting in consumers facing a tradeoff between self-interest and societal benefits (White *et al.*, 2011). In addition, consumers might not be certain about whether the consequences will have a direct impact on the environment (White *et al.*, 2011). Such contextual characteristics might result in the ineffectiveness of the goal framing valence.

For H2b, the one-way ANOVA results provide support that goal framing messages stated from a loss perspective are more influential than those stated from a gain perspective, since a significant main effect was identified ($M_{loss} = 6.10$, SD = 1.00, $M_{gain} = 5.76$, SD = 1.12, $F(1, 403) = 10.29$, $p < 0.001$). In comparing the communication effectiveness of the four different goal framing messages, one-way ANOVA results show that different goal framing messages affect participants' attitude ratings differently ($F(3, 400) = 4.28$, $p < 0.01$). A Tukey HSD post hoc test reveals interesting insights: among the four goal framing messages, when the consequence is stated as *avoid loss* (positive valence, loss perspective), participants tend to have significantly higher attitude ratings than when the consequence is stated as *obtain gain* ($M_{avoid\_loss} = 6.23$, $M_{obtain\_gain} = 5.74$, $p = 0.01$), or as *forgo gain* ($M_{forgo\_gain} = 5.77$, $p < 0.05$).

Meanwhile, when the consequence is stated as avoiding loss, its effect is not significantly different from when the consequence is stated as suffering loss ($M_{suffer\_loss} = 5.99$).

Interaction effect of issue involvement and goal framing valence. H3b argues that a participant's EI interacts with message valence to influence the dependent variable. Results did not identify a significant interaction and thus, failed to support H3b (F (1, 400) = 0.36, $\beta = 0.05$, SE = 0.08, $t = 0.60$, p = NS). In addition, no JN region-of-significance was found.

Interaction effect of issue involvement and gain/loss perspective. Lastly, we tested whether the goal framing message perspective would interact with participants' EI to affect the evaluations (H3c). A regression using PROCESS showed a marginally significant interaction (F (1, 400) = 3.21, $\beta = -0.14$, SE = 0.08, $t = 1.79$, $p < 0.10$, 95% CI [0.31, 0.54]). We examined the two-way interaction by using the JN technique (Figure 1, panel C). The JN point ($p < 0.05$) for the gain framing perspective moderator occurred at an EI value of 5.36, which was 0.04 standard deviations above the mean. The result indicates that the goal framing messages stated from a loss perspective resulted in significantly higher attitude toward the firm than messages stated from a gain perspective at EI values above 5.36 (95% CI: −0.39, −0.01). In addition, there was no significant difference between the two below the JN point. Therefore, H3c is partially supported, for participants with EI above 5.36.

Discussion

This research provides insights into the role of transparency within the SSCM realm. In particular, results of the framing approaches suggest that how firms disclose their sustainability efforts impacts consumers' reactions. By taking an MRT approach, our results shed insight to specific context and mechanisms by which scholars can better understand the relationship between supply chain transparency and consumer reactions. While framing effects are generally well-understood, such effects might have different effects under the SSCM context because firms' actions do not have a direct and immediate impact on consumers. Our findings provide contextual understanding of how transparency can be executed when communicating with consumers. This level of granularity contributes to the further development of SSCM theory, going beyond the assumption that "the more transparency the better," (Mol, 2015, p. 155) to elucidating specific mechanisms (attribute or goal-framing messages, using valence, probability and gain/loss perspectives) that provide specific results to specific consumer groups (e.g. those with high/low EI).

In the context of SSCM both attribute framing and goal framing efforts can be effective disclosure mechanisms. Attribute frames are more pronounced when participants are presented with intermediate, rather than extreme probabilities. When presented with extreme probabilities, the attribute framing effects disappear (no significant difference between positive and negative attribute messages); however, when presented with intermediate probabilities, the attribute framing effects are more significant (positive attribute framing results in higher consumer attutide than negative attribute framing). Hence, our results provide support for ceiling/floor effects for probabilities in attribute framing. Regarding the interaction between attribute framing probability and valence, our result suggests that messages that pair intermediate probabilities with positive valence are most effective. Furthermore, a negative valence message features an intermediate probability results in the lowest consumer evaluations. Goal framing efforts can also be effective, but in contrast to Levin's *et al.* (1998) predictions, we find that goal framing messages with an "avoid loss" consequence yield the most substantial effect on consumers. This finding demonstrates the value of MRT. Within our context, findings contrary to established findings suggest boundary conditions on the expected $x \rightarrow y$ relationship (Pellathy *et al.*, 2018).

Adding further to the contextualization of the framing mechanisms, the EI of participants provided interesting nuances to the results. We found a conditional interaction of valence and

EI on attitude when employing attribute framing for those participants with an EI score of 4.1 or greater. In contrast, goal framing mechansims resulted in a conditional interaction of gain/loss perspective and EI on attitude for those with an EI score greater than 5.36, incidating that the framing effect only manifests for people who already care about environmental issues. These interactive effects demonstrate additional boundary conditions for understanding how, when or to whom the relationship between the sustainability message and consumer reactions can be explained.

Our granular approach also contributes to the framing literature with a comprehensive study of how framing effects can affect consumer attitudes in the sustainable communication domain. This context specificity provides interesting perspective for interpreting results that were contrary to our predictions, or to established literature. For instance, we did not find support for two of our goal framing hypotheses (H2a and H3b). These results are in line with findings that the effects of goal framing might be less reliable and consistent than found in attribute framing (Levin *et al.*, 2002), further suggesting the contextual dependence of goal framing effects. With respect to goal framing valence (H2a), the context of disclosing SSCM information to consumers might be unique (Amatulli *et al.*, 2017). In the SSCM context, consumers face a tradeoff between self-interest and societal benefits (White *et al.*, 2011), because the consequences of the framed event do not impact consumers' personal outcomes. Nor can consumers be certain that participation in sustainable activities will actually benefit the environment (White *et al.*, 2011), especially if others do not participate to the same degree (Amatulli *et al.*, 2017). Relatedly, in testing H3b, previous research (Cho, 2015) suggests that high EI consumers tend to be more knowledgeable and concerned about sustainability issues, thereby employing different information processing procedures than low EI consumers, which would consequently affect the framing effectiveness. Alternatively, consumers might focus on different perspectives when evaluating the SSCM messages, which might result in the unexpected results. For instance, consumers with high EI might care more about the positive attribute and the potential loss while focusing less on the company's infrastructure (e.g. the focal company's sustainability initiatives).

These considerations emphasize the importance of understanding the specific context of SSCM transparency with respect to the disclosure mechanisms of the framing efforts, demonstrating the value of theoretical exploration at the middle range. Established relationships between variables often represent generalized results, but by exploring relationships within specific contexts, results provide greater clarity not just of a given context but also on the robustness of generalized theoretical relationships (Pellathy *et al.*, 2018). The findings of our research contribute to the ongoing dialogue of framing effects by adding further details to what has generally been known about the causal relationship between framing and perceptions. These details include boundary conditions to established, previously generalized findings.

Managerial implications

The value of MRT can also be found in the ability to bridge theory to practice. The context specificity of the research provides evidence that consumers do respond positively to firms' supply chain transparency efforts, providing further motivation for firms to disclose sustainable information to these stakeholders. This is particularly interesting because supply chain practices are often invisible to end consumers. Disclosing SSCM practices may serve to strengthen consumers' affiliations with brands, and thus have positive implications for firms' performance.

When considering how to achieve greater transparency, managers can be reassured that supply chain processes can be part of the sustainability message. Our results suggest, for example, that attribute framing seems to have more consistent effects on consumers than goal framing. For firms that are communicating SSCM information to general consumers,

disclosure by focusing on the favorable attribute and emphasizing the high probability of success could induce a "valence-consistent shift," in which consumers come to prefer the favorable attribute given the associated positive impression in memory. If firms are targeting concerned consumers, it is extremely important to disclose SSCM information by focusing on the favorable attribute while recognizing the probability magnitude will be less significant. Consistently, firms should avoid disclosing SSCM information from the negative perspective, and especially if paired with an intermediate probability.

For firms that want to disclose outcome information by using goal framing, our results indicate a loss-avoidance message seems to resonate best with consumers, potentially due to loss aversion as well as consumers' perception that it is not critical or possible to create gain to the natural environment. Firms can either emphasize the severity of the negative consequence of not conducting some act, or focus on the benefits of avoiding negative consequence when some acts are conducted. Such a strategy is more effective when targeted to high EI consumers.

Our results reveal that supply chain managers must understand their consumer audience. Environmentally conscious consumers reacted most to the loss-avoidance goal framing approach, whereas those with lower EI scores did not. Thus, managers may need to find different ways to disclose their sustainability practices to different target audiences. Additionally, managers in other sectors may find that attribute framing may work better (or differently) than goal framing disclosures did in the current research. While the current research focuses on a specific industrial sector, the broader message for managers is that attribute framing and goal framing approaches should be tested within their specific business contexts so as to determine the most effective way to provide disclosure to consumers. The response of the high EI participants in this research demonstrates that certain consumers do care about the supply chain practices of companies, even when they do not directly benefit from the actions. Making invisible supply chain processes more visible to consumers and communicating effectively with them provides new opportunities for supply chain managers to support their organization's mission. While supply chain managers may not "own" the relationships with consumers, the importance of supply chain strategy and operations in managing the consumer relationship through disclosure is highlighted in this research.

Limitations and future research

As with all research efforts, this research has limitations and simultaneously offers opportunities for future research. While we focused solely on the environmental dimension of sustainability, future research should address the framing effects of disclosing SSCM information about social and economic impacts as well.

The specific context of electronic products provides opportunities to test the pervasiveness of our findings in other contexts, to further enhance understanding of how supply chain transparency can be communicated. MRT provides limited generalizability due to context-specificity of a given research effort. The MRT approach here provides a context-specific look at disclosure efforts between a high-tech computer manufacturer and its consumers. This is but one look at the context domain of SSCM in general, as well as the use of framing efforts within that domain. Future research can test the attribute and goal framing effects across other industrial contexts, and at other supply chain echelons. Retailers also manage relationships with consumers, for example, and the effect of attribute vs goal framing messaging of retailers' sustainability efforts should be assessed. A body of work across industrial sectors and supply chain echelons will over time provide more robust understanding of "how to be transparent" to consumers. Of course, consumers are not the only stakeholders for whom transparency is important. Further research should also explore role of framing in disclosing supply chain processes to other stakeholder groups.

While our study provides evidence for the ceiling/floor effects of attribute framing at various probability levels, we did not systematically examine the underlying reasons for the ceiling/floor effects. Such effects might be attributed to individuals' cognitive ability to practically understand numbers and mathematical procedures and associated problem solving (Garofalo and Lester, 1985). Low numeracy individuals are more likely to encounter attribute framing bias since they tend to base their judgments on the terms presented in the messages and rely less on the quantitative values (Gamliel *et al.*, 2016). Future studies can further explore the effectiveness of attribute framing messages under different probability levels.

Lastly, Levin *et al.* (1998) pointed out two approaches: simple negation and alternative terminology in describing the outcome for goal framing. Alternative terminology might introduce unintended variations (Maheswaran and Meyers-Levy, 1990). While we tried to adopt simple negation consistently, it was practically difficult for certain scenarios. Future research should examine this issue by comparing different effects of alternative terminology with simple negation in the framing context.

Notes

1. Since sustainable communications do not typically involve a choice between risky alternatives, we only focus on attribute framing and goal framing in this research.
2. Valence means the "frame casts the same critical information in either a positive or a negative light" (Levin *et al.*, 1998, p. 150). Though valence considerations appear in both attribute and goal framing, the manner of valence manipulation varies slightly across the two framing types.

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Corresponding author
Diane A. Mollenkopf can be contacted at: diane.mollenkopf@canterbury.ac.nz

Appendix

Measure	Adapted from	Item description	Anchors	Alpha
Construct measures				
Attitude toward the firm	Burton *et al.* (1994)	*ATT 1-3*: What is your overall attitude toward company A?	1 = Very unfavorable 7 = Very favorable 1 = Bad 7 = Good 1 = Negative 7 = Positive	0.963
Environmental involvement	Savitz and Weber (2006)	I am concerned about the: *EI 1*: Pollutants emitted *EI 2*: Recycling and reuse *EI 3*: Product responsibility *EI 4*: Carbon footprint *EI 5*: Product impacts	1 = Strongly disagree 7 = Strongly agree	0.928

Research method commentary	
Pre-test analyses	(1) Power analyses prior to data analysis suggested sufficient sample size for both studies to detect effect size ≥0.18 (2) Prior to analyses, assumptions of linearity, independence, normality and homoscedasticity were satisfied (3) The tolerance and variance inflation factors (VIF) were well below the recommended threshold, indicating no multicollinearity (Hair *et al.*, 2009) (4) Cronbach's alpha for each measure exceeded the 0.7 cutoff point
Manipulation check study 1: Attribute framing	Valence manipulation: each participant was asked to rate the degree to which they agreed with the statement: *The excerpts convey more negative information than positive information.* (1 = "strongly disagree"; 7 = "strongly agree") (Maheswaran and Meyers-Levy, 1990). Results indicated that participants in negative attribute framing groups found the messages significantly different from those in positive attribute framing groups ($M_{negative} = 4.05$, $M_{positive} = 2.18$, $F(1, 396) = 110.80$, $p < 0.001$)

(*continued*)

Research method commentary	
Manipulation check study 2: Goal framing	An out of sample ($n = 56$) manipulation check tested whether positive goal frame messages were perceived differently than negative goal frame messages, as well as whether goal framing from a gain perspective significantly differed from the loss perspective. Participants were first asked to rate to what degree they agreed with the statement: *Company A presents the negative consequence from not engaging in corporate social responsibility activities*. A one-way ANOVA result indicated that people who received positive valence goal framing messages generated significantly lower ratings than those who received negatively framed goal framing messages ($M_{negative} = 2.36$, $M_{positive} = 4.10$, $F(1, 54) = 14.05$, $p < 0.001$). Participants also were asked to rate the degree to which they agreed with the statement: *Company A conveys the potential loss from not engaging in corporate social responsibility activities.* A one-tailed *t*-test result indicated that people who received goal framing messages with gain perspective generated significantly lower ratings than those who received goal framing messages with loss perspective ($M_{gain} = 4.33$, $M_{loss} = 4.79$, $t = -1.7$, $p < 0.05$)
Statistical technique	(1) A regression-based Macro, PROCESS allows researchers to estimate different models, ranging from simple mediation and moderation models, to multiple mediation and multiple moderation models, and conditional mediation models. PROCESS applies a bootstrapping approach with repeated sampling that results in narrower confidence intervals for estimates, providing greater asymptotic accuracy than regular regression (Hayes, 2013) (2) Johnson–Neyman technique (i.e. floodlight analysis). This method allows us to identify a range of the moderator variable in which identifies the effect of the independent variable on the dependent variable is significant (Johnson and Neyman, 1936; Spiller *et al.*, 2013). One advantage of JN over the traditional pick-a-point approach is that the former allows researchers to avoid arbitrarily selecting a value (e.g. $M \pm 1$SD) when probing the interaction effect (Hayes, 2013)