

An experimental investigation of attribute framing effects on risky sourcing behaviour: the mediating role of attention allocated to suppliers' quality information

Attribute framing effects on risky sourcing

205

Received 26 September 2022
Revised 25 January 2023
Accepted 12 February 2023

Ricky S. Wong

Business Analytics and Systems Group, University of Hertfordshire, Hatfield, UK

Abstract

Purpose – Despite its significance, research on how attribute framing affects ordering decisions in dual sourcing remains insufficient. Hence, this study investigated the effects of attribute framing in a sourcing task involving certain and uncertain qualities of two suppliers and analysed the role of attention with respect to suppliers' information in framing effects.

Design/methodology/approach – The impacts of attribute framing on sourcing decisions were demonstrated in two online between-subject (2×2 factorial) experimental studies involving professional samples. Study 2 was an eye-tracking experiment.

Findings – In Study 1 ($N = 251$), participants presented with a “high-quality” rather than a “low-quality” frame made different sourcing decisions, opting for larger percentage of order(s) from a supplier under the “high-quality” frame. This pattern holds true for suppliers who differ in risk. This finding was replicated in Study 2 ($N = 129$). Attention asymmetry related to the information on supplier quality contributes to this effect. Attention directed towards information regarding the supplier's quality under a positive frame mediated the relationship between attribute framing and sourcing decisions.

Practical implications – Highlighting the positive attributes of a risky supplier is essential when ordering from the risky supplier is an optimal decision. It is advantageous for suppliers to highlight positive rather than negative attributes when describing the quality of their components against others.

Originality/value – This is the first study to examine the effect of attention on the relationship between attribute framing and dual sourcing. This presents a new behavioural perspective wherein managers' attention to information plays a vital role.

Keywords Attribute framing, Dual entities, Sourcing, Optimal decision, Risk-taking, Attention asymmetries
Paper type Research paper

1. Introduction

Within the field of behavioural operations management (BOM), the topic of ordering decisions has emerged as a primary area (Becker-Peth *et al.*, 2018; Perera *et al.*, 2020), because human behaviour remains prominent in sourcing and ordering decisions. The success of a company and its supply chain relies on effective ordering decisions. One important factor to be considered in sourcing decisions is the quality of suppliers' components (Krause *et al.*, 2007) because it largely determines product quality and thus affects buyers' profitability and sustainability (De Boer *et al.*, 2001). Recent supply chain disruptions have resulted in quality



© Ricky S. Wong. Published by Emerald Publishing Limited. This article is published under the Creative Commons Attribution (CC BY 4.0) licence. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this licence may be seen at <http://creativecommons.org/licenses/by/4.0/legalcode>

The author is grateful for the support provided by Business School, University of Hertfordshire and the Big Data Intelligence Centre, HSUHK.

International Journal of Operations
& Production Management
Vol. 43 No. 13, 2023
pp. 205-225
Emerald Publishing Limited
0144-3577
DOI 10.1108/IJOPM-09-2022-0604

degradation (Bulter, 2020) and damage to perishable components (Alicke and Strigel, 2020), making effective ordering decisions more difficult. In some cases, buyers must expand their existing supplier portfolio or turn to a new supplier in a shortage situation (Bulter, 2020; Shih, 2020; van Hoek, 2020). Subjective judgements of managers play a role in supplier selection and sourcing decisions (Kaufmann *et al.*, 2014; Sureeyatanapas *et al.*, 2018).

Indubitably, a theoretical research gap exists. Donohue *et al.* (2019) emphasised that a better understanding of the cognitive processes that drive ordering behaviour is paramount; otherwise, it would be hard to identify the theories that best explain actual behaviour. Likewise, Fahimnia *et al.* (2019) suggested that BOM research must continue to explore how decision-making in practice is influenced by human judgement. Thus, this study aims to examine how information about suppliers' component quality in dual sourcing, when presented differently, affects ordering decisions and their underlying mechanisms.

This research considers the context of sourcing roses, a key component in the fragrance and essential oils industry. It is said to be crucial in the industry for the following reasons. First, the global perfume and essential oil markets are projected to grow to USD 43.2 billion at a compound annual growth rate (CAGR) of 5.0% in the 2021–2028 period and USD 18.25 billion at a 9% CAGR in 2028 (Fortune Business Insights, 2021, 2022). Second, a shift has been observed in the market towards natural fragrances and essential oils rather than artificial fragrance chemicals for health reasons (Lee and Kwon, 2022; Surugue, 2019). Finally, European perfume manufacturers have encountered key component shortages due to supply chain disruptions, changes in agricultural practices, and natural disasters (Mira, 2022; Spencer *et al.*, 2022; Vulser, 2014). Taken together, these findings suggest that fragrance and essential oil manufacturers are likely to explore the supply of natural flowers from new suppliers.

Previous studies have explained the benefits of dual sourcing, including supply risk mitigation (Cachon *et al.*, 2008), more competitive prices (Chen and Guo, 2014) and more leverage for the buying firm in future procurement (Niu *et al.*, 2019). Wu *et al.* (2011) highlighted the benefits of having information regarding suppliers' component quality to a buying firm in dual sourcing, as this information helps reduce quality uncertainty in the final products. Additionally, Tse and Tan (2011) noted that the visibility of a supplier is vital in managing quality risk and is determined by the level of disclosure and accuracy of *quality information*. However, the quality of new suppliers is sometimes only partially known to buyers (Deng and Elmaghraby, 2005; Quigley *et al.*, 2018). Coupling this with the prevalence of dual sourcing strategy (Gupta and Ivanov, 2020; Li *et al.*, 2019), an empirical investigation of the behavioural aspects regarding how the presentation of quality information affects ordering decisions is necessary.

To address these gaps in the literature, particularly on dual sourcing and supplier quality, this study focuses on the sourcing problem in a dual-supplier situation faced by a buyer who can source from one or both suppliers: one for certain qualities (e.g. the number of high- or low-quality items is known) and another of risky quality (e.g. a buyer only knows the distribution of high- or low-quality items). The rationale is that most businesses still have a sense of the distribution of the supplier's quality, even when the exact quality is not known. For brevity, the former is referred to as a riskless supplier and the latter as a risky supplier. Considering the higher expected quality of risky suppliers, a sourcing manager could take some risks by placing some of the orders with a risky supplier, which is a more optimal decision when the cost of dual sourcing is insignificant. However, as will be demonstrated in Section 1.1, senior management in the industries shared that they consider ordering from a risky supplier when the expected quality is higher than that of the riskless suppliers and that the sourcing team was often reluctant to take risks.

Attribute framing emphasises the characteristics of a product or other entity (Levin and Gaeth, 1988). In dual sourcing, the quality of both riskless and risky supplier components may be described either positively (90% acceptable parts) or negatively (10% defective

parts). However, the current knowledge regarding the effects of attribute framing within a supply chain management (SCM) context is limited to single-entity evaluations. In a dual-sourcing context, the effects of attribute framing on ordering decisions have *not* been studied at all so far. Therefore, this experimental research examines how framing riskless and risky suppliers' quality induces different sourcing decisions, wherein the descriptions of the quality of riskless and risky suppliers are the focus of our framing manipulations. More importantly, we investigate the effects of mixed-attribute framing. That is, the quality of one supplier is described positively, whereas that of the other is described negatively. Additionally, this study examines the underlying mechanism of attribute framing – *attention mechanism*. As claimed by attribute-framing scholars (Kreiner and Gamliel, 2018, 2019), few studies have empirically examined the role of attention. Specifically, to the best of our knowledge, no prior study has tested this mechanism in dual sourcing. Thus, the mechanism of attention remains incipient.

1.1 Practical relevance

Apart from addressing the existing research gaps, our experimental findings will have practical values to real-life situations. This is addressed by discussing the sourcing concerns of industry experts. The current research is motivated by direct interactions with the Head of the supply chain management (SCM) division at a multinational company, headquartered in Austria. We interviewed the Head of the SCM division in January 2022.

This company sells fragrances and essential oils in the international market. It uses plants and wood for production. The recent challenges faced by the company include a reduced number of suitable suppliers owing to the COVID-19 pandemic and supply chain disruptions. The Head of the SCM division stated, “Our suppliers of plants use different planting methods. The quality of some suppliers' products can be estimated using the historical data, but the quality of some suppliers is not always known. For the latter, we relied on our professional network and tried to come up with some estimates. Also, the information about the quality of suppliers' components was usually gathered by our sub-ordinates and it was then presented to the sourcing team. Taking a riskier approach during the supply chain disruption seems unavoidable, as we have already encountered a sudden shortage of materials. We also sometimes order more than the required quantity. We are open to a new supplier that uses other planting methods. We are currently engaging with new suppliers for other materials or components required for other products, and the information about their quality can only be approximately estimated. One crucial observation is that although our analysts had estimated that some of the new suppliers gave higher expected quality, we, as the senior management team, noticed that our sourcing team was reluctant to order from the risky or new suppliers. This could impede our profitability (see [supplementary_material_appendix_1](#) for the interaction with another company).”

1.2 Research objectives and contributions

This study has two objectives. First, it aims to extend the knowledge of attribute framing to ordering decisions, entailing the interplay of the positive or negative descriptions of dual suppliers. To the best of our knowledge, this is the *first* attempt to consider attribute-framing effects involving dual suppliers when riskiness is different. Second, this study aims to advance the understanding of how attribute framing affects managers' decision-making by empirically testing the attention mechanism. For this purpose, two online experimental studies were conducted using professional samples. Accordingly, Study 1 investigates the effects of attribute framing on sourcing decisions. In Study 2, a web-based eye-tracking tool was applied to test whether the quality of supplier items, when framed differently, prompts a change in managers' attention to information about the two suppliers. The results reveal that

framing a supplier's quality (when framed positively) leads to a larger proportion with this supplier than when framed negatively, indexed by the percentage of order(s) placed with riskless and risky suppliers. Notably, this effect holds true for both riskless and risky suppliers. Moreover, the findings indicate that attribute framing affects the distribution of participants' attention directed towards information about riskless and risky suppliers, which explains the framing effect on ordering decisions. It is worth noting that our research findings may also apply to industries in which the quality of suppliers' components is partially known to buying firms and the cost of quality is relatively low (e.g. scraps of unacceptable components) (Shin *et al.*, 2009).

The current experimental findings have important theoretical implications as they confirm that earlier work on attribute framing with a single entity can be extended to a more complex decision-making environment involving dual entities with different levels of quality risk. More importantly, the present study contributes to the emerging theoretical account of attribute framing in the context of the dual sourcing attention mechanism (Kreiner and Gamliel, 2018, 2019; Wong, 2021).

Moreover, this study extends the findings of previous reviews on emerging topics (Fahimnia *et al.*, 2019; Pournader *et al.*, 2020). An empirical contribution of this study is that its results have crucial practical implications by clearly identifying the condition under which framing would nudge a more optimal sourcing decision from managers. Further, the findings highlight the importance of addressing the incentive-compatibility issue in BOM experiments (e.g. participants in this study were incentivised to make decisions that maximise high-quality components), which strengthens external validity. Last but not least, this study methodologically contributes by demonstrating the capability and flexibility of online eye trackers. It elucidates that this technology can be applied in future BOM research.

2. Theoretical background and hypotheses

2.1 Behavioural perspective of ordering decisions and attribute framing

Extant literature on sourcing strategy highlights the importance of suppliers' quality in the overall effectiveness of the supply chain and considers quality as an important risk factor (Rijkema *et al.*, 2014; Tse and Tan, 2012). The decision models developed from studies on supplier quality risk require that a buying firm orders from the supplier with the best expected quality, usually represented in expected total quality cost (Canbolat *et al.*, 2008; Shin *et al.*, 2009). It means the supplier with the lowest expected total quality cost. However, this might not necessarily be the case. Hamdi *et al.* (2018) classified the different behaviours in past studies on supplier selection into two categories: risk averse and risk neutral behaviours. Their findings provide strong evidence that decision-makers tend to be risk-averse in supplier selection. Risk-averse decision-makers prefer guaranteed lower returns rather than potential higher returns with risk. Extending the findings from Hamdi *et al.*'s (2018) review on ordering decision, it is unsurprising that the riskless supplier could be more appealing to the participants in our study. This contention is also consistent with interviewees' suggestions. This warrants attention in examining how the presentation of information about suppliers' quality affects ordering decisions.

Many situations in SCM contexts can be framed differently. For instance, when an attribute of a supplier (e.g. quality) is described positively (vs negatively), significant attribute-framing effects can potentially influence sourcing behaviour when there is a riskless supplier (i.e. the number of high- or low-quality items is known) and a risky supplier (i.e. the distribution of high- or low-quality items is estimated). Specifically, these effects are reflected in the percentage of order(s) with the supplier(s) in our study. In accordance with scholars' arguments, the visibility of material quality is important in determining the probability of quality risk occurring in the supply chain (Tse and Tan, 2011, 2012). More importantly, the

visibility of a supplier depends on the evaluation of the level of disclosure of quality information, such as incoming inspection data (Tse and Tan, 2011), but this information may not be readily available or may involve high variations when using a new supplier. A stream of research on the moral-hazard problem in a supplier-buyer relationship has also considered a situation in which a supplier's quality is not observable (Balachandran and Radhakrishnan, 2005; Quigley *et al.*, 2018). This suggests that an investigation of attribute-framing effects involving a risky supplier is connected to practice.

2.2 Attribute framing: association-activation mechanism and ordering decisions

The attribute-framing effect on evaluation with a single entity offers theoretical underpinnings for predicting its effect on dual sourcing. Levin *et al.* (1998) introduced an association-activation mechanism to explain the attribute-framing effect on evaluation. This mechanism involves the activation of valence associated with the labels used in positive or negative framing descriptions (e.g. 80% high quality vs 20% low quality). Thus, decision-makers convert information relative to their descriptive valence. Teigen (2015) further clarifies that positive (negative) descriptions operate as priming cues that trigger the activation of more positive (negative) associations with the to-be-evaluated entity.

The findings from extant behavioural operation studies generally support the prediction of association-activation mechanisms. Using a controlled experiment, Tokar *et al.* (2016) investigated simple attribute framing in replenishment decisions. When the positive attribute of a new inventory ordering policy is emphasised (i.e. in-stock rate), it receives a higher evaluation than when the negative attribute is emphasised (i.e. the out-of-stock rate). Wong (2021) examined attribute framing in the evaluation of the performance of a single supplier. When a positive characteristic is emphasised, a more favourable outcome or evaluation is provided than when a negative characteristic is highlighted. Wong (2021) extended the framing effect to choices and provided indirect evidence that the positive framing of supplier performance would increase the likelihood that the same supplier would be selected in the future. Implicit in this finding is that in the context of sourcing, framing may lead to biased ordering decisions from the supplier that is "seemingly" more favourable.

The discussion thus far surrounds attribute framing involving a single entity. This study investigates a largely underexplored area and thoroughly tests framing effects involving *dual* suppliers. We test whether highlighting the positive or negative attributes of dual suppliers would nudge the decision-maker to make a more optimal decision. As introduced earlier, the sourcing situation investigated here is that the expected quality of the risky supplier is higher than that of the riskless supplier with known quality. For instance, placing 70% of the order with the risky supplier and 30% with the riskless supplier is more optimal than ordering 100% from the riskless supplier. We focus on the situation in which the valence of attribute framing for riskless and risky suppliers may be different. Suppose that the quality of riskless supplier is framed *positively* while that of risky supplier is framed *negatively*. If the framing of a risky supplier's quality attribute changes from negative (e.g. 20% low quality) to positive (e.g. 80% high quality) and all other things are equal, the association-activation mechanism explains that the positive frame increases the overall attractiveness of the risky supplier by generating a positive association with the high quality of the risky supplier's component.

We speculate the same pattern of results as predicted above for the framing effect of riskless suppliers when controlling for the framing message of risky suppliers. This is because the association-activation mechanism does not suggest an interaction effect between risk and framing. When making sourcing decisions, managers usually assess information about different suppliers' performance sequentially before deciding on how much they order from the supplier(s). The encoding process of information about a supplier's quality should be

independent of how the quality of the alternative supplier is framed. Thus, under negative framing, a supplier becomes a less appealing option, as managers tend to order more from the alternative supplier under a positive framing, irrespective of the riskiness of supplier's quality.

- H1. When a risky supplier's quality is positively framed, the percentage of order(s) placed with a risky supplier will be higher than when it is negatively framed, regardless of whether the quality of riskless supplier is positively or negatively framed.
- H2. Decision makers order a larger percentage from the riskless supplier when the quality of its component is positively framed than when it is negatively framed, regardless of whether the quality of risky supplier's component is positively or negatively framed.

2.3 Attribute framing and the attention mechanism: explaining ordering decision

Recent attribute-framing studies have offered an alternative underlying mechanism of the attribute-framing effect in evaluating a single entity — the attention mechanism (see [Jain et al., 2020](#); [Kreiner and Gamliel, 2018](#); [Wong, 2021](#), for examples). This mechanism is a conceptualisation of [Kahneman's \(2011\)](#) "What You See Is All There Is" (WYSIATI) principle and [Keren's \(2011\)](#) contention that "*the most prevailing facet of framing is to direct attention to some aspects while suppressing others*" (p. 21). According to the attention mechanism, when a positive attribute is highlighted, one's attention is focused on the positive frame that is explicitly described (e.g. 80% high-quality). Therefore, the logically complementary negative frame (e.g. 20% low quality) is neglected. Consequently, the focus of unbalanced attention drives and regulates how decision-makers evaluate an entity. The same logic applies to an explicitly described negative frame. [Keren \(2011\)](#) and [Kreiner and Gamliel \(2019\)](#) argued that decision-makers' cognition operates in this manner to lower the cognitive load and cope with limited cognitive capacity.

As [Kreiner and Gamliel \(2019\)](#) highlighted, few studies have considered the empirical contribution of the attention mechanism. In line with [Kreiner and Gamliel \(2018\)](#), we regard the association-activation and attention mechanisms as *jointly* contributing to the relationship between attribution framing and evaluation. Specifically, [Kreiner and Gamliel \(2019\)](#) suspected that the relative contribution of the attention mechanism is greater than that of the association account. However, this contention is based on experimental studies that use manipulation questions to shift attention. Only two studies directly measured attention in a single-entity evaluation task ([Wong, 2021](#); [Jain et al., 2020](#)), and the findings generally support the attention mechanism. This study addresses a significant gap in the attention mechanism by which framing affects ordering decisions involving dual suppliers. Since the processes between supplier evaluations and sourcing decisions are likely to differ, a brief literature review on attention and choice will further elucidate the relationship between framing and sourcing decisions.

Here, we discuss another tenet of research highlighting the *active* role of attention when a decision is made ([Krajbich et al., 2010, 2012](#)), which helps develop hypotheses. The attentional drift-diffusion model (aDDM) offers a quantitatively accurate depiction of how decision-making processes are affected by attention ([Tavares et al., 2017](#)) and sheds light on the relationship between attention and value-based choices (e.g. the choice between two refreshments) ([Krajbich et al., 2010, 2012](#)). The aDDM posits that attention influences choices through its effect on the value comparison process and suggests that decision makers assign relatively larger weight to attended information. Extending this logic to sourcing decisions, we posit that increased attention to supplier information is predictive of increased preferences and a tendency to order more from the supplier.

Attention-related research has demonstrated that manipulating decision-makers' attention leads to a shift in their preferences (Armel *et al.*, 2008; Kunar *et al.*, 2017). The argument presented here is that framing the quality of suppliers' components directs managers' attention to the information of suppliers in a predictable manner. In dual sourcing, the framing of riskless and risky suppliers' quality could be the same (e.g. both positive and negative) or different (e.g. one negatively framed and another positively framed). Suppose that the negative attribute of a riskless supplier is highlighted (e.g. 20% low quality), whereas the attribute of the risky supplier is positively framed. The low quality of the riskless supplier's component occupies the focus of managers' attention, and the logically implied complementary aspect of the riskless supplier's component (i.e. 80% high quality) is likely to be neglected.

Consequently, the riskless supplier becomes less appealing, and managers then shift their attention more to the quality information about the risky supplier than they would have done if both suppliers' attributes had been positively highlighted. In accordance with the addm, a higher preference for the risky supplier develops, owing to the increased attention paid to the supplier. Since we do not expect an interaction between attribute framing and supplier riskiness, the effects of framing in a dual-supplier situation would follow when we flip the situation by framing the risky supplier's quality negatively and the riskless supplier's quality positively. Under a positive framing, more attention paid to information about the supplier induces a relatively higher preference for that supplier than it would under a negative framing, so that a buyer would place a larger order with this supplier. In other words, attention to supplier information mediates the effects of framing and sourcing decisions.

- H3.* Independent of the suppliers' riskiness, when a supplier's attribute is positively framed, buyers will attend more to the information about this supplier's quality than they would when it is negatively framed.
- H4.* Attention to supplier information mediates the relationship between framing and sourcing decisions.

3. Study 1: attribute framing effect on risk-taking sourcing

3.1 Methods

Study 1 involved a between-subjects 2×2 factorial (*framing of riskless supplier quality*: positive vs negative; *framing of risky supplier quality*: positive vs negative) online experiment. We randomly assigned the participants to one of the four experimental conditions. The experiment involved participants sourcing roses for the production of fragrances and essential oils. We also considered our interviewees' input that the expected quality of the risky supplier would be higher than that of the riskless supplier. In the "positive riskless framing and positive risky framing" condition, the positive framing manipulation ("80% of roses are of high quality") highlighted the positive attribute of the riskless supplier and the positive attribute of the risky supplier ("Your sourcing team has done some preliminary analysis and concluded that the percentage of high-quality roses is uniformly distributed between 70% and 95%."). Under negative framing for both riskless and risky suppliers, the percentages of low-quality roses were emphasised instead (riskless supplier: "20% of roses are of low quality" and risky supplier: "Your sourcing team has done some preliminary analysis and concluded that the percentage of low-quality roses is uniformly distributed between 5% and 30%."). Thus, the expected quality of risky supplier was more optimal (i.e. 82.5%) than the guaranteed quality of riskless suppliers (i.e. 80%). In the other two conditions, mixed framing messages of the suppliers were presented, and participants read the corresponding message (see [supplementary_material_appendix_2](#) for the results of the manipulation checks).

Participants were reminded that there were no correct or incorrect answers, and that no information about their identity was collected.

3.2 Realism checks

We adopt qualitative and quantitative approaches to evaluate the realism of the scenario and independent variable (Rungtusanatham *et al.*, 2011; Thomas *et al.*, 2013). Initially, we relied on academic literature to develop the original scenarios and the independent variable (i.e. framing suppliers' quality information). Two academic experts subsequently reviewed them with expertise in behavioural experimentation. These experts offered feedback on language use, length of scenarios, and credibility. The scenarios were revised, which was considered appropriate by the experts. We then shared the scenarios in the four experimental conditions with the head of the supply chain management and the deputy whom we interviewed. These two industry experts conducted their assessments and offered important comments on the realism of the scenarios and ordering decision tasks. The changes included: (1) the percentages of high- and low-quality roses, (2) the presentation of suppliers' quality information in the form of texts instead of graphs, (3) allowing participants to have different "total order sizes" of roses, and (4) incentivising participants to make a decision that may result in a more high-quality component. The experts particularly emphasised that incentive compatibility was important because, in real-life situations, ordering decisions were highly related to the business unit's performance, which would ultimately affect the performance bonus that staff members receive. After implementing the changes, the experts agreed that the scenarios and framing of the suppliers' quality information captured a realistic and understandable sourcing decision-making environment. The experts' feedback confirms the validity of the percentages of high- and low-quality roses and the expected qualities of both suppliers adopted in the scenarios.

A quantitative realism check was performed following the qualitative realism check. This ensures that participants would find the scenarios and the corresponding independent variables realistic and understandable (Golgeci *et al.*, 2022; Louviere *et al.*, 2000; Thomas *et al.*, 2013). Three items were used to assess the realism of scenarios and experimental design ("The situation described in the scenario was realistic", "The scenario was believable", and "I can imagine myself in the described situation".) (Bozkurt and Gligor, 2021; Dabholkar, 1994). A seven-point Likert scale was used for all items (1 = *strongly disagree*, 7 = *strongly agree*).

A pilot study with 28 undergraduate students majoring in supply chain management was conducted for realism checks and to ensure that the sourcing task and suppliers' quality information were easy to understand for all four conditions. The three items for the student group yielded an average score of 5.26 and high internal consistency (Cronbach's alpha = 0.80). The mean scores for the four conditions were similar. In addition, we conducted another pilot study with ten professional participants who worked for the companies interviewed (Rungtusanatham *et al.*, 2011). The average score on the realism check was 6.33, with a Cronbach's alpha of 0.83. Both findings indicate that the participants perceived the scenarios and independent variables as realistic. The results of the realism checks suggest that the data from the experiment would offer very good indications of the relationship between framing and real-life sourcing decisions.

3.3 Participants

We recruited 288 participants (40.6% women) from the UK via Prolific Academic. It is a crowdsourcing platform which intermittently requires participants to provide documentation or information to confirm their eligibility to participate in a research study (e.g. work experience) [1]. The same participants were only permitted to participate once. A fixed payment of £0.90 was given. To incentivise the participants' decisions, they received

a bonus payment depending on their order strategy and the quality of roses received. The payment scheme was as follows: the cost of each 100 kg of roses was £0.02, and they were the same for both suppliers. For 100 kg of high-quality roses, they would receive a bonus payment of £0.01 after deducting the cost of roses, but for 100 kg of low-quality roses, a £0.005 penalty would be deducted from their payment. We selected these payment parameters based on a pilot study. The participants' average age was 40.8 years (SD = 10.5), and the mean years of experience in sourcing was 10.3 years (SD = 7.4).

3.4 Procedures and scenario

First, the participants answered questions that elicited information about their work experience. Next, they received details about the procurement task and scenario entailing the need for 10,000 kg of roses to produce high-end fragrances and essential oils. Participants were informed that the goal was to maximise the number of high-quality roses, and that the costs of single and dual sourcing were identical. They were given the authority to order up to 15,000 kg of roses. The participants also learned how the fixed and bonus payments worked. The participants completed a short quiz to check whether they understood the bonus payment and the different riskiness of the two suppliers. Last, we randomly assigned participants to one of the four conditions, and participants were given details regarding the suppliers. After completing the sourcing task, the number of high-quality roses from the supplier(s) was displayed on their screen.

3.5 Measures

Measures for the independent variable were modified from extant behavioural operations literature (Wong, 2021) and were adapted to a sourcing task with dual suppliers.

3.5.1 Ordering decision. Participants were required to order roses from the supplier(s) of their choice. They were asked to indicate the number of roses they would order from riskless and risky suppliers in an ordered form. In cases where a participant did not want to order roses from either the riskless or risky supplier, he or she was required to enter "0" in the corresponding order form. We computed the percentage of order(s) for each participant with riskless and risky suppliers. Only the percentage of order(s) with risky suppliers was reported, as a higher percentage of order(s) with risky suppliers indicated a lower percentage with the riskless supplier, and vice versa. For instance, to test whether positive framing of risky suppliers' quality would lead to a higher percentage of orders with the risky supplier, we compared the differences in the order percentages between the "positive framing of risky supplier quality" and the "negative framing of risky supplier quality" conditions.

3.6 Results

A univariate analysis of variance (ANOVA) was performed to investigate the effects of attribute framing on sourcing decisions. Significant framing effects of riskless and risky suppliers were found for the percentage of order(s) placed with the risky supplier, respectively. No interaction effect (*framing of riskless supplier quality* × *framing of risky supplier quality*) was found, suggesting that the framing effect on sourcing did not vary with suppliers' riskiness (see supplementary_table for relevant statistics).

Planned contrasts with Bonferroni adjustment were conducted to examine the relationship between the framing messages of both suppliers and sourcing decisions (see Table 1 for descriptive statistics). When the framing of riskless supplier was fixed at *negative*, and the risky supplier quality was positively framed, the percentage of the orders from the risky supplier was higher compared with the percentage associated with the negatively

framed quality of the risky supplier (*Estimated Marginal Mean Difference* = 12.39, *S.E.* = 5.06, $p = 0.015$, 95% CL for Difference [2.44, 22.33], $d = 0.41$). Focussing on the *positive framing of the riskless supplier quality* condition, buyers in the *positive framing of risky supplier* condition ordered a larger percentage from risky suppliers than those in the *negative framing of risky supplier* condition did (*Estimated Marginal Mean Difference* = 11.13, *S.E.* = 5.02, $p = 0.027$, 95% CL for Difference [1.26, 21.00], $d = 0.37$). These findings support [Hypothesis 1](#). When controlling for the framing of risky suppliers to be negative, buyers in the *positive framing of the riskless supplier quality* condition ordered a smaller percentage from risky suppliers (i.e. a larger percentage from the riskless supplier) than those in the *negative framing* condition (*Estimated Marginal Mean Difference* = -13.11, *S.E.* = 5.06, $p = 0.010$, 95% CL for Difference [-23.06, -3.16], $d = -0.43$). Considering only the cases in the *positive framing of risky supplier quality* condition, participants under positive framing ordered a *smaller* percentage from risky suppliers than those under negative framing (*Estimated Marginal Mean Difference* = -14.37, *S.E.* = 5.01, $p = 0.004$, 95% CL for Difference [-24.25, -4.50], $d = -0.48$). Our findings support [Hypothesis 2](#).

3.7 Discussion

Our findings revealed that attribute framing had profound impacts on sourcing decisions. Positively framing the quality of supplier’s component led to a larger proportion of orders from the supplier. This effect was robust because the attribute-framing effect exists in dual sourcing irrespective of the suppliers’ riskiness. Our findings suggest that to nudge participants into making a more optimal decision (i.e. ordering more from risky suppliers), the quality of risky suppliers should be framed positively, whereas that of riskless suppliers should be framed negatively. Apart from the association-activation mechanism, recent developments in studies on attribute framing have offered the attention mechanism of the simple attribute-framing effect ([Jain et al., 2020](#); [Wong, 2021](#)). This study also considered this perspective in the context of dual suppliers. Therefore, Study 2 was conducted to elucidate the relationships between framing, attention, and sourcing decisions.

4. Study 2: attribute framing and managers’ attention

Study 2 was an online experiment, and we adopted web-based eye-tracking technology. This method enabled the framing effect on sourcing to be explained from the aDDM perspective. Recent studies on human-computer interactions have adopted eye trackers ([Kim et al., 2015](#); [Wong, 2021](#)). Eye movements are considered an accurate indicator of attention ([Kim et al., 2015](#)) because they eliminate the potential issues of self-reported findings.

Table 1.
Studies 1 and 2: Mean (standard deviation) percentage of order(s) placed with the risky supplier by experimental conditions

Study 1		Riskless Supplier Framing	
		Positive	Negative
Risky Supplier Framing	Positive	42.01% (32.06)	56.38% (33.19)
	Negative	30.88% (25.54)	43.99% (31.24)
Study 2		Riskless Supplier Framing	
		Positive	Negative
Risky Supplier Framing	Positive	42.39% (28.99)	57.39% (36.10)
	Negative	23.65% (24.49)	39.88% (27.59)
Source(s): Author work			

4.1 Methods

The experiment had the same four conditions, procedure and task as in Study 1. After completing questions on demographic work experience and reading the introduction to the scenario, the calibration of the eye tracker began. This calibration step was essential because the participants' sitting positions and computer displays may be different (see [supplementary material appendix 3](#) for detail). They were then notified of whether optimal calibration was achieved, followed by the sourcing task. If the first attempt at calibration was unsuccessful, the participants could recalibrate four more times. Cases with five unsuccessful calibrations were excluded.

4.2 Apparatus

Web-based eye tracking devices have been employed in recent studies on attention (Bott *et al.*, 2017; Semmelmann and Weigelt, 2018). This was employed in Study 2 using the RealEye.io system (<https://www.realeye.io/>), because it facilitated access to a sample of professionals. Also, some head movements of the participants during the experiment would not compromise the quality of the data, thus better mimicking a procurement-related decision-making environment. The RealEye platform has been used in previous studies (e.g. Fazio *et al.*, 2021; Federico *et al.*, 2021) and has been proven to be a reliable technology when we would not need analyse a detailed spatial resolution (Semmelmann and Weigelt, 2018). Yang and Krajbich (2021) replicated findings in a decision-making study using a web-based eye tracker based on previous findings obtained in the laboratory.

Web-based eye trackers have a disadvantage associated with lower sampling rate. To ensure that the tracking accuracy was comparable with that of previous studies that deployed eye trackers (Bott *et al.*, 2017; Krajbich *et al.*, 2012), our web-based device provided a good sampling rate of 50 Hz. The RealEye online eye tracking algorithm also performed data quality check for each participant. For instance, the level of data quality would be low during eye tracking when participants looked away from the computer screen or when a problem occurred with the lighting. We included only data with a satisfactory level of quality in the data analyses.

4.3 Participants

Twenty-two participants were excluded from the analyses because they failed both calibration and recalibration or they did not generate satisfactory data. The final sample comprised 129 participants. The mean age was 38.2 years ($SD = 11.7$). Their mean year of experience in sourcing was 5.3. All the participants declared that they had normal (or corrected-to-normal) vision.

4.4 Dependent measures

4.4.1 Ordering decision. We used the same measures as in Study 1.

4.4.2 Relative attention to AOIs. We defined the two areas of interest (AOIs) and measured participants' attention to these AOIs (see [supplementary material appendix 4](#)). The two AOIs referred to descriptions of the quality of riskless and risky suppliers' products, namely riskless supplier AOI and risky supplier AOI, respectively. To mitigate measurement errors, both AOIs were in rectangles by a minimum of 150px in all directions and were displayed in the middle part of the participants' screen. The two AOIs were at least 250px apart. Fixation duration and fixation counts have been widely used measures of attention (Seo *et al.*, 2018). Here, fixation duration refers to the length of time that a participant attended to information regarding a supplier's quality. Based on similar studies (Kim *et al.*, 2015; Wong, 2021), a fixation count, indicating relatively stationary eye movements, was defined when the fixation time was more than 50 ms. Higher fixation counts indicated that more attention was directed towards AOI. The *percentages* of fixation duration and fixation count related to the AOIs of

the two suppliers were computed for each participant. The relative attention to the two AOIs in the form of percentages allowed for empirically testing the hypotheses; for example, whether the riskless supplier AOI received larger percentages of fixation duration and fixation counts under the riskless supplier positive framing condition than under the riskless supplier negative condition.

216

4.5 Results and discussion

We conducted an ANOVA with two independent variables: framing of riskless suppliers and risky suppliers to check whether the findings from Study 1 could be replicated. Table 1 illustrates the descriptive statistics across conditions and Table S1 shows the relevant statistics of the ANOVA (see supplementary_table). As seen in Table 2, the findings from Study 1 were replicated.

Table 3 shows the means and standard deviations of the percentages of attention received for the risky supplier AOI. Only the relative attention to risky supplier AOI was reported because 100% minus this relative attention would equal to the relative attention to riskless supplier AOI. We conducted two ANOVAs on the relative fixation duration and fixation

	Estimated Marginal Mean Difference	S.E.	p value	95% CL	Cohen-d
<i>Riskless supplier (negative frame)</i> Risky supplier – positive vs negative	17.51	7.00	0.013	[3.68, 31.33]	0.59
<i>Riskless supplier (positive frame)</i> Risky supplier – positive vs negative	18.74	6.68	0.006	[5.55, 31.93]	0.64
<i>Risky supplier (negative frame)</i> Riskless supplier – positive vs negative	-16.23	6.85	0.019	[-29.78, -2.68]	-0.55
<i>Risky supplier (positive frame)</i> Riskless supplier – positive vs negative	-15.00	6.82	0.029	[-28.48, -1.52]	-0.51

Table 2. Study 2: Attribute effects on the percentage of order(s) sourced from the risky supplier using planned contrasts results with Bonferroni adjustment

Note(s): For the riskless supplier conditions, the negative mean differences indicated that participants ordered more from the riskless supplier in the positive framing condition than those they did in the negative framing condition

Source(s): Author work

Study 2	Percentage of fixation duration on risky supplier AOI	Riskless supplier framing	
		Positive	Negative
Risky Supplier Framing	Positive	68.75% (15.79)	82.11% (12.23)
	Negative	38.71% (16.04)	58.95% (15.84)

Table 3. Mean percentages (standard deviations) of attention measures on the AOI for the risky supplier under experimental conditions

Study 2	Percentage of fixation count on Risky Supplier AOI		
		Positive	Negative
Risky Supplier Framing	Positive	76.40% (16.19)	83.92% (11.56)
	Negative	39.32% (12.69)	55.46% (11.98)

Source(s): Author work

count received for the risky supplier AOI. As seen in Table 4, the main effects of framing of riskless suppliers and risky suppliers were significant. No interaction effect was observed. Planned contrasts with Bonferroni adjustment revealed that irrespective of the framing condition of the riskless supplier, the risky supplier AOI received higher percentages of fixation duration when the risky supplier's quality was positively framed than when it was negatively framed (see Table 5 for relevant statistics). In contrast, regardless of how the risky

Source	SS	df	MS	F	P	Partial η^2
<i>Percentage of fixation duration</i>						
Framing of riskless	9,030	1	9,030	39.47	<0.0005	0.24
Framing of risky	22,641	1	22,641	98.94	<0.0005	0.44
Framing of riskless*Framing of risky	379.27	1	379.27	1.66	0.20	
Corrected Model	33,139	3	11,046	48.27	<0.0005	0.54
Error	28,604	125	228.84			
Corrected Total	61,743	128				
<i>Percentage of fixation count</i>						
Framing of riskless	4,854	1	4,854	27.51	<0.0005	0.17
Framing of risky	37,276	1	37,276	211.26	<0.0005	0.61
Framing of riskless*Framing of risky	645.77	1	645.77	3.66	0.058	
Corrected Model	43,008	3	14,336	81.25	<0.0005	0.644
Error	23,820	135	176.45			
Corrected Total	66,829	138				

Source(s): Author work

Table 4. Univariate Analysis of Variance (ANOVA): Effects of framing dual suppliers on the percentages of fixation duration and fixation count for the risky supplier AOI

	Estimated Marginal Mean Difference	S.E.	p-value	95% CL	Cohen-d
<i>Relative fixation duration</i>					
<i>Riskless supplier (negative frame)</i>					
Risky supplier – positive vs negative	23.16	3.79	<0.0005	[15.66, 30.66]	1.53
<i>Riskless supplier (positive frame)</i>					
Risky supplier – positive vs negative	30.04	3.78	<0.0005	[22.57, 37.51]	1.99
<i>Risky supplier (negative frame)</i>					
Riskless supplier – positive vs negative	-20.24	3.62	<0.0005	[-27.40, -13.08]	-1.34
<i>Risky supplier (positive frame)</i>					
Riskless supplier – positive vs negative	-13.36	3.94	0.001	[-21.15, -5.56]	-0.88
<i>Relative fixation count</i>					
<i>Riskless supplier (negative frame)</i>					
Risky supplier – positive vs negative	28.46	3.25	<0.0005	[22.04, 34.88]	2.14
<i>Riskless supplier (positive frame)</i>					
Risky supplier – positive vs negative	37.09	3.13	<0.0005	[30.90, 43.28]	2.79
<i>Risky supplier (negative frame)</i>					
Riskless supplier – positive vs negative	-16.14	3.18	<0.0005	[-22.42, -9.86]	-1.21
<i>Risky supplier (positive frame)</i>					
Riskless supplier – positive vs negative	-7.51	3.20	0.020	[-13.85, -1.18]	-0.57

Source(s): Author work

Table 5. Study 2: Attribute effects on relative fixation duration and relative fixation count for the risky supplier AOI using planned contrasts results with Bonferroni adjustment

supplier's quality was framed, participants in the *positive riskless supplier framing* conditions allocated lower percentages of fixation duration to the risky supplier AOI than those in the *positive riskless supplier framing* conditions.

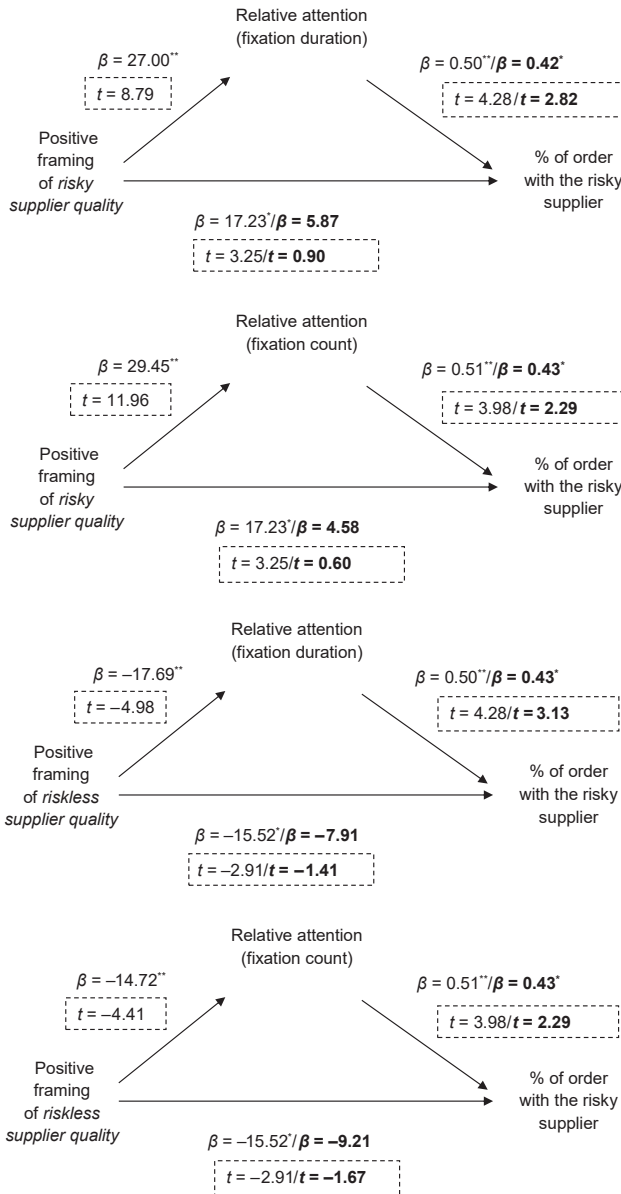
We found significant main effects of riskless supplier framing and risky supplier framing on the percentage of fixation count. The interaction effect was marginally insignificant. To test whether the framing messages shifted participants' attention as indexed by the relative fixation count, we performed planned contrasts with a Bonferroni adjustment. Consistent with the analyses for relative fixation duration, the results showed that the percentage of fixation count for the risky supplier AOI was statistically higher under the positive framing of risky supplier conditions than under the negative framing of risky supplier conditions (see [Table 5](#) for the relevant statistics). Regarding the framing effects on how participants allocated attention to risky supplier AOI in the *riskless supplier framing* conditions, the results indicated that at both levels of framing of risky supplier's quality, participants in the positive framing conditions spent relatively less attention to this AOI than those in the negative framing conditions. Together, these findings support [Hypothesis 3](#).

4.5.1 Mediation analyses for framing of risky supplier quality. First, we focused on the effect of framing risky supplier's quality. As shown in [Figure 1](#), we observed a significant direct effect of framing on the percentage of order(s) from the risky supplier. Regression of the order percentage in relation to framing and the percentage of fixation duration received for the risky supplier's AOI revealed a significant effect of relative fixation duration on this AOI. However, the effect of framing on the percentage of order(s) from the risky supplier was insignificant. We followed [Preacher and Hayes' \(2009\)](#) bootstrapping procedure, using the PROCESS technique to test the indirect effect. The results for 10,000 resamples indicated that zero was not included in the 95% confidence interval (CI) for the indirect effect of the percentage of fixation duration on risky supplier AOI (95% CI [3.63, 19.24]). Regression of the percentage of order(s) with the risky supplier in relation to framing and the percentage of fixation counts revealed that the impact of framing on the percentage of fixation counts was significant. The effect on the percentage of order(s) with the risky supplier was insignificant when the percentage of fixation count was controlled for. Bootstrapping with 10,000 resamples showed that the CI (95% CI [1.68, 24.04]) did not include zero.

4.5.2 Mediation analyses for framing of riskless supplier quality. Regression of the percentage of order(s) with the risky supplier and the percentage of fixation duration received for the risky supplier's AOI revealed a significant effect of relative fixation duration in relation to this AOI. The effect of framing on the percentage of order(s) from the risky supplier was insignificant (see [Figure 1](#)). The results for 10,000 resamples showed that zero was excluded in the 95% CI for the indirect effect of the percentage of fixation duration on the risky supplier AOI (95% CI [-13.77, -3.36]). For the percentage of fixation count, the bootstrapping results with 10,000 resamples showed that zero was excluded in the 95% CI for the indirect effect of the percentage of fixation duration on the risky supplier AOI (95% CI [-12.17, -2.47]). Together, the results suggest that attention to the risky supplier's AOI relative to that of the riskless supplier played a mediating role in the relationship between the framing messages of the two suppliers and the percentage of order(s) with the risky supplier. These findings support [Hypothesis 4](#).

5. General discussion and conclusion

Past studies on attribute framing in product evaluation has focused on the effects of highlighting an attribute in a positive vs negative light ([Jain et al., 2020](#); [Teigen, 2015](#)). A growing body of BOM research has begun to study the effects of attribute framing in the SCM context. However, these studies have focused on the single-supplier situation, so we know little about the relationship between framing dual suppliers' attributes and sourcing decisions ([Wong, 2021](#)). These effects are important, especially when single sourcing is not ideal owing to supply chain disruptions ([van Hoek, 2020](#)).



Note(s): $df = 127$. The bolded coefficient β is based on the analysis when relative attention is included. The coefficient β in plain font indicates that the focus is only on the relationship between the two variables. $*p < 0.05$, $**p < 0.0005$

Source(s): Author work

Figure 1. Mediation analyses for framing of risky supplier quality: Relative fixation duration and fixation count for the risky supplier's AOI

It can be posited that in an environment comprising a riskless and a risky supplier, positive or negative framing of the quality of the riskless or risky supplier affects managers' sourcing decisions. The results of Studies 1 and 2 provide strong support for this contention. Under the conditions of positive and negative framing, the descriptions of the two suppliers' quality were identical. Nevertheless, participants who received a positive framing of riskless (risky) supplier quality opted for a larger percentage of order(s) from the riskless (risky) supplier compared with those who received a negative framing. Importantly, the effect of this attribute framing holds true for both the riskless supplier and the risky supplier. Recall that all the participants correctly identified which of these two suppliers was riskier. These results suggest that differential framing strongly impacts managers' decision-making, regardless of the perceived risk of the supplier.

In our experiments, the sourcing scenario comprised a risky supplier with a higher expected quality than the riskless supplier (i.e. 82.5% high-quality vs 80% high-quality components). As demonstrated in our findings, *positively* framing risky supplier quality and *negatively* framing riskless supplier quality helps nudge buyers make a more optimal decision. The expected value of the riskier choice was not substantially higher than that of the riskless choice. We speculate that if the expected value of the risky choice increases, it becomes more appealing to buyers. Additionally, the framing effects found are applicable to other real-world situations. For example, supply chain disruption and shortage of components may make some suppliers riskier than others in terms of other attributes (e.g. delivery time). The general pattern of our findings may be reflected in other scenarios.

Study 2 investigated the impact of attribute framing on how practitioners allocated their attention to information about two suppliers. The results for the gaze variables indicated that attribute framing affected the distribution of participants' attention directed towards information about riskless and risky suppliers. Generally, participants paid relatively more attention to information about a positively framed supplier's quality than to the negatively framed supplier's quality. Consistent with the framing effect on ordering, the framing effect on attention holds for different levels of suppliers' riskiness. Moreover, attention to the information mediates the impact of attribute framing on risky sourcing decisions. Together, the findings suggest that an attention drift explained why buyers, facing two suppliers—one's quality negatively framed and another positively framed—placed a larger percentage with the supplier under the positive frame.

Our findings contribute to the literature on behavioural operations by exploring different framing effects to ordering decisions. An increasing body of research in this field has focused on situations wherein managers make decisions in uncertain environments (Fahimnia *et al.*, 2019; Ha and Tang, 2017; Loch, 2017; Quigley *et al.*, 2018). The present study not only extended attribute-framing studies into a dual-supplier context but also supported the attention mechanism of attribute framing (Kreiner and Gamliel, 2019). Although attention has been studied within cognitive psychological research, its influence on behavioural operations remains largely unexamined (Wong, 2021). This study posits that attention should be considered an important factor when managers' decisions are affected by how they process information. Another theoretical contribution of our research is that aDDM appropriately predicts managers' decisions when the variable of interest (i.e. percentage of order) is continuous. Considered in combination, these results not only advance knowledge of attribute framing but also open avenues for further studies on biases in behavioural operations.

One might think that our experimental setup appears similar to another type of framing (*risky choice framing*). Risky choice framing involves a task consisting of choosing between two *independent* options (e.g. Option 1: saving 300 (losing 700) lives for sure of 1,000 lives; Option 2: saving 1/3 (losing 2/3) of all 1,000 lives). Prospect theory posits that individuals are risk-seeking when facing loss but risk-averse when dealing with gain (see Kahneman, 2011, for example). Option 1 is preferable when "saving lives" is emphasised. However, this is not the experimental setup of this study: the options were dependent (i.e. ordering more from the

risky supplier means ordering less from the riskless supplier). Levin and Gaeth (1988) encourage researchers to study attribute framing when risk is involved. As echoed by Kreiner and Gamliel (2019), risk-choice framing must involve choosing either a certain *or* probabilistic option. When comparing the percentages of orders with the risky supplier in the “*positive risky- and positive riskless suppliers framing*” and the “*negative risky- and negative riskless suppliers framing*” conditions, no significant differences were found in both Study 1 and Study 2, as Prospect theory predicts. Another theoretical contribution is that different types of framing are likely to follow distinct mechanisms.

This study has several limitations that necessitate caution when interpreting the findings. First, it did not consider the costs associated with dual sourcing. Costly dual sourcing may conceivably affect the strength of the framing effect. If framing is sufficiently powerful, then the cost of dual sourcing may drive managers to rely more on suppliers whose performance (such as quality) is positively framed. Second, the cost of quality considered in this study is relatively low (i.e. scraps of low-quality components with a small cost). It would be useful to understand whether framing dual suppliers’ performance leads to similar results when the cost of quality is much higher (e.g. in a high-tech industry). Future research should explore the relationship between framing dual suppliers and sourcing decisions in different environments.

The current experimental results offer guidance to researchers and sourcing managers on how to look out when different presentations of supplier quality coexist. An important practical implication is that when one supplier is a more optimal choice, its attribute should be framed positively, whereas another supplier who generates a suboptimal outcome should be framed negatively. When a riskier option is justifiable (e.g. lower expected total quality cost), correctly framing suppliers’ quality information helps nudge managers to take risks. The current findings may also help sourcing managers avoid falling prey when sourcing from a riskier supplier is unjustified (e.g. low expected quality). Sourcing managers should also be cautious when a risky supplier presents their own quality along with comparisons of other riskless suppliers’ quality. This presentation may deliberately focus on others’ negative attributes, while presenting a more appealing self-portrayal. Last, the results stress the importance of how descriptions of suppliers’ quality should be framed, depending on the buyers’ goals. Sometimes, strategic sourcing decisions are made at group levels (Banaeian *et al.*, 2018). The decisions of these managers may be inconsistent when they individually frame the quality of suppliers differently.

An important conclusion of this study is that training should be provided to sourcing managers to understand how framing different suppliers’ attributes works, as this may guide them in making better decisions. We conclude that an emphasis on the positive attributes of risky suppliers’ quality can increase more risky sourcing decisions when justified. Given the important role of attention, future studies are needed to determine how the framing effect on sourcing decisions will evolve when managers’ attention to information is manipulated.

Note

1. Details about the crowdsourcing platform is available at: <https://prolific.co/#check-sample>

References

- Alicke, K. and Strigel, A. (2020), “Supply chain risk management is back”, *McKinsey & Company*, Vol. 1 No. 1, pp. 1-9.
- Armel, K. C., Beaumel, A. and Rangel, A. (2008), “Biasing simple choices by manipulating relative visual attention”, *Judgment and Decision Making*, Vol. 3 No. 5, pp. 396-403.
- Balachandran, K.R. and Radhakrishnan, S. (2005), “Quality implications of warranties in a supply chain”, *Management Science*, Vol. 51 No. 8, pp. 1266-1277.

- Banaeian, N., Mobli, H., Fahimnia, B., Nielsen, I.E. and Omid, M. (2018), "Green supplier selection using fuzzy group decision making methods: a case study from the agri-food industry", *Computers and Operations Research*, Vol. 89, pp. 337-347, doi: [10.1016/j.cor.2016.02.015](https://doi.org/10.1016/j.cor.2016.02.015).
- Becker-Peth, M., Thonemann, U.W. and Gully, T. (2018), "A note on the risk aversion of informed newsvendors", *Journal of the Operational Research Society*, Vol. 69 No. 7, pp. 1135-1145, doi: [10.1080/01605682.2017.1390525](https://doi.org/10.1080/01605682.2017.1390525).
- Bott, N.T., Lange, A., Rentz, D., Buffalo, E., Clopton, P. and Zola, S. (2017), "Web camera based eye tracking to assess visual memory on a visual paired comparison task", *Frontiers in Neuroscience*, Vol. 11, p. 370, doi: [10.3389/fnins.2017.00370](https://doi.org/10.3389/fnins.2017.00370).
- Bozkurt, S. and Gligor, D. (2021), "Distinguishing between the impact of social media public and private compliments on customers' future service recovery expectations", *Journal of Retailing and Consumer Services*, Vol. 60, 102448.
- Bulter, A. (2020), "Supplier quality problems during a global pandemic", *Manufacturing Business Technology*, available at: <https://www.mbtmag.com/quality-control/article/21132550/supplier-quality-during-a-major-supply-chain-disruption-like-covid19>
- Cachon, G.P., Terwiesch, C. and Xu, Y. (2008), "On the effects of consumer search and firm entry in a multiproduct competitive market", *Marketing Science*, Vol. 27 No. 3, pp. 461-473.
- Canbolat, Y.B., Gupta, G., Matera, S. and Chelst, K. (2008), "Analysing risk in sourcing design and manufacture of components and sub-systems to emerging markets", *International Journal of Production Research*, Vol. 46 No. 18, pp. 5145-5164.
- Chen, J. and Guo, Z. (2014), "Strategic sourcing in the presence of uncertain supply and retail competition", *Production and Operations Management*, Vol. 23 No. 10, pp. 1748-1760.
- Dabholkar, P.A. (1994), "Incorporating choice into an attitudinal framework: analyzing models of mental comparison processes", *Journal of Consumer Research*, Vol. 21 No. 1, pp. 100-118.
- De Boer, L., Labro, E. and Morlacchi, P. (2001), "A review of methods supporting supplier selection", *European Journal of Purchasing and Supply Management*, Vol. 7 No. 2, pp. 75-89, doi: [10.1016/S0969-7012\(00\)00028-9](https://doi.org/10.1016/S0969-7012(00)00028-9).
- Deng, S.J. and Elmaghraby, W. (2005), "Supplier selection via tournaments", *Production and Operations Management*, Vol. 14 No. 2, pp. 252-267, doi: [10.1111/j.1937-5956.2005.tb00022.x](https://doi.org/10.1111/j.1937-5956.2005.tb00022.x).
- Donohue, K. and Schultz, K. (2018), "The future is bright: recent trends and emerging topics in behavioral operations", *The Handbook of Behavioral Operations*, pp. 619-651.
- Fahimnia, B., Pournader, M., Siemsen, E., Bendoly, E. and Wang, C. (2019), "Behavioral operations and supply chain management—A review and literature mapping", *Decision Sciences*, Vol. 50 No. 6, pp. 1127-1183, doi: [10.1111/deci.12369](https://doi.org/10.1111/deci.12369).
- Fazio, M., Reitano, A. and Loizzo, M.R. (2021), "Consumer preferences for new products: eye tracking experiment on labels and packaging for olive oil based dressing", *Proceedings*, Vol. 70, p. 59, doi: [10.3390/foods_2020-08124](https://doi.org/10.3390/foods_2020-08124).
- Federico, G., Ferrante, D., Marcatto, F. and Brandimonte, M.A. (2021), "How the fear of COVID-19 changed the way we look at human faces", *PeerJ*, Vol. 9, Article e11380.
- Fortune Business Insights (2021), "Essential oils market size, share and COVID-19 impact analysis and regional forecast, 2021-2028", available at: <https://www.fortunebusinessinsights.com/industry-reports/essential-oils-market-101063>
- Fortune Business Insights (2022), "Perfume market size, share and COVID-19 impact analysis and regional forecast, 2021-2028", available at: <https://www.fortunebusinessinsights.com/perfume-market-102273>
- Golgeci, I., Ali, I., Bozkurt, S., Gligor, D.M. and Arslan, A. (2022), "The impact of corporate support programs on environmental and social innovation: empirical insights from the food and beverage industry", *International Journal of Operations and Production Management*, Vol. 42 No. 7, pp. 898-929.
- Gupta, V. and Ivanov, D. (2020), "Dual sourcing under supply disruption with risk-averse suppliers in the sharing economy", *International Journal of Production Research*, Vol. 58 No. 1, pp. 291-307.

-
- Ha, A.Y. and Tang, C.S. (2017), *Handbook of Information Exchange in Supply Chain Management*, Springer.
- Hamdi, F., Ghorbel, A., Masmoudi, F. and Dupont, L. (2018), "Optimization of a supply portfolio in the context of supply chain risk management: literature review", *Journal of Intelligent Manufacturing*, Vol. 29, pp. 763-788.
- Jain, G., Gaeth, G.J., Nayakankuppam, D. and Levin, I.P. (2020), "Revisiting attribute framing: the impact of number roundedness on framing", *Organizational Behavior and Human Decision Processes*, Vol. 161, pp. 109-119, doi: [10.1016/j.jobhdp.2020.04.006](https://doi.org/10.1016/j.jobhdp.2020.04.006).
- Kahneman, D. (2011), *Thinking, Fast and Slow*, Macmillan, New York.
- Kaufmann, L., Meschnig, G. and Reimann, F. (2014), "Rational and intuitive decision-making in sourcing teams: effects on decision outcomes", *Journal of Purchasing and Supply Management*, Vol. 20 No. 2, pp. 104-112, doi: [10.1016/j.pursup.2014.03.003](https://doi.org/10.1016/j.pursup.2014.03.003).
- Keren (2011), "Perspectives on framing", Keren, G. (Ed.), *On the Definition and Possible Underpinnings of Framing Effects: A Brief Review and a Critical Evaluation*, Psychology Press, New York, pp. 3-33.
- Kim, J., Thomas, P., Sankaranarayana, R., Gedeon, T. and Yoon, H.J. (2015), "Eye-tracking analysis of user behavior and performance in web search on large and small screens", *Journal of the Association for Information Science and Technology*, Vol. 66 No. 3, pp. 526-544, doi: [10.1002/asi.23187](https://doi.org/10.1002/asi.23187).
- Krajbich, I., Armel, C. and Rangel, A. (2010), "Visual fixations and the computation and comparison of value in simple choice", *Nature Neuroscience*, Vol. 13 No. 10, pp. 1292-1298.
- Krajbich, I., Lu, D., Camerer, C. and Rangel, A. (2012), "The attentional drift-diffusion model extends to simple purchasing decisions", *Frontiers in Psychology*, Vol. 3, pp. 1-18, doi: [10.3389/fpsyg.2012.00193](https://doi.org/10.3389/fpsyg.2012.00193).
- Krause, D.R., Handfield, R.B. and Tyler, B.B. (2007), "The relationships between supplier development, commitment, social capital accumulation and performance improvement", *Journal of Operations Management*, Vol. 25 No. 2, pp. 528-545, doi: [10.1016/j.jom.2006.05.007](https://doi.org/10.1016/j.jom.2006.05.007).
- Kreiner, H. and Gamliel, E. (2018), "The role of attention in attribute framing", *Journal of Behavioral Decision Making*, Vol. 31 No. 3, pp. 392-401.
- Kreiner, H. and Gamliel, E. (2019), "'Alive' or 'not dead': the contribution of descriptors to attribute-framing bias", *Quarterly Journal of Experimental Psychology*, Vol. 72 No. 12, pp. 2776-2787.
- Kunar, M.A., Watson, D.G., Tsetsos, K. and Chater, N. (2017), "The influence of attention on value integration", *Attention, Perception and Psychophysics*, Vol. 79, pp. 1615-1627.
- Lee, J. and Kwon, K.H. (2022), "The significant value of sustainable cosmetics fragrance in the spotlight after COVID-19", *Journal of Cosmetic Dermatology*, Vol. 21 No. 12, pp. 6540-6548.
- Levin, I.P. and Gaeth, G.J. (1988), "How consumers are affected by the framing of attribute information before and after consuming the product", *Journal of Consumer Research*, Vol. 15 No. 3, pp. 374-378.
- Levin, I.P., Schneider, S.L. and Gaeth, G.J. (1998), "All frames are not created equal: a typology and critical analysis of framing effects", *Organizational Behavior and Human Decision Processes*, Vol. 76 No. 2, pp. 149-188, doi: [10.1006/obhd.1998.2804](https://doi.org/10.1006/obhd.1998.2804).
- Li, G., Zhang, X., Chiu, S.-M., Liu, M. and Sethi, S.P. (2019), "Online market entry and channel sharing strategy with direct selling diseconomies in the sharing economy era", *International Journal of Production Economics*, Vol. 218, pp. 135-147.
- Loch, C.H. (2017), "Creativity and risk taking aren't rational: behavioral operations in MOT", *Production and Operations Management*, Vol. 26 No. 4, pp. 591-604, doi: [10.1111/poms.12666](https://doi.org/10.1111/poms.12666).
- Louviere, J.J., Hensher, D.A. and Swait, J.D. (2000), *Stated Choice Methods: Analysis and Applications*, Cambridge University Press, Cambridge.

- Mira, N. (2022), "European cosmetics manufacturers facing new sourcing crisis", *Reuters*, available at: <https://www.fashionnetwork.com/news/European-cosmetics-manufacturers-facing-new-sourcing-crisis,1397069.html>
- Niu, B., Li, J., Zhang, J., Cheng, H.K. and Tan, Y. (2019), "Strategic analysis of dual sourcing and dual channel with an unreliable alternative supplier", *Production and Operations Management*, Vol. 28 No. 3, pp. 570-587.
- Perera, H.N., Fahimnia, B. and Tokar, T. (2020), "Inventory and ordering decisions: a systematic review on research driven through behavioral experiments", *International Journal of Operations and Production Management*, Vol. 40 Nos 7/8, pp. 997-1039.
- Pournader, M., Kach, A. and Talluri, S. (2020), "A review of the existing and emerging topics in the supply chain risk management literature", *Decision Sciences*, Vol. 51 No. 4, pp. 867-919, doi: [10.1111/deci.12470](https://doi.org/10.1111/deci.12470).
- Preacher, K. and Hayes, A. (2009), "SPSS and SAS macro for bootstrapping specific indirect effects in multiple mediation models", In: Retrieved.
- Quigley, J., Walls, L., Demirel, G., MacCarthy, B.L. and Parsa, M. (2018), "Supplier quality improvement: the value of information under uncertainty", *European Journal of Operational Research*, Vol. 264 No. 3, pp. 932-947, doi: [10.1016/j.ejor.2017.05.044](https://doi.org/10.1016/j.ejor.2017.05.044).
- Rijkema, W.A., Rossi, R. and van der Vorst, J.G.A.J. (2014), "Effective sourcing strategies for perishable product supply chains", *International Journal of Physical Distribution and Logistics Management*, Vol. 44 No. 6, pp. 494-510, doi: [10.1108/IJPDLM-01-2013-0013](https://doi.org/10.1108/IJPDLM-01-2013-0013).
- Rungtusanatham, M., Wallin, C. and Eckerd, S. (2011), "The vignette in a scenario-based role-playing experiment", *Journal of Supply Chain Management*, Vol. 47 No. 3, pp. 9-16.
- Semmelmann, K. and Weigelt, S. (2018), "Online webcam-based eye tracking in cognitive science: a first look", *Behavior Research Methods*, Vol. 50 No. 2, pp. 451-465, doi: [10.3758/s13428-017-0913-7](https://doi.org/10.3758/s13428-017-0913-7).
- Seo, Y.N., Kim, M., Lee, D. and Jung, Y. (2018), "Attention to eSports advertisement: effects of ad animation and in-game dynamics on viewers' visual attention", *Behaviour and Information Technology*, Vol. 37 No. 12, pp. 1194-1202.
- Shih, W.C. (2020), "Global supply chain in a post-pandemic world", *Harvard Business Review*, available at: <https://hbr.org/2020/09/global-supply-chains-in-a-post-pandemic-world>
- Shin, H., Benton, W.C. and Jun, M. (2009), "Quantifying suppliers' product quality and delivery performance: a sourcing policy decision model", *Computers and Operations Research*, Vol. 36 No. 8, pp. 2462-2471.
- Spencer, M., Za, V. and Zecchini, F. (2022) "European cosmetics makers face supply crisis amid scarcity of Ukraine resources", *Reuters*, available at: <https://www.reuters.com/business/european-cosmetics-makers-face-supply-crisis-amid-scarcity-ukraine-resources-2022-04-12/>
- Sureeyatanapas, P., Sriwattananusart, K., Niyamosoth, T., Sessomboon, W. and Arunyanart, S. (2018), "Supplier selection towards uncertain and unavailable information: An extension of TOPSIS method", *Operations Research Perspectives*, Vol. 5, pp. 69-79, doi: [10.1016/j.orp.2018.01.005](https://doi.org/10.1016/j.orp.2018.01.005).
- Surugue, L. (2019), "The perfume industry is moving towards sustainable fragrances", *Euronews*, available at: <https://www.euronews.com/green/2019/04/04/the-perfume-industry-is-moving-towards-sustainable-fragrances>
- Tavares, G., Perona, P. and Rangel, A. (2017), "The attentional drift diffusion model of simple perceptual decision-making", *Frontiers in Neuroscience*, Vol. 11, p. 468, doi: [10.3389/fnins.2017.00468](https://doi.org/10.3389/fnins.2017.00468).
- Teigen, K.H. (2015), "Framing of numerical quantities", *Blackwell Handbook of Judgment and Decision Making: An Interdisciplinary Perspective*, Blackwell, Oxford.
- Thomas, S.P., Thomas, R.W., Manrodt, K.B. and Rutner, S.M. (2013), "An experimental test of negotiation strategy effects on knowledge sharing intentions in buyer-supplier relationships", *Journal of Supply Chain Management*, Vol. 49 No. 2, pp. 96-113.

-
- Tokar, T., Aloysius, J., Waller, M. and Hawkins, D.L. (2016), "Exploring framing effects in inventory control decisions: violations of procedure invariance", *Production and Operations Management*, Vol. 25 No. 2, pp. 306-329, doi: [10.1111/poms.12430](https://doi.org/10.1111/poms.12430).
- Tse, Y.K. and Tan, K.H. (2011), "Managing product quality risk and visibility in multi-tier global supply chain", *International Journal of Product Research*, Vol. 49 No. 1, pp. 139-158.
- Tse, Y.K. and Tan, K.H. (2012), "Managing product quality risk and visibility in multi-layer supply chain", *International Journal of Product Economics*, Vol. 139, pp. 49-57.
- van Hoek, R. (2020), "Research opportunities for a more resilient post-COVID-19 supply chain – closing the gap between research findings and industry practice", *International Journal of Operations and Production Management*, Vol. 40 No. 4, pp. 341-355.
- Vulser, N. (2014), "Perfume manufacturers must cope with the scarcity of precious supplies", *The Guardian*, available at: <https://www.theguardian.com/business/2014/mar/04/chanel-perfume-legislation-guerlain-loreal> (accessed 4 March 2014).
- Wong, R.S. (2021), "An alternative explanation for attribute framing and spillover effects in multidimensional supplier evaluation and supplier termination: focusing on asymmetries in attention", *Decision Sciences*, Vol. 52 No. 1, pp. 262-282, doi: [10.1111/dec.12435](https://doi.org/10.1111/dec.12435).
- Wu, J., Zhai, X., Zhang, C. and Liu, X. (2011), "Sharing quality information in a dual-supplier network: a game theoretic perspective", *International Journal of Production Research*, Vol. 49 No. 1, pp. 199-214.
- Yang, X. and Krajbich, I. (2021), "Webcam-based online eye-tracking for behavioral research", *Judgment and Decision Making*, Vol. 16 No. 6, pp. 1485-1505, available at: <https://journal.sjdm.org/21/210525/jdm210525.pdf>

Further reading

- Donohue, K., Özer, Ö. and Zheng, Y. (2020), "Behavioral operations: past, present, and future", *Manufacturing and Service Operations Management*, Vol. 22 No. 1, pp. 191-202, doi: [10.1287/msom.2019.0828](https://doi.org/10.1287/msom.2019.0828).
- Fiedler, S. and Glöckner, A. (2012), "The dynamics of decision making in risky choice: an eye-tracking analysis", *Frontiers in Psychology*, Vol. 3, p. 335, doi: [10.3389/fpsyg.2012.00335](https://doi.org/10.3389/fpsyg.2012.00335).
- Lewandowska, B. (2019), "RealEye eye-tracking system technology whitepaper", available at: <https://support.realeye.io/realeye-accuracy/>
- Wisiecka, K., Krejtz, K., Krejtz, I., Sromek, D., Cellary, A., Lewandowska, B. and Duchowski, A.T. (2022), "Comparison of webcam and remote eye tracking", *Symposium on Eye Tracking Research and Applications*. doi: [10.1145/3517031.3529615](https://doi.org/10.1145/3517031.3529615).

Supplemental material online

The supplementary material for this article can be found online.

About the author

Ricky S. Wong (PhD, 2007, London School of Economics and Political Science) is a Principal Lecturer at University of Hertfordshire. His research interests are negotiation theory, psychology of judgement and decision-making and supplier evaluation and selection. Ricky S. Wong can be contacted at: r.wong3@herts.ac.uk

For instructions on how to order reprints of this article, please visit our website:

www.emeraldgrouppublishing.com/licensing/reprints.htm

Or contact us for further details: permissions@emeraldinsight.com