Technology-mediated scarcity messages: A systematic literature review

Abstract:

Purpose: Technology-mediated scarcity messages (TMSM) are increasingly used in the online marketplace to nudge purchases. Research looking into TMSM has picked up considerable momentum but is conceptually fragmented with inconsistent findings. This article therefore reports a systematic review of the TMSM literature, to contribute to a comprehensive understanding of this digital marketing concept.

Design/Methodology/Approach: The review included 78 articles, which were subjected to qualitative analysis.

Findings: The review led to the development of an integrated conceptual framework and a TMSM typology.

Research limitations/implications: Several new avenues are identified to extend the theoretical and methodological scope of TMSM research.

Practical implications: The review offers guidance to marketers on how to better use TMSM.

Originality: The review advances digital marketing research by uncovering a friction between marketers' interest in conversion and consumers' priority of well-being. It sheds light on the dark side of TMSM, i.e., that it can exacerbate impulse buying.

Keywords: digital marketing; digital nudges; impulse buying; impulsive purchases; online consumer behavior; online scarcity promotions; scarcity cues; technology-mediated scarcity messages; systematic literature review.

Article Classification: Literature Review

Introduction

Scarcity marketing is crucial for e-commerce conversions. As over 60% of consumer journeys start online with email click-throughs or visits to Amazon (Kerrigan, 2020), technology-mediated scarcity messages (TMSM) are increasingly used to make products and services stand out in the crowded electronic marketplace (Cremer, 2018; Sun et al., 2022). These attention-grabbing promotional cues are presented to consumers through the internet, mobile apps, and emails to highlight shortages and increase perceived value, ultimately aiming to nudge purchases (Gierl et al., 2008). It is no coincidence that more than one-third of products on Amazon can come with TMSM at a given point in time (Kordrostami et al., 2022). Predictably, research looking into TMSM has picked up considerable momentum in the last decade. However, it is conceptually fragmented, leaving its outcomes unclear for consumers and firms.

Scarcity messages, whether offline or technology-mediated, leverage similar psychological techniques to signal limited availability and drive demand. Both share theoretical foundations such as commodity theory (Lynn, 1991) and psychological reactance theory (Brehm, 1966). Nonetheless, TMSM, as opposed to scarcity messages in general, deserve dedicated scholarly attention because their effects on contemporary consumer behavior cannot be explained solely based on the traditional scarcity literature.

TMSM are different from offline scarcity messages in four major ways. First, offline scarcity messages are tangible, localized, reliant on salesforce engagement, and constrained by space (Parker and Lehmann, 2011). In contrast, TMSM's accessibility via the internet expands its reach to a wider audience. Second, unlike offline scarcity messages, TMSM can be algorithmically adapted and personalized (Koch, 2015). Hence, TMSM create deeper involvement in the consumer journey compared with offline scarcity messages (Hult et al., 2019; Ju and Ahn, 2016). Third, TMSM are not encountered in isolation but in conjunction

with other online marketing cues and electronic word-of-mouth (eWOM) about products, services and brands (Kordrostami et al., 2022). This abundance of information, not usually available with offline scarcity messages, may overwhelm consumers and complicate their decision-making when exposed to TMSM. Fourth, compared with offline scarcity messages, TMSM are viewed by consumers with greater skepticism, as they are often perceived as a manipulative sales tactic (Hmurovic et al., 2023). Given these differences, TMSM and offline scarcity messages are unlikely to have identical consequences.

Although interest in TMSM research is burgeoning, empirical studies have resulted in inconclusive findings. For example, some found limited-quantity TMSM, such as "only 15 items left in stock," to be more effective than limited-time TMSM, such as "available for only 15 days" (Cremer, 2018). Others found the converse to be true (Banerjee and Pal, 2020; Koh and Seah, 2023). Yet some studies reported no difference between the use of limited-quantity and limited-time TMSM (Li et al., 2023). Again, some found demand-framed TMSM, such as "in high demand," to result in higher purchase intention than supply-framed TMSM, such as "in limited supply" (Huang et al., 2020), whereas others discovered the opposite effect (Kim et al., 2020a). Recognizing the need to synthesize the empirical evidence, this article reports a systematic review of the TMSM literature.

A potential explanation for the inconclusive findings lies in the disparate and fragmented conceptualizations of the ways TMSM shape consumer behavior. While some studies focused on behavioral outcomes (Drossos et al., 2019), others only considered consumer perceptions and intentions (Huang et al., 2020). Hence, it is important to bring current conceptualizations together into an integrated framework, which can provide greater clarity regarding mediators, moderators, and outcomes of TMSM. To understand the status quo of TMSM research holistically, our first research question is:

RQ 1: How is the influence of TMSM on consumer behavior conceptualized?

Moreover, the literature seems to lack a coherent typology of TMSM. Some studies examined TMSM such as "this wine is very unique and rare" (Bozkurt and Gligor, 2019). Others investigated annotations such as "this product has been purchased 11 times in the last 24 hours" (Drossos et al., 2019), and "95% of the hotels similar to this hotel in the city have been booked for your dates" (Song et al., 2019b). As technology has amplified the possible shapes that scarcity messages can take, it is necessary to capture all TMSM types within an encompassing typology. Thus, we investigate the following research question:

RQ 2: What are the different types of TMSM studied in the literature?

Furthermore, it is necessary to analyze the methodological approaches employed in the TMSM literature, as equivocality might well be an inadvertent consequence of methodological idiosyncrasies in the field. Therefore, our final research question is:

RQ 3: What are the methodological trends in TMSM research?

This review differs from others on related topics. For example, Chan et al. (2017) and Paul et al. (2022) reviewed online impulse buying and the urge to buy, respectively, which are highlighted as consequences of scarcity. However, they did not focus attention on TMSM. Shi et al. (2020) reviewed the scarcity literature from 1970 to 2017. Similarly, Barton et al. (2022) reviewed scarcity-related articles published over 50 years, but included only one article from 2020. In contrast, this review specifically focuses on TMSM studies published until December 2023 and incorporates several articles not considered by Shi et al. (2020) or Barton et al. (2022).

The review makes several contributions. For one, while the idea of scarcity has existed for decades, it specifically brings technology-mediated scarcity into prominence. The exclusive focus on TMSM is in line with Barton et al.'s (2022) call for a better understanding of how the digital retail environment affects the effectiveness of scarcity marketing. Moreover, the review develops a TMSM typology that could enable digital marketers to

revisit their scarcity messaging tactics. The typology provides them with a consistent framework to analyze what works and what flounders in specific contexts. Furthermore, the review highlights the potential downsides of TMSM, such as their ability to encourage impulse buying. It advances digital marketing research by uncovering a friction between marketers' interest in conversion and consumers' priority of well-being. Overall, the findings of this review offer a strong foundation for future research in the field and a roadmap for digital marketing practitioners to effectively implement TMSM.

Methodology

Literature search

The literature search was conducted on Scopus, a meta-database that indexes articles from all major academic databases and disciplines (Lee et al., 2022; Mirbabaie et al., 2022). Such a meta-database was preferred to individual databases, such as ScienceDirect or SpringerLink, for two reasons. First, searching a meta-database obviates the need to search other databases separately, as the latter would only yield duplicates (Banerjee, 2021; Lee et al., 2022). Second, as databases vary in terms of their algorithms and search functionalities, conducting the literature search on a single meta-database ensures greater consistency, replicability, and transparency (Priharsari et al., 2020).

Specifically, Scopus was chosen for its greater comprehensiveness compared with competitors such as Web of Science (Verma and Yadav, 2021; Zhu and Liu, 2020). Moreover, it imposes stringent quality criteria for indexation. Hence, articles retrieved through Scopus must have undergone a rigorous peer-review process (Donthu et al., 2021). As expected, recent reviews have relied solely on Scopus to retrieve articles (Abedin, 2022; Stocchi et al., 2022; Verma and Yadav, 2021).

To develop the literature search protocol, several pilot searches were conducted. Queries such as ("scarcity cue" OR "scarcity message" OR "scarcity marketing") AND (online OR digital OR e-commerce), when applied to titles, abstracts, and keywords, failed to return a large enough initial pool of articles. Search phrases such as "online scarcity message" and "online scarcity cue" were also explored. Including the word "online" turned out to be overly restrictive. Furthermore, applying the search solely to titles, abstracts and keywords eliminated several seemingly relevant articles.

Hence, to ensure comprehensiveness, the query "scarcity cue" OR "scarcity message" OR "scarcity marketing" was applied to all fields for the final search. This returned 607 articles. Exclusion criteria included outputs not in English as well as publication types such as books, conceptual articles, editorials and reviews. The remaining 540 articles were admitted for literature screening.

Literature screening and cross-referencing

The inclusion criterion was that articles must report empirical work with TMSM as a focal concept. This was applied through a two-step literature screening process. In the first step, the title and the abstract of each article were read to assess their relevance. Those clearly unrelated were removed. In the second step, the relevance of the remaining 158 articles was assessed through full-text screening. It emerged that several articles did not explicitly clarify their focus on TMSM. For example, in Jang et al. (2015), whether the focus was on offline scarcity messages or TMSM remains fuzzy. All such instances were eliminated, leaving 67 articles for inclusion.

To complement the search results, backward and forward citation searches were carried out. This cross-referencing helped identify more potentially relevant articles, which

underwent the same screening steps outlined earlier. It resulted in 11 additional articles. Figure 1 depicts the literature identification process.

[Insert Figure 1 here]

Literature coding and analysis

Each of the 78 articles in the sample was read to identify excerpts related to the following: objectives, theoretical underpinnings, site of data collection, study context, methods, and findings. These excerpts were then subjected to qualitative analysis.

An iterative approach was adopted, following guidelines on thematic synthesis for systematic reviews (Thomas and Harden, 2008; Webster and Watson, 2002). The analysis was first done by two of the authors independently. This constituted inductive coding. Descriptive themes were developed based on the inductive codes. These were then synthesized to generate higher-level themes to structure the field of TMSM research. Inter-relationships among the themes were identified next. Throughout this process, inconsistencies were resolved through discussion and cross-checked by another author, resulting in the final findings presented below.

Findings

While the first TMSM article appeared in 2012, the majority were published over the last five years. The outlets cover several disciplines. They range from general management journals, such as *Journal of Business Research* (Bozkurt and Gligor, 2019), and marketing journals, such as *Journal of Interactive Marketing* (Koch and Benlian, 2015b), to sector journals, such as *International Journal of Contemporary Hospitality Management* (Chung et al., 2017), and economics and policy-oriented journals, such as *Information Economics and Policy* (Courty and Ozel, 2019). This shows that TMSM research has widespread appeal. The

Appendix summarizes the articles in the sample. Table 1 presents the theoretical lenses and the variables studied in these articles.

[Insert Table 1 here]

Conceptualizing TMSM's influence on consumer behavior (RQ 1)

How the exposure to TMSM and the types of TMSM could optimize firms' marketing outcomes emerged as the central phenomenon of interest in the literature. This focal phenomenon was found to have been approached in five different ways.

First, some studies examined the relationship between TMSM exposure/type and consumer perceptions (coded as 'TMSM exposure/type-perception'). The perceptions studied in the literature could be grouped into three themes: perceptions about TMSM, such as perceived falsity (Lee et al., 2018); perceptions about products/brands, such as perceived quality as inferred from TMSM (Hmurovic et al., 2023); and emotions, such as hope that could be triggered by TMSM (Trivedi et al., 2023).

Second, some studies examined the relationship between TMSM exposure/type and consumer intentions (coded as 'TMSM exposure/type-intention'). Purchase intention remains one of the most widely studied intentions. Many of these studies on purchase intention examined perception-related mediators ranging from perceived quality (He and Oppewal, 2018) to perceived falsity (Lee et al., 2018). Other intentions that have received scholarly attention include willingness to pay (Kim et al., 2020a) and willingness to recommend (Song et al., 2019a).

Third, some studies examined the relationship between TMSM exposure/type and actual behavioral outcomes (coded as 'TMSM exposure/type-behavior'). Examples of behavioral variables studied include adding to cart or click-throughs (Drossos et al., 2019),

impulse buying (Wu et al., 2021), the number of recommendations (Song et al., 2019a), and purchase quantity/sales (Park et al., 2020).

Fourth, some studies examined how TMSM exposure/type interacts with other moderating variables (coded as 'TMSM's boundary conditions'). The moderators were categorized as marketing or consumer factors. Marketing-related moderators include brand reputation (Lee et al., 2014), decision reversibility (Lee et al., 2018), product type (Mou and Shin, 2018), and TMSM platform characteristics, such as the availability of product video (Gupta et al., 2023) or anchor competence in livestream commerce (Chen and Zhang, 2023). In contrast, examples of consumer-related moderators include cognitive resources utilized in the purchase process (Lee et al., 2014), consumer culture (Broeder and Wentink, 2022), consumer location (Sun et al., 2022), and a variety of individual differences (Abbott et al., 2023).

Finally, only two studies employed eye-tracking (Mou and Shin, 2018; Yi et al., 2023) to examine the degree to which TMSM attract visual attention (coded as 'TMSM's visual attention'). To understand the captivating power of TMSM, they analyzed fixation counts and durations.

To integrate these five approaches into a coherent whole, we propose a 'TMSM exposure/type-perception-intention-behavior' framework with marketing and consumer factors as moderators (Figure 2). The 'perception-intention-behavior' sequence is informed by well-established theories such as the technology acceptance model (Davis et al., 1989) and the theory of planned behavior (Ajzen, 1991). In the integrated conceptualization, perception-related variables include both self-reported measures and objective measures, such as visual attention. Like self-reported perceptions, visual attention is also known to shape behavioral intentions (Yi et al., 2023).

[Insert Figure 2 here]

Future research based on this integrated conceptualization could draw upon several theories. The likes of cueing theory (Coulter and Roggeveen, 2012) and psychological reactance theory (Chung et al., 2017) could be used to justify the importance of studying the impact of TMSM on consumers. Broadly, these theories explain how online cues that highlight scarcity entice individuals to react hastily. Theories could also be leveraged to justify the inclusion of specific variables in TMSM research. For example, cognitive dissonance theory, competitive arousal theory, regret theory, and regulatory focus theory have been used to justify the inclusion of the variables of cognitive dissonance (Kim et al., 2020a), arousal (Guo et al., 2017), anticipated regret (Luo et al., 2021), and regulatory focus (Das et al., 2018), respectively.

Having developed the integrated conceptualization, we made three major reflections. First, more efforts are needed to better understand various competing forces in TMSM research. For example, on the one hand, competitive arousal theory suggests that TMSM can give rise to positive affect among consumers (Ku et al., 2005). On the other hand, cognitive dissonance theory implies that TMSM can make the decision-making process challenging (Festinger, 1957). Such tensions have yet to be reconciled.

Second, several facets are noticeably absent from the integrated conceptualization. For example, how products with TMSM affect consumers' eWOM intentions/behaviors has not been studied. In the case of products sold with an open return policy, little is known about how TMSM shape variables such as willingness to return or undo purchases. The literature is also largely silent about how consumers' exposure to TMSM shapes their offline intentions/behaviors over time.

Third, the integrated conceptualization reveals that the focus is largely on the interests of marketers, while those of consumers tend to be overlooked. For example, Bozkurt and Gligor (2019) found that feelings of being rejected and ostracized make consumers

susceptible to TMSM. Hence, they recommended, "when a product is already promoted by a scarcity cue, marketers may consider inducing the feeling of social exclusion in their promotions or advertisements" (Bozkurt and Gligor, 2019, p. 279). Moreover, variables such as post-purchase satisfaction or willingness to make unplanned purchases, which have implications for consumer well-being, have not been widely studied. Little light has been shed on the possibility that TMSM may result in overconsumption and spendthrift tendencies. Future research needs to offer a more socially responsible perspective (Akareem et al., 2021), highlighting how TMSM can serve both marketers and consumers.

The research directions that emerge from the integrated conceptualization coupled with the authors' three-fold reflections mentioned above are discussed later as **Research Avenue 1** and **Research Avenue 2**. The former focuses on the use of TMSM to meet consumers' interests, while the latter takes a more holistic approach to serving marketers' purposes.

Types of TMSM (RQ 2)

The sample was also coded based on the types of TMSM studied, as stated in the articles. Limited-quantity and limited-time TMSM have been widely studied. The literature generally confirms both to be significant predictors of online purchases (Guo et al., 2017; Luo et al., 2021; Wu et al., 2021). However, a few studies found limited-quantity TMSM to be superior to limited-time TMSM (Cremer, 2018; Song et al., 2021). That said, boundary conditions need to be carefully considered. For example, according to Sun et al. (2022), limited-quantity TMSM were useful in encouraging smartphone users' purchase intentions when they were at home, but limited-time TMSM performed better when individuals were in stores. According to Banerjee and Pal (2020), limited-time TMSM worked better for luxury

hotels, a context that has not been studied in any other TMSM article. Thus, more replication efforts are needed.

Demand-framed and supply-framed TMSM have also been investigated, specifically in the hospitality context. According to Huang et al. (2020), demand-framed TMSM were more effective for restaurants. However, Kim et al. (2020a) found that consumers consider demand-framed TMSM for hotels to be more ambiguous compared with supply-framed TMSM. More research is needed to identify the conditions under which one works better than the other.

While the pairs of limited-quantity vs. limited-time and demand-framed vs. supply-framed TMSM have attracted substantial attention, we also identified several other types of TMSM, as evident from Table 2 (second column). Hence, we develop a typology to classify the TMSM types studied hitherto (Figure 3).

[Insert Table 2 and Figure 3 here]

Broadly, TMSM could be of two types: limited-quantity and limited-time. Limited-quantity TMSM could be either supply-framed or demand-framed. Limited-quantity TMSM due to supply-related factors are typically called limited-edition products (Wu and Lee, 2016). Consumers are informed in advance that these products will be sold in specific quantities. Limited-quantity TMSM due to demand-related factors are not set in advance but emerge naturally during the selling process due to consumer demand (Gierl et al., 2008; Shi et al., 2020). These could be either vague, such as "selling fast" (Moser et al., 2019), or specific (Sun et al., 2022).

Specific limited-quantity TMSM due to demand are widely used to reflect accurate inventory information, as in "only 5 left" (Peschel, 2021). They could also present real-time popularity information, also called social presence information, as in "10 people are watching this" (Ju and Ahn, 2016). Specific limited-quantity TMSM due to demand could further

appear in the form of unit scarcity or option scarcity (Song et al., 2019b). Unit scarcity cues are product-specific appeals (e.g., "90% of the rooms in this hotel are booked for your travel dates"), while option scarcity cues offer market-level information (e.g., 90% of similar hotels in the city are booked for your travel dates").

Both unit and option scarcity messages could be further divided into two categories: inventory-focused and popularity-focused. Inventory-based unit TMSM offer real-time stock information, such as "only 3 items left." Popularity-based unit TMSM highlight ongoing demand, as in "53 people looking at this deal" (Ju and Ahn, 2016; Moser et al., 2019). Likewise, inventory-based option TMSM offer market-level stock information, such as "3% of all beds in the city are available." Popularity-based option TMSM highlight market-level demand information, as in "3,472 people are looking for a place to stay in this city" (Teubner and Graul, 2020).

When it comes to limited-time TMSM, these could be either vague or specific. Vague limited-time TMSM do not specify the time limit, as in "40% off for a limited time" (Hmurovic et al., 2023). Specific limited-time TMSM, as the name suggests, specify the time limit, as in "offer ends in 20 min" (Song et al., 2021). Furthermore, these could be either static, such as "sale ends on June 20th" (Hmurovic et al., 2023), or dynamic, including real-time countdown timers to heighten the sense of urgency (Koh and Seah, 2023; Moser et al., 2019).

When the articles that considered TMSM types were examined through the lens of our proposed typology, we found a lack of consistent evidence. Two articles compared limited-edition TMSM and demand-framed vague TMSM. Specifically, Bozkurt and Gligor (2019) found limited-edition TMSM (e.g., "this wine is very unique and rare") to be more effective than demand-framed vague TMSM (e.g., "this wine is very popular among consumers"). Das

et al. (2018) showed that the effectiveness of limited-edition TMSM and demand-framed vague TMSM (e.g., "#1 Best Seller") was dependent on contextual nuances.

Besides, several articles have covered various types of TMSM but with little replication. For example, Drossos et al. (2019) studied demand-framed vague TMSM (e.g., "the product may be soon out of stock") along with unit popularity-focused TMSM (e.g., "this product has been purchased 11 times in the last 24 hours"). Ju and Ahn (2016) studied unit inventory-focused TMSM (e.g., "572 out of 1,000 bought") and unit popularity-focused TMSM (e.g., "there are 53 people looking at this deal"). Mou and Shin (2018) studied unit inventory-focused TMSM (e.g., "250 products in stock") and limited-time specific TMSM (e.g., "12 days left"). Song et al. (2019b) studied unit popularity-focused TMSM (e.g., "95% of the rooms in this hotel have been booked for your dates") and option popularity-focused TMSM (e.g., "95% of the hotels similar to this hotel in the city have been booked for your dates").

Overall, the understanding of how various types of TMSM affect consumer behavior differently remains largely unclear. The research directions that emerge from the typology are discussed later as **Research Avenue 3**, the exploration of which could be undergirded by the theory of message framing.

Methodological trends (RQ 3)

As shown in Table 2 (third column), most TMSM studies have been conducted in the US and China. A few articles examined cultural differences (e.g., Broeder and Wentink, 2022). It further emerged that several articles did not specify the country they investigated. Hospitality (hotels and restaurants) remains one of the most investigated contexts, as shown in Table 2 (fourth column). That said, several contextual nuances turned out to be conspicuous by their absence. For example, although TMSM have been studied in hospitality,

factors such as price discounts, eWOM, countdown timers, and personalization cues have been mostly overlooked.

As evident from Table 3, quantitative methodology dominates the TMSM research landscape. Experiments are most common, ranging from lab experiments (Guo et al., 2017) and online experiments (Ju and Ahn, 2016) to field experiments (Luo et al., 2019). Although field experiments are more powerful than simulated ones, access to data is one of their biggest impediments. Scholars could address this by collaborating with businesses to co-design research questions (Luo et al., 2019). Furthermore, in Lee et al.'s (2018) experiment, participants were given printouts of websites with TMSM, but such an approach raises questions about ecological validity. Eye-tracking research on TMSM remains relatively rare.

[Insert Table 3 here]

Among studies requiring data collection from participants, responses were received from student samples (Lee et al., 2018), the crowdsourcing platform Amazon Mechanical Turk (Song et al., 2020), as well as research panels such as Qualtrics (Sun et al., 2022) and Prolific (Teubner and Graul, 2020). In addition, some articles drew their data from undisclosed third-party data collection companies (Noone and Lin, 2020). While the sampling was mostly purposive, Peschel (2021) adopted quota sampling to ensure representativeness. Going forward, greater use of such sampling techniques would be insightful.

In the reviewed articles, methodological details were not always explicit. For example, in Das et al. (2018), it is not clear how participants recruited from Amazon Mechanical Turk in Study 1 were exposed to printed ads. Likewise, for Study 1 in Bozkurt and Gligor (2019), it is difficult to infer if the experiment was conducted in a laboratory setting or online. Such methodological fuzziness hinders replicability.

Moreover, qualitative TMSM research has been rare; the sample did not include any purely qualitative work. Only three mixed-methods articles were identified (Lamis et al., 2022; Moser et al., 2019; Teubner and Graul, 2020). That said, there was a distinct difference between quantitative TMSM research and the qualitative findings from the three mixed-methods articles. In quantitative TMSM research, the implicit assumption is that the more TMSM can trigger purchases, the better they are. This body of literature is predominantly geared toward serving marketers' interests.

In contrast, qualitative TMSM research reveals how consumers are pressurized by and wary of TMSM. This is evident from the following consumer quotes that appear in Moser et al. (2019): "I try to keep very little money on the card I use for online purchases," and "Staying off Amazon and Wish[.com] completely is my only chance [to protect myself from impulse purchases]." It is further reflected in the following quotes presented in Teubner and Graul (2020): "I would [book] just because it seems like I may not have many options if I waited too long," and "I never make any purchase in a hurry. If anyone tries to rush me, I view it as a red flag and leave." These convey how marketers' use of TMSM for the purpose of conversion takes a toll on consumer well-being: The friction between marketers' interest in conversion and consumers' priority of well-being is evident.

The observations related to the methodological trends in TMSM research give rise to **Research Avenue 4**, which is discussed later. Furthermore, we call for methodological diversification in exploring all the four proposed research avenues.

Discussion and recommendations for future research

We identify four research avenues, as shown in Table 4. The common thread that runs through each of them has to do with the ethics behind TMSM, which we argue should strike a better balance in meeting marketers' and consumers' interests.

[Insert Table 4 here]

Research Avenue 1: Using TMSM to meet consumers' interests

Impulsive personas are attractive to marketers, who use TMSM to latch on to their impulsivity and 'fear of missing out' (Chan et al., 2017; Wu et al., 2021). That said, this review uncovers friction between marketers' interest in conversion and consumers' priority of well-being: As evident from the integrated conceptualization, the variables studied in the existing TMSM literature tend to focus primarily on marketers' interests rather than consumer well-being.

To address this lopsidedness in the literature, TMSM research should engage with theories of consumer well-being to consider variables such as post-purchase satisfaction and happiness (Akareem et al., 2021). These could be measured not only after exposure to TMSM but also after the point of purchase decision-making, when individuals are likely to reconsider whether what they bought was actually a necessity. The outcome variable of purchase decision could be granularly teased out into planned and unplanned purchases to better understand the role of TMSM in triggering these two distinct buying behaviors. If such lines of inquiry confirm that TMSM take a toll on consumer well-being by making them susceptible to unplanned and impulse purchases, it would be a clear cue for marketers to use scarcity messaging more responsibly (Wrabel et al., 2022).

Additionally, the use of TMSM may make consumers frustrated, especially if they eventually recognize that such messages exacerbate impulse buying tendencies (Chan et al., 2017; Shi et al., 2020). However, the literature is silent on the ways in which consumers reconcile positive affect (e.g., pleasure) with negative affect (e.g., cognitive dissonance) while processing TMSM. Moreover, while current research implicitly assumes that consumers trust the authenticity of TMSM, this may not be the case (Hmurovic et al., 2023).

Individuals who are skeptical of TMSM could contribute to public criticisms and negative eWOM (Shi et al., 2020). However, such possibilities have yet to be investigated. These lines of inquiry could inform marketers of the need to enhance transparency around their use of TMSM. Greater transparency is likely to inspire confidence among consumers and might turn out to be a win-win solution for both marketers and consumers.

Research Avenue 2: Using TMSM to meet marketers' interests

To better serve the interests of marketers, the current set of outcome variables in TMSM research should be widened. For one, it should include eWOM intentions/behaviors. The volume and valence of eWOM can make or break the fate of firms through its effect on sales (Verma and Yadav, 2021), yet despite such immense business value, it is conspicuous by its absence as an outcome variable. Variables closest to eWOM that have been studied include the number of recommendations (Song et al., 2019a) and social sharing or online referrals (Koch, 2015). Future research could consider variables such as intention to create positive and negative eWOM after making TMSM-nudged purchases.

Furthermore, the outcome in TMSM research should encompass variables such as willingness to undo purchases when money-back is guaranteed. This is important because managers can choose to sell products and services with an open or a restrictive return policy (Lee et al., 2018). However, if TMSM with open return policies engender willingness to undo purchases too frequently, TMSM with a no-return policy would turn out to be administratively more viable and financially more profitable.

Moreover, as webrooming behaviors—the practice of exploring online but purchasing offline—continue to increase, there is a need to investigate how the influence of TMSM translates to the offline world. This is important to ensure a smooth consumer journey across offline and online settings (Xu et al., 2022). Few studies have gone beyond examining the

impact of TMSM on online perceptions and behaviors. A notable exception is Sun et al. (2022), which examined the effect of TMSM on smartphones as a function of consumers' location (at-home vs. in-store). More research along these lines would help elucidate how TMSM have a spillover effect on consumer behavior in the offline world and can provide directions for managers to effectively meet the needs of omnichannel shoppers.

Furthermore, TMSM research has been predominantly cross-sectional, with little longitudinal consideration. In consequence, how exposure to TMSM for a product/service at a given time affects subsequent behaviors in the consumer journey has remained overlooked. The role of TMSM in the evolution of brand loyalty and the development of repeat purchasing tendencies also needs further investigation.

Research Avenue 3: Demystifying the role of TMSM types

The proposed TMSM typology could serve as a guiding framework for future research. Thus far, some studies have examined limited-quantity demand-framed vague TMSM and unit popularity-focused TMSM (Drossos et al., 2019). Others have compared unit inventory-focused TMSM and unit popularity-focused TMSM (Ju and Ahn, 2016). Yet others have considered option inventory-focused TMSM and option popularity-focused TMSM (Teubner and Graul, 2020). Given the ad hoc focus of these studies, there is hardly any converging evidence in terms of TMSM types that consistently work well to promote conversions without jeopardizing consumer well-being. Unsurprisingly, recent research has called for a deeper understanding of how consumers respond to different types of scarcity cues (Barton et al., 2022).

Moreover, further research is needed to understand consumer behavior when multiple TMSM types co-exist. The presence of one type of TMSM does not necessarily rule out the presence of another. For example, it is possible for a consumer looking to book

accommodation to see unit inventory-focused TMSM (e.g., “Only 3 rooms left in this hotel”) along with option popularity-focused TMSM (e.g., “95% of the hotels similar to this hotel in the city have been booked for your dates”). However, there is little research on how such co-existing TMSM affect outcomes such as purchases. This gap needs plugging to better inform marketers of the combinations of TMSM types that are ideal for balancing marketers’ interest in conversion and consumers’ priority of well-being.

Research Avenue 4: Studying TMSM in light of contextual nuances

The effects of TMSM types should be studied in conjunction with other marketing mix elements like price (e.g., discounts) and promotion (e.g., eWOM). This is because consumers commonly view TMSM alongside such other cues rather than in isolation. Park et al. (2020) considered discounts, while Kordrostami et al. (2022) considered the volume and valence of online reviews in their studies of TMSM. However, the question of how various TMSM types combine with price discounts and eWOM to affect consumer behavior remains largely unaddressed.

Moreover, technology enables marketers to enhance the attractiveness of TMSM through personalization cues. However, their effects on consumer behavior have not been widely examined. Potential differences between personalized and non-personalized TMSM constitute an important area to explore when considering privacy-personalization tension. Furthermore, little is known about how perceptions and behaviors are shaped by the medium of exposure to TMSM—e-commerce platforms, mobile apps, and emails—and consumers’ location, such as indoors versus outdoors, or at-home versus in-store. Exploring how TMSM presentation nuances influence consumer behavior is crucial for optimizing its display. More research is needed on the role of TMSM in new e-commerce contexts such as livestream

commerce, virtual reality shopping, and marketing involving non-fungible tokens (Guo et al., 2023; Zhang and Phang, 2023).

Furthermore, only three of the reviewed articles considered consumers' cultural differences (Broeder and Wentink, 2022; Choi and Qu, 2023; Lee et al., 2015). Currently, there is insufficient evidence regarding aspects of TMSM that work in one country but fail in another. We, therefore, call for more cross-country and cross-cultural research on TMSM to cater to the needs of global brands. This is vital given the porousness of national and cultural boundaries in the realm of technology-mediated marketing.

A call for methodological diversification

In exploring these four research avenues, we call for a greater methodological diversity compared with extant research. Most articles hitherto have adopted positivist paradigms and undertaken quantitative research. Interpretive research—adopting qualitative approaches—could also be helpful to elucidate the sociocultural dynamics surrounding TMSM and their impact on consumer behavior. Beyond mainstream approaches like in-depth interviews and focus groups, emerging qualitative data collection techniques such as screencast videography could be explored. This approach can help better understand how consumers feel and react in real time when exposed to TMSM (Kawaf, 2019).

Among quantitative studies, while experimental research design has been quite common, more online field experiments would be useful to enhance ecological validity. Articles such as Luo et al. (2019), however, reveal that conducting online field experiments with rigor requires collaboration and data sharing between scholars and businesses. More academia-industry partnerships could be the way forward to bridge this data divide for field experiments with TMSM.

In addition, few eye-tracking studies have been conducted on TMSM. They analyzed variables such as fixation count and fixation duration but did not consider pupil dilation, an objective measure of arousal (Kreuzmair et al., 2017). Wu et al. (2021) measured perceived arousal using questionnaires, but the extent to which perceived arousal correlates with actual arousal—captured through eye-tracking—in response to TMSM remains unknown. More eye-tracking experiments that consider a wider array of variables from our integrated conceptualization would be helpful. Neuroimaging techniques could also provide more clarity on consumers' cognitive processes when exposed to TMSM.

In terms of sampling, most of the articles utilized student samples or respondents from third-party companies and research panels. Greater use of representative samples is recommended to specifically understand how consumers of a given culture respond to TMSM. Although the use of TMSM is a global phenomenon, consumers across the globe are unlikely to exhibit identical behaviors (Broeder and Wentink, 2022). On a related note, we found that some articles did not specify the country where the study was conducted or from which most participants came (e.g., Banerjee and Pal, 2020). Scholars are recommended to provide as much contextual and methodological detail as possible for better replicability.

Conclusions

To clarify the TMSM literature, this systematic review was guided by three research questions that focused on conceptualization (RQ 1), TMSM types (RQ 2), and methodological trends (RQ 3). With respect to RQ 1, an integrated conceptual framework was developed. Based on RQ 2, an encompassing TMSM typology was proposed. Regarding RQ 3, we identified a need for more attention to contextual nuances and greater methodological diversity in TMSM research. In interpreting the findings, however, the

limitation should be kept in mind that only English articles were included in the sample. This might have particularly affected the geographical spread of the studies.

Theoretical contributions

The review contributes to the literature in several ways. First, it is the earliest attempt to bring the concept of technology-mediated scarcity into prominence. The proposed integrated conceptualization of TMSM (Figure 2) is different from previous conceptualizations of general scarcity messages (Barton et al., 2022; Shi et al., 2020), which did not consider moderators such as personalization, mediators such as perceived TMSM falsity, or behavioral outcomes such as click-throughs—all of which are crucial for modern-day digital marketing. This reinforces our original premise that TMSM are different from offline scarcity cues and, hence, deserve dedicated scholarly attention.

Second, by proposing a new typology of TMSM (Figure 3), the review identifies a lack of coherence in the literature. Several TMSM types have been studied and compared arbitrarily (e.g., Drossos et al., 2019; Ju and Ahn, 2016; Teubner and Graul, 2020). This ad hoc and inconsistent focus, coupled with contextual nuances (e.g., country of investigation, study context), has led to the fragmented literature. The proposed typology could help steer the field in the right direction so that different types of TMSM could be compared more systematically.

Third, the review sheds light on the dark side of TMSM. It advances digital marketing research by uncovering the friction between marketers' interest in conversion and consumers' priority of well-being. The issue of transparency and ethics behind TMSM should play a central role in future research on this topic. Subsequent scholarly efforts on TMSM should not always be based on the implicit assumption that consumers automatically trust all TMSM to be authentic. More efforts should be made to balance marketers' and consumers' interests.

Otherwise, the growing use of artificial intelligence and advanced predictive analytics on individuals' online behavioral data can give rise to tailored—and almost manipulative—digital marketing stimuli, making consumers overly vulnerable to impulse buying, overconsumption, and spendthrift tendencies.

Practical implications

The review offers two implications for digital marketing practitioners. First, by organizing all the variables studied in the TMSM literature, our integrated conceptual framework can clarify how TMSM contribute to marketing objectives, aiding strategic decision-making. It provides marketers with a comprehensive set of consumer perceptions that explain the relationship between TMSM exposure and purchase behaviors. By understanding how TMSM function and interact with various marketing and consumer factors, efforts can be made to craft messages that enhance desirable perceptions, such as credibility and quality, but attenuate undesirable ones, such as risk and skepticism. In addition, the conceptual framework identifies several marketing and consumer factors that could act as boundary conditions. Such factors should be carefully considered when utilizing TMSM. Furthermore, our typology offers marketers a quiver of TMSM options to choose from. It also provides them with a consistent framework to analyze which TMSM type works and which flounders in specific contexts.

Second, digital marketers are advised to avoid being overly aggressive in using TMSM as a pressure tactic. This is because a few articles, using large-scale secondary data analyses, raised questions about the effectiveness of TMSM in the first place. For example, in the context of durable goods, Park et al. (2020) showed that disclosing scarcity messages to signal impending stockouts decreased daily sales. Even in the distinctly different 'non-durable' context of air travel where seats unsold on a given day are not possible to sell later,

Courty and Ozel (2019) showed that scarcity signals have negligible impact on revenues. Given the rising concerns around impulse buying triggered by TMSM, it is important for marketers to convey that they value consumer well-being. Hence, they could provide caution messages next to TMSM to help consumers self-regulate their impulsiveness. They also need to find ways to better highlight the authenticity of their TMSM to inspire confidence among consumers. These can foster additional benefits such as favorable brand attitudes, positive eWOM, repeat purchases, and loyal customers.

Overall, finding the right balance between conversion marketing and consumer well-being with respect to TMSM is not a simple puzzle to crack. Given the ethical dilemmas involved, we call for more efforts from both scholars and practitioners so that TMSM are optimally utilized to boost sales without jeopardizing the welfare of consumers.

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Table 1: Theoretical lenses employed and variables studied in TMSM research.

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
1. Abbott et al. (2023)	• Stimulus-Organism-Response (S-O-R) framework	Dark pattern stimuli including different types of scarcity message	Impulse buying	Big Five personality traits (openness, conscientiousness, extraversion, agreeableness, neuroticism)	N/A	N/A
2. Akram et al. (2018)	• Naive economic theory • Commodity theory • Psychological reactance theory • Need for uniqueness theory	Scarcity, serendipity	Impulse buying behavior	Social shopping, adventure shopping, value shopping, relaxation shopping, idea shopping	N/A	N/A
3. Akram et al. (2023)	• S-O-R framework • Motivation theory	Hedonic web browsing, utilitarian web browsing	Purchase intention	Perceived scarcity	N/A	N/A
4. Baek and Yoon (2020)	• Small-area hypothesis • Goal gradient theory	**Study 1**: Time urgency (high vs. low) **Study 2:** Time urgency (high vs. low)	**Study 1:** Purchase intention **Study 2**: Attitude toward the mobile reward app, brand attitude	**Study 1:** Goal progress framing (to-date vs. to-go) **Study 2**: Goal progress framing (to-date vs. to-go), progress level (high vs. low)	**Study 1:** Perceived goal importance **Study 2:** N/A	N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
5. Banerjee and Pal (2020)	Not specified	Type of scarcity message (limited quantity vs. limited time)	Booking intention	Purchase frequency (high vs. low)	N/A	N/A
6. Bozkurt and Gligor (2019)	• Need for uniqueness theory	**Study 1, 2:** Social exclusion (rejected vs. accepted customers)	**Study 1, 2:** Product choice	N/A	**Study 1, 2:** Need for uniqueness	N/A
7. Broeder and Wentink (2022)	• Competitive arousal theory • Hofstede's cultural dimensions	Limited-time scarcity (present vs. absent)	Purchase intention	Culture	Perceived scarcity, perceived competition	N/A
8. Chen and Yao (2018)	• S-O-R framework	Scarcity, discount as well as other website quality factors such as ease of use	Impulse buying behavior	N/A	Normative evaluation, positive affect	N/A
9. Chen and Zhang (2023)	• Yale model • Benefit-risk framework	Broadcaster competence, online crowding, information diagnosticity	Purchase intention	Perceived scarcity	Perceived price attractiveness, perceived uncertainty	Watch frequency, age, gender, education
10. Choi and Qu (2023)	• Commodity theory • Value-satisfaction-loyalty framework	Scarcity	Customer loyalty	N/A	Hedonic value, utilitarian value, urge to buy impulsively, customer satisfaction	Gender, age, education

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
11. Chung et al. (2017)	• Commodity theory • Need for uniqueness theory • Psychological reactance theory • Naïve economic theory • Process theory	Impulsiveness	Urge to buy impulsively	Perceived scarcity	Hedonic shopping value, utilitarian shopping value	N/A
12. Coulter and Roggeveen (2012)	• Cueing theory • Regret theory	**Study 1:** Purchase limit, time-to-expiration **Study 2:** Purchase limit, time-to-expiration	**Study 1:** Purchase likelihood **Study 2:** Purchase intention	**Study 1:** Buyer number **Study 2:** Buyer number	**Study 1:** N/A **Study 2:** Perceived value, regret	N/A
13. Courty and Ozel (2019)	• Commodity theory	Scarcity signals	Seller revenue, consumption	N/A	N/A	N/A
14. Cremer (2018)	• Framing theory • Theory of planned behavior	Scarcity signals	Sales quantity in a specific time frame	Product quality, time on market, price	N/A	Number of site visitors, observation time frame
15. Cremer and Loebbecke (2021)	• Commodity theory • Expectation disconfirmation theory	Scarcity signals	Sales quantity in a specific time frame	Stage in purchase process, availability of digital version, price discount of	N/A	Hour/day of the observation time window

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
	• Prospect theory			digital version, past quality perception, time since first launch, price, product type		
16. Das et al. (2018)	• Regulatory focus theory	**Study 1:** Limited-edition vs. best-seller	**Study 1:** Purchase intention	**Study 1:** Regulatory focus (promotion vs. prevention)	**Study 1:** N/A	N/A
		Study 2: Limited-edition vs. best-seller	**Study 2:** Purchase intention	**Study 2:** Product type (hedonic vs. utilitarian)	**Study 2:** N/A	
		Study 3: Limited-edition vs. best-seller	**Study 3:** Purchase intention	**Study 3:** Regulatory focus (promotion vs. prevention)	**Study 3:** Perceived risk, perceived uniqueness	
17. Drossos et al. (2019)	Not specified	Different traffic sources	Website conversion (adding to cart)	Persuasion technique (scarcity vs. social proof)	N/A	N/A
18. Eisenbeiss et al. (2015)	• Commodity theory • Unavailability theory	**Study 1:** Time constraint (high vs. low), discount level (high vs. low)	**Study 1:** Deal attractiveness	**Study 1:** Product type (hedonic vs. utilitarian)	N/A	**Study 1:** Deal proneness
		Study 2: Promotion		**Study 2:**		**Study 2:**

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
		duration, discount	**Study 2:** Sales	Product type (hedonic vs. utilitarian)		Soldout, weekday, month, year
19. Elisa et al. (2022)	• S-O-R framework	Scarcity cues	Impulse buying behavior	Social media use	Perceived value	N/A
20. Fogel and Setton (2022)	• Commodity theory	Different types of internet advertisements	Functional attitude, symbolic attitude, persuasion knowledge, advertising skepticism	N/A	N/A	Age, gender, race/ethnicity
21. Guo et al. (2017)	• S-O-R framework • Competitive arousal theory	Type of scarcity message (limited quantity vs. limited time)	Impulse buying behavior	N/A	Arousal	Age, gender, online shopping self-efficacy
22. Guo et al. (2023)	• Capability, Opportunity, Motivation – Behavior framework	Limited-quantity scarcity (high vs. low), cognitive involvement (high vs. low), affective involvement (high vs. low)	Online information search	Impulsiveness	N/A	Age, gender, purchase frequency
23. Gupta et al. (2023)	• Regulatory focus theory	Impulse buying, user satisfaction with app	Impulse buying behavior	Limited-quantity scarcity (present vs. absent), product video (present vs. absent)	N/A	N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
24. Hao and Huang (2023)	• Psychological reactance theory	**Study 1:** Limited-time scarcity (high vs. low)	**Study 1:** Impulse buying	**Study 1:** Product type (hedonic vs. utilitarian)	**Study 1:** Perceived urgency	**Study 1:** Demographic variables, prior experience with livestream shopping
		Study 2: Limited-time scarcity (high vs. low)	**Study 2:** Impulse buying	**Study 2:** Product type (hedonic vs. utilitarian)	**Study 2:** Perceived urgency	**Study 2:** N/A
25. He and Oppewal (2018)	• Cue utilization theory	**Study 1:** Limited-quantity scarcity (present vs. absent)	**Study 1:** Product choice	**Study 1:** Sales information (present vs. absent)	**Study 1:** Perceived popularity, perceived quality	**Study 1:** Topic familiarity
		Study 2: Limited-quantity scarcity (high vs. low vs. none)	**Study 2:** Product choice	**Study 2:** Sales information (present vs. absent), brand familiarity	**Study 2:** Perceived popularity, perceived quality	**Study 2:** Topic familiarity
26. Hmurovic et al. (2023)	• Persuasion knowledge	**Study 1:** Limited-time scarcity (with justification vs. without justification vs. none)	**Study 1:** Perceived justification, perceived product availability after the promotional period, perceived quality, purchase intention	**Study 1:** N/A	**Study 1:** Persuasion knowledge activation	N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
		Study 2a: Limited-time scarcity (with justification vs. without justification) **Study 2b:** Limited-time scarcity (with justification vs. without justification vs. none) **Study 3:** Type of scarcity message (limited-time with justification vs. limited-quantity with justification vs. none)	**Study 2a:** Persuasion knowledge activation **Study 2b:** Ad engagement, page engagement **Study 3:** Email engagement	**Study 2a:** N/A **Study 2b:** Time remaining (two days vs. one day vs. less than one day) **Study 3:** N/A	**Study 2a:** Perceived justification **Study 2b:** N/A **Study 3:** N/A	
27. Huang et al. (2020)	• Approach-inhibition theory of power • Social distance theory of power	Type of scarcity message (demand-framed vs. supply framed)	Purchase intention	Sense of power (high vs. low)	Perceived risk	Income
28. Jee and Hyun (2023)	• Generic advanced decision-making model	Demand-framed scarcity (high vs. low)	Perceived availability, estimated likelihood of finding a better deal	Framing (frequency vs. percentage)	N/A	Purchase timing
29. Ju and Ahn (2016)	• S-O-R framework	Social presence (high vs. low vs. medium), music tempo	Impulse buying behavior	Limited-quantity scarcity (high vs. low vs.	Pleasure, Arousal	N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
				medium)		
30. Kim et al. (2020a)	• Cognitive dissonance theory • Commodity theory	**Study 1:** Demand-framed scarcity (present vs. absent), supply-framed scarcity (present vs. absent)	**Study 1:** Booking intention, product choice, willingness to pay, cognitive dissonance, willingness to undo (dissonance reduction)	**Study 1:** Price (regular vs. discounted)	N/A	N/A
		Study 2: Demand-framed scarcity (present vs. absent), supply-framed scarcity (present vs. absent)	**Study 2:** Booking intention, product choice, cognitive dissonance, willingness to undo (dissonance reduction)	**Study 2:** Price (regular vs. discounted)		
31. Kim et al. (2020b)	• Construal level theory	**Study 1:** Limited-time scarcity (present vs. absent)	**Study 1:** Brand attitude, purchase intention	**Study 1:** Construal level (high vs. low), deadline type (explicit vs. implicit)	N/A	N/A
		Study 2: Limited-time scarcity (present vs. absent)	**Study 2:** Brand attitude, purchase intention	**Study 2:** Construal level (high vs. low), countdown timer (present vs. absent)		

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
32. Koch (2015)	• Social transmission theory	Limited-quantity scarcity (high vs. low vs. none)	Social sharing	Personalization (present vs. absent)	N/A	Privacy concerns, product involvement, market mavenism, need for uniqueness, image-impairment concerns
33. Koch and Benlian (2015a)	• Need for uniqueness theory • Bandwagon effect/social proof theory	Demand-framed scarcity (present vs. absent)	Referral propensity	Social proof (present vs. absent)	Perceived value	Privacy concerns, product involvement, need for uniqueness, offer relevance, image-impairment concerns
34. Koch and Benlian (2015b)	• Economic market theory • Need for uniqueness theory • Bandwagon effect/social proof theory	Demand-framed scarcity (high vs. low vs. none)	Referral propensity	Personalization (present vs. absent)	Perceived value, gratitude	Privacy concerns, product involvement, market mavenism, need for uniqueness, perceived information

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
						relevance to others, image-impairment concerns, age, gender
35. Koh and Seah (2023)	Not specified	Dark patterns of activity message, countdown timer, limited-quantity, limited-time (present vs. absent)	Product choice	Age, gender, impulsivity	N/A	N/A
36. Kordrostami et al. (2022)	• Heuristic-systematic model • Persuasion knowledge framework	**Study 1:** Supply-framed scarcity (present vs. absent)	**Study 1:** Brand attitude	**Study 1:** Review volume (high vs. low), review valence (positive vs. negative)	N/A	**Study 1:** N/A
		Study 2: Supply-framed scarcity (present vs. absent)	**Study 2:** Sales	**Study 2:** Review volume, review valence		**Study 2:** Price, product title length, product description length, expected shipping delay, number of user questions
37. Kowalczyk et al. (2020)	Not specified	Type of scarcity message (limited-quantity vs. stock-out)	Number of items bought	Offer disclosure time (ex post on the product page vs. ex ante on	N/A	Context-relevant consumer characteristics

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
				the multiple items page where different products are visible)		
38. Lamis et al. (2022)	• Competitive arousal theory • Pleasure-arousal-dominance model • S-O-R framework	Limited-quantity scarcity, limited-time scarcity, flash sale characteristics	Impulse buying	N/A	Attitude, arousal, pleasure	N/A
39. Lee et al. (2014)	Not specified	Limited-quantity scarcity (high vs. low vs. medium)	Product evaluation	Cognitive load (high vs. low), brand reputation (good vs. poor)	Sales tactic inference	N/A
40. Lee et al. (2015)	• Hofstede's cultural dimensions	Type of scarcity message (limited-quantity vs. limited-time)	Impulse buying	Message framing type (positive vs. negative), country (China vs. Korea), need for cognitive closure (high vs. low)	N/A	N/A
41. Lee et al. (2018)	Not specified	Type of scarcity message (limited-quantity vs. limited-time vs. none)	Purchase intention, willingness to pay	Decision reversibility (high vs. low)	Falsity inference	N/A
42. Lee et al. (2023)	Not specified	Type of scarcity message (limited-	Purchase intention	Sender type (corporate vs.	N/A	N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
		quantity vs. limited-time)		customer)		
43. Li et al. (2021)	• Accessibility-diagnosticity framework • Bandwagon effect/social proof theory	**Study 1, 3:** Not TMSM-related **Study 2:** Demand-framed scarcity cue (high vs. low occupancy rate), rating consistency (consistent vs. inconsistent)	**Study 1, 3:** Not TMSM-related **Study 2:** Booking choice	N/A	**Study 1, 3:** Not TMSM-related **Study 2:** Safety inference, popularity inference, quality inference	N/A
44. Li et al. (2023)	• S-O-R framework • Competitive arousal theory • Dual system theory	**Study 1a:** Type of scarcity message (limited-quantity vs. limited-time vs. none) **Study 1b:** Not TMSM-related **Study 2:** Scarcity promotion (present vs. absent)	**Study 1a:** Impulse buying **Study 1b:** Not TMSM-related **Study 2:** Impulse buying	**Study 1a:** N/A **Study 1b:** Not TMSM-related **Study 2:** Cause-related events (yes vs. no)	**Study 1a:** Arousal **Study 1b:** Not TMSM-related **Study 2:** N/A	**Study 1a:** Income, price awareness, product attractiveness, self-construal **Study 1b:** Not TMSM-related **Study 2:** Price awareness, product attractiveness, self-construal
45. Luo et al. (2019)	• Consumer goal stage theory	Ecommerce cart targeting	Purchase	Scarcity cue, price incentive	N/A	Demographic variables,

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
						historical purchase behaviors, product category, cart timing
46. Luo et al. (2021)	• S-O-R framework • Regret theory	Type of scarcity message (limited quantity vs. limited time)	Impulse buying behavior	Product type (FMCG vs. non-FMCG), Impulsiveness	Upward anticipated regret, Downward anticipated regret	N/A
47. Maojie (2023)	• S-O-R framework	Anchor characteristics (professionalism, interactivity, popularity)	Premium purchase intention	Perceived scarcity	Perceived value	N/A
48. Moser et al. (2019)	Not specified	N/A (the quantitative part of the article is a content analysis; no inferential statistics is used in any of the two studies)				
49. Mou and Shin (2018)	• Signaling theory • Commodity theory • Psychological reactance theory	Limited-time scarcity (high vs. low), Popularity cue (high vs. low)	Perceived value, perceived product quality, website trust, fixation duration, fixation count	Product type (on-body vs. off-body)	N/A	N/A
50. Mukherjee and Lee (2016)	• Persuasion knowledge framework	**Study 1:** Limited-quantity scarcity (present vs. absent) **Study 2-3:** Not	**Study 1:** Brand attitude, Perceived quality **Study 2-3:** Not	**Study 1:** Scarcity expectation due to demand **Study 2-3:** Not	N/A	N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
		TMSM-related	TMSM-related	TMSM-related		
51. Noone and Lin (2020)	• Construal level theory • Prospect theory	Type of scarcity message (price promotions-limited-time scarcity and demand-framed limited-quantity scarcity)	Booking intention	Booking lead-time (long vs. short)	Perceived competition, Perceived price uncertainty, Anticipated regret	Familiarity with variable pricing practices, price consciousness, deal proneness, attribution for the limited availability of the price discount
52. Park (2023)	• Self-licensing theory	Level of supply-framed scarcity (high vs. low)	Impulse buying	Environmental consciousness (high vs. low)	Ease of justification	N/A
53. Park et al. (2017)	• Commodity theory • Psychological reactance theory	Limited-quantity scarcity (high vs. low), Popularity (high vs. low)	Booking intention	Online ratings (high vs. low)	N/A	N/A
54. Park et al. (2020)	• Commodity theory	Limited-quantity scarcity (present vs. absent), price	Sales	N/A	N/A	N/A
55. Park et al. (2022)	• Commodity theory • Need for uniqueness theory • Psychological reactance theory • Evolutionary perspective and	**Study 1:** Limited-quantity scarcity (present vs. absent) **Study 2:** Limited-quantity scarcity (present vs. absent) **Study 3:** Limited-	**Study 1:** Relative preference **Study 2:** Relative preference **Study 3:** Relative	**Study 1:** N/A **Study 2:** Childhood socioeconomic status **Study 3:**	**Study 1:** Relative evaluation **Study 2:** N/A **Study 3:** N/A	**Study 1:** Age, gender, mood, prior experience **Study 2:** N/A **Study 3:** N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
	life history theory	quantity scarcity (present vs. absent)	preference	Materialism		
56. Peng et al. (2019)	• Value-intention framework	Limited-time scarcity (high vs. low), Perceived value	Purchase intention	Product involvement type (high vs. low)	N/A	Age, gender, education, online shopping experience, online consumption in the last year, experience of participating in sales promotions
57. Peinkofer et al. (2016)	• Expectation disconfirmation theory	Limited-quantity scarcity (high vs. low)	Shopping satisfaction	Deal proneness, In stock vs. out-of-stock scarcity cue	Expected consumer competition	Implicit vs. explicit inventory disclosure
58. Peschel (2021)	• Evolutionary psychology framework	Weight status, income level	Decision to buy, number of units to buy	N/A	N/A	N/A
59. Qu et al. (2023)	• S-O-R framework	Impulse buying tendency	Purchase decision	N/A	Regret, rejoice	Age, gender, education, income
60. Sergeeva et al. (2023)	• Nudge theory	Age, gender, education, neuroticism	Perceived influence	N/A	N/A	N/A
61. Song et al. (2017)	• Construal level theory • Consumer goal stage theory	Limited-quantity scarcity (high vs. low)	Purchase intention	Tie strength (strong vs. weak), shopping stage (early vs. late)	N/A	N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
62. Song et al. (2019a)	• Commodity theory • Expectancy theory • Social motives theory	Type of scarcity message (limited-quantity vs. limited-time vs. both limited-quantity and limited-time vs. none)	Willingness, probability and number of recommendations	Reward (present vs. absent)	N/A	Referrals made in the past
63. Song et al. (2019b)	• Resource matching theory	Type of scarcity message (unit vs. option)	Booking intentions, Perceived message credibility, perceived sell-out risk	Booking lead-time (long vs. short)	Perceived message credibility, perceived sell-out risk	Risk aversion
64. Song et al. (2020)	• Expectancy theory • Social motives theory	Limited-quantity scarcity (high vs. low)	Recommendation to strong and weak ties	Reward (present vs. absent)	N/A	Referrals made in the past
65. Song et al. (2021)	Not specified	Type of scarcity message (limited-quantity vs. limited-time)	Willingness to purchase	Social cue (present vs. absent)	Perceived consumer competition	Perceived message credibility
66. Sun et al. (2022)	• Psychological reactance theory	**Study 1:** Type of scarcity message (limited-quantity vs. limited-time vs. vague vs. none) **Study 2:** Type of scarcity message (limited-quantity vs.	**Study 1:** Purchase intention **Study 2:** Purchase intention	**Study 1:** Product involvement type (high vs. low) **Study 2:** Product involvement	N/A	**Study 1:** Internet experience, mobile shopping experience **Study 2:** Internet experience,

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
		limited-time vs. vague vs. none)		type (high vs. low), location (at-home vs. in-store)		mobile shopping experience
67. Teubner and Graul (2020)	• Psychological reactance theory • Bandwagon effect/social proof theory	Perceived scarcity (combination of supply-framed and popularity-framed scarcity cues)	Intention to book	Product type (B2C vs. C2C)	Perceived urgency, perceived value	Age, gender, prior experience, risk affinity
68. Trivedi et al. (2023)	• Theory of imaginative hedonism • Appraisal theory of emotion	Short-lived surprise deal (high vs. low)	Repurchase intention	Self-enhancement goal (high vs, low)	Purchase intention, peak-transcendent experience, hope of finding a similar deal	Brand knowledge
69. Vannisa et al. (2020)	Not specified	Perceived perishability (limited-time), perceived scarcity (limited-quantity)	Shopping enjoyment, impulse buying behavior	N/A	Attitude toward flash sale	N/A
70. Wang et al. (2021)	• Theory of planned behavior • Prospect theory • Equity theory	**Study 1:** Limited-time scarcity (present vs. absent)	**Study 1:** Clickthrough intention	**Study 1:** Offer exclusivity	**Study 1:** Offer evaluation/ perceived value	**Study 1:** Prior experience
		Study 2: Limited-time scarcity (present vs.	**Study 2:** Clickthrough	**Study 2:** Offer exclusivity	**Study 2:** N/A	**Study 2:** N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
		absent)				
71. Wang et al. (2023)	• Commodity theory • Psychological reactance theory	**Study 1:** Limited-quantity scarcity (present vs. absent) **Study 2:** Limited-quantity scarcity (present vs. absent)	**Study 1:** Attractiveness, choice **Study 2:** Choice	**Study 1:** Sales volume (high vs. low vs. medium) **Study 2:** Sales volume (high vs. low vs. medium), Sales dynamic changes (stationary, smaller-sooner sales volume increase, larger-later sales volume increase)	**Study 1:** N/A **Study 2:** N/A	**Study 1:** N/A **Study 2:** N/A
72. Wrabel et al. (2022)	• Commodity theory • Competitive arousal theory	Limited-quantity scarcity (present vs. absent)	Product choice (purchase decision accuracy)	N/A	Processed textual review information, perceived value	Persuasion knowledge, emotional perception, topic familiarity, socio-demographics
73. Wu and Lee (2016)	• Need for Uniqueness theory	**Study 1:** Type of scarcity message (scarcity cue vs. popularity cue) **Study 2**: Type of	**Study 1:** Attitude, purchase intention **Study 2:**	**Study 1:** Consumption target (self vs. others) **Study 2:** N/A	**Study 1:** N/A **Study 2:**	**Study 1:** N/A **Study 2:** N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
		scarcity message (scarcity cue vs. popularity cue)	Purchase intention for self		Perceived uniqueness, perceived value	
		Study 3: Type of scarcity message (scarcity cue vs. popularity cue)	**Study 3:** Purchase intention for others	**Study 3:** N/A	**Study 3:** Perceived consumption risk, perceived value	**Study 3:** N/A
		Study 4: Type of scarcity message (scarcity cue vs. popularity cue)	**Study 4:** Attitude, purchase intention	**Study 4:** Consumption target (self vs. others), price level (high vs. low)	**Study 4:** Perceived consumption risk, perceived uniqueness, perceived value	**Study 4:** price levels
74. Wu et al. (2021)	• Competitive arousal theory	Limited-quantity scarcity (high vs. low), Limited-time scarcity (high vs. low)	Impulse buying behavior	Impulsiveness	Arousal	Online shopping self-efficacy, price consciousness
75. Xu et al. (2023)	• S-O-R framework	Time pressure, quantity pressure, price pressure	Impulse buying	N/A	Arousal, pleasure	N/A
76. Yi et al. (2023)	• Commodity theory • Shopping goals theory	**Study 1:** Limited-time scarcity (high vs. low), Popularity cue (high vs. low)	**Study 1:** Adding to cart, clickthrough	**Study 1:** Goal specificity (high vs. low)	**Study 1:** N/A	**Study 1:** N/A

Article	Theoretical Lenses	Key Variables (for quantitative studies that dominate the TMSM landscape)				
		Predicting Variables	**Outcome Variables**	**Moderators**	**Mediators**	**Control Variables**
		Study 2: Limited-time scarcity (high vs. low), Popularity cue (high vs. low)	**Study 2:** Purchase intention, fixation durations	**Study 2:** Goal specificity (high vs. low)	**Study 2:** N/A	**Study 2:** Age, gender, Internet experience, online shopping experience
77. Zhang and Phang (2023)	• Commodity theory	Perceived scarcity, need for uniqueness	Purchase intention	N/A	Perceived uniqueness, perceived value	N/A
78. Zhao et al. (2021)	• Cognitive dissonance theory	**Study 1-3:** Not TMSM-related **Study 4:** Limited-quantity scarcity (high vs. low)	**Study 1-3:** Not TMSM-related **Study 4:** Like, purchase intention	**Study 1-3:** Not TMSM-related **Study 4:** Preference ranking, Warning message (add after purchasing vs. add after removing vs. none)	**Study 1-3:** Not TMSM-related **Study 4:** Anticipated regret	N/A

Source: Authors' own work

Table 2: Types of TMSM studied in the literature along with study sites and contexts

Article	TMSM Types	Study Site	Study Context
1. Abbott et al. (2023)	Limited-quantity, High-demand	N/A	Cholesterol-reducing supplement
2. Akram et al. (2018)	Limited-quantity, Limited-time	China	Social commerce
3. Akram et al. (2023)	Limited-quantity, Limited-time	China	Cosmetics m-commerce
4. Baek and Yoon (2020)	Limited-time	**Study 1, 2:** US	**Study 1, 2:** Mobile reward app
5. Banerjee and Pal (2020)	Limited-quantity, Limited-time	N/A	Luxury hotel
6. Bozkurt and Gligor (2019)	Scarcity cue, Popularity cue	N/A	**Study 1:** Bobblehead **Study 2:** Wine
7. Broeder and Wentink (2022)	Limited-time	Italy, the Netherlands	Smartwatch
8. Chen and Yao (2018)	Limited-quantity, Limited-time	N/A	M-Commerce mobile auction
9. Chen and Zhang (2023)	Limited-quantity	China	Livestream shopping
10. Choi and Qu (2023)	Limited-quantity, Limited-time	China, South Korea	Group buying
11. Chung et al. (2017)	Limited-quantity, Limited-time	South Korea	Restaurant
12. Coulter and Roggeveen (2012)	Limited-quantity, Limited-time, Number of buyers	**Study 1, 2:** US	**Study 1:** Groupon deals **Study 2:** Restaurant
13. Courty and Ozel (2019)	Limited-quantity, Limited-time, Demand interest	N/A	Air travel
14. Cremer (2018)	Limited-quantity, Limited-time	N/A	Physical information goods (books and videos in physical format)
15. Cremer and Loebbecke (2021)	Limited-quantity	N/A	Printed book
16. Das et al. (2018)	Scarcity cue, Popularity cue	N/A	**Study 1:** DSLR camera (which is both hedonic and utilitarian) **Study 2:** Sunscreen, perfume **Study 3:** DSLR camera (which is both hedonic and utilitarian)
17. Drossos et al. (2019)	Scarcity cue, Popularity cue	N/A	Hair and beauty
18. Eisenbeiss et al. (2015)	Limited-time	**Study 1:** Europe **Study 2:** North	**Study 1:** Deal-of-the-day promotions

Article	TMSM Types	Study Site	Study Context
		America	**Study 2:** Groupon deals
19. Elisa et al. (2022)	Limited-quantity, Limited-time	Indonesia	Healthcare
20. Fogel and Setton (2022)	High-demand, Limited-quantity, Limited-time, Countdown timer	US	Luxury skincare
21. Guo et al. (2017)	Limited-quantity, Limited-time	China	Tea coupon
22. Guo et al. (2023)	Limited-quantity	China	Livestream shopping (vacuum-insulated cup, duck neck, electric mosquito repellent, mineral water)
23. Gupta et al. (2023)	Limited-quantity	India	Mobile shopping
24. Hao and Huang (2023)	Limited-time	**Study 1, 2:** China	**Study 1:** Livestream shopping (perfume, power bank) **Study 2:** Livestream shopping (skincare, desk lamp)
25. He and Oppewal (2018)	Limited-quantity	**Study 1, 2:** US	**Study 1:** Book **Study 2:** Chocolate bar
26. Hmurovic et al. (2023)	Limited-time	**Study 1, 2a, 2b:** N/A **Study 3:** US	**Study 1:** Pizza **Study 2a, 2b:** Fashion **Study 3:** Music
27. Huang et al. (2020)	Demand-framed, Supply-framed	US	Restaurant
28. Jee and Hyun (2023)	Demand-framed	US	Sport ticket
29. Ju and Ahn (2016)	Limited-quantity, Social presence	N/A	Social commerce (13 different product categories)
30. Kim et al. (2020a)	Demand-framed, Supply-framed	**Study 1, 2:** US	**Study 1, 2:** Hotel
31. Kim et al. (2020b)	Limited-time	**Study 1, 2:** US	**Study 1, 2:** Jeans
32. Koch (2015)	Limited-quantity	Germany	Fashion
33. Koch and Benlian (2015a)	Demand-framed	Germany	Book summarizing service
34. Koch and Benlian (2015b)	Demand-framed	Germany	Fashion
35. Koh and Seah (2023)	Activity message, Countdown timer, Limited-quantity, Limited-time	Singapore	Printer
36. Kordrostami et al. (2022)	Supply-framed	**Study 1:** US **Study 2:** N/A	**Study 1:** Shoe **Study 2:** Fertilizer

Article	TMSM Types	Study Site	Study Context
37. Kowalczyk et al. (2020)	Limited-quantity	N/A	Fashion
38. Lamis et al. (2022)	Limited-quantity, Limited-time	Indonesia	E-commerce flash sale
39. Lee et al. (2014)	Limited-quantity	Canada	Wine
40. Lee et al. (2015)	Limited-quantity, Limited-time	China, South Korea	Jeans
41. Lee et al. (2018)	Limited-quantity, Limited-time	Canada	Fashion (sunglasses)
42. Lee et al. (2023)	Limited-quantity, Limited-time	N/A	Golf equipment
43. Li et al. (2021)	Demand-driven scarcity cue	**Study 1, 3:** Not TMSM-related **Study 2:** UK	**Study 1, 3:** Not TMSM-related **Study 2:** Hotel
44. Li et al. (2023)	Limited-quantity, Limited-time	**Study 1b:** Not TMSM-related **Study 1a, 2:** China	**Study 1b:** Not TMSM-related **Study 1a, 2:** Livestream shopping (agricultural product)
45. Luo et al. (2019)	Limited-quantity, Limited-time	Asia	Maternal and baby product (ecommerce cart targeting)
46. Luo et al. (2021)	Limited-quantity, Limited-time	China	Snack bag, Sneakers
47. Maojie (2023)	Limited-quantity, Limited-time	N/A	Livestream shopping (food)
48. Moser et al. (2019)	Exclusive product, Exclusive price, Limited-quantity for sale, Limited-time discount with countdown timer, Limited-time product availability (with or without clock), Lock in discount now, Low stock warning, Order deadline for shipping, Sold out/back-ordered tag, Selling fast, Social presence/Popularity cue (number of customers interested/watching, number of units sold, social media friends who have purchased)	**Study 1, 2:** US	**Study 1, 2:** E-commerce
49. Mou and Shin (2018)	Limited-time, Popularity cue	South Korea	Healthcare

Article	TMSM Types	Study Site	Study Context
50. Mukherjee and Lee (2016)	Limited-quantity	**Study 1:** US **Study 2, 3:** Not TMSM-related	**Study 1:** Consumer electronics **Study 2, 3:** Not TMSM-related
51. Noone and Lin (2020)	Limited-quantity, Limited-time	US	Hotel
52. Park (2023)	Supply-framed	South Korea	Shoe (C2C second-hand trading platform)
53. Park et al. (2017)	Limited-quantity	US	Hotel
54. Park et al. (2020)	Limited-quantity	US	Durable good
55. Park et al. (2022)	Limited-quantity, Limited-time	**Study 1-3:** US	**Study 1-3:** Hotel
56. Peng et al. (2019)	Limited-time	China	E-commerce flash sale (laptop, cup)
57. Peinkofer et al. (2016)	Limited-quantity	US	Consumer electronics
58. Peschel (2021)	Limited-quantity	Denmark	Food
59. Qu et al. (2023)	Limited-quantity, Limited-time	China	Livestream shopping (sneaker, clothing, accessories, beauty)
60. Sergeeva et al. (2023)	Limited-offer, Limited-offer with countdown timer, Quantity in Stock, Sales indicator	N/A	E-commerce
61. Song et al. (2017)	Limited-quantity	China	Badminton racket
62. Song et al. (2019a)	Limited-quantity, Limited-time, Both limited-quantity and limited-time	N/A	Financial service
63. Song et al. (2019b)	Unit, Option	US	Hotel
64. Song et al. (2020)	Limited-quantity	N/A	Financial service
65. Song et al. (2021)	Limited-quantity, Limited-time	US	Hotel
66. Sun et al. (2022)	Limited-quantity, Limited-time, Vague	**Study 1, 2:** US	**Study 1, 2:** Laptop, chocolate bar
67. Teubner and Graul (2020)	Popularity cue, Supply-framed	N/A	Hotel and peer-based hospitality (Airbnb)
68. Trivedi et al. (2023)	Short-lived surprise deal	India	Perfume (aspirational out-group brand)
69. Vannisa et al. (2020)	Limited-quantity, Limited-time	Indonesia	E-commerce flash sale
70. Wang et al. (2021)	Limited-time	**Study 1, 2:** China	**Study 1:** Hotel **Study 2:** Restaurant
71. Wang et al.	Limited-quantity	**Study 1, 2:**	**Study 1, 2:** Coupon

Article	TMSM Types	Study Site	Study Context
(2023)		China	(intertemporal context)
72. Wrabel et al. (2022)	Limited-quantity	N/A	Headphone
73. Wu and Lee (2016)	Limited-quantity	**Study 1-4:** US	**Study 1:** Coffee mug **Study 2:** Bobble head **Study 3:** Bottle of wine **Study 4:** Bottle of wine
74. Wu et al. (2021)	Limited-quantity, Limited-time	China	Milk tea coupon
75. Xu et al. (2023)	Limited-quantity, Limited-time	China	Group buying
76. Yi et al. (2023)	Limited-time, Popularity cue	**Study 1, 2:** China	**Study 1:** Polo product **Study 2:** Travel product
77. Zhang and Phang (2023)	Limited-quantity	China	Luxury fashion non-fungible tokens
78. Zhao et al. (2021)	Limited-quantity	**Study 1-3:** Not TMSM-related **Study 4:** China	**Study 1-3:** Not TMSM-related **Study 4:** E-commerce

Note. In the column 'Study Site', N/A means that the country where the research was conducted was not possible to identify from the article.

Source: Authors' own work

Table 3: Methodological approaches and samples in TMSM research

Article	Quantitative / Qualitative / Mixed	Data Collection Strategy	Sample Size
1. Abbott et al. (2023)	Quantitative	Online experiment	1,226 Amazon Mechanical Turk (MTurk) users
2. Akram et al. (2018)	Quantitative	Survey (pen-and-paper, online)	671 online shoppers
3. Akram et al. (2023)	Quantitative	Online survey	988 mobile users
4. Baek and Yoon (2020)	Quantitative	**Study 1:** Lab experiment **Study 2:** Lab experiment	**Study 1:** 138 undergraduate (UG) students **Study 2:** 188 UG students
5. Banerjee and Pal (2020)	Quantitative	Online experiment	96 online shoppers
6. Bozkurt and Gligor (2019)	Quantitative	**Study 1:** Experiment **Study 2:** Online experiment	**Study 1:** 94 UG students **Study 2:** 110 MTurk users
7. Broeder and Wentink (2022)	Quantitative	Online experiment	208 Europeans
8. Chen and Yao (2018)	Quantitative	Online survey	401 online shoppers
9. Chen and Zhang (2023)	Quantitative	Online survey	392 livestream shoppers from a research panel
10. Choi and Qu (2023)	Quantitative	Survey (pen-and-paper, online)	564 participants involving UG and postgraduate (PG) students from a Korean university, and customers of a Chinese retailer
11. Chung et al. (2017)	Quantitative	Online survey	332 participants from a research panel
12. Coulter and Roggeveen (2012)	Quantitative	**Study 1:** Secondary analysis of data **Study 2:** Online experiment	**Study 1:** Data from 109 deals on Groupon **Study 2:** 121 adults
13. Courty and Ozel (2019)	Quantitative	Secondary analysis of data	Data from Expedia with 539,506 observations of prices, scarcity signals, and availability for one-way trips
14. Cremer (2018)	Quantitative	Secondary analysis of data	Data from an e-commerce platform for 34,748 physical information goods
15. Cremer and Loebbecke (2021)	Quantitative	Secondary analysis of data	Data from an e-commerce platform for 36,766 books
16. Das et al. (2018)	Quantitative	**Study 1:** Experiment **Study 2:** Lab experiment **Study 3:** Experiment	**Study 1:** 162 MTurk users **Study 2:** 124 UG students **Study 3:** 122 UG students
17. Drossos et al.	Quantitative	Online field	1,126 users who landed on the

Article	Quantitative / Qualitative / Mixed	Data Collection Strategy	Sample Size
(2019)		experiment	experimental website
18. Eisenbeiss et al. (2015)	Quantitative	**Study 1:** Lab experiment **Study 2:** Secondary analysis of data	**Study 1:** 126 participants from a university **Study 2:** Data from Groupon involving 5,698 observations
19. Elisa et al. (2022)	Quantitative	Online survey	320 social media users
20. Fogel and Setton (2022)	Quantitative	Pen-and-paper survey	789 college students
21. Guo et al. (2017)	Quantitative	Lab experiment	182 college students
22. Guo et al. (2023)	Quantitative	Online experiment	402 livestream shoppers from a research panel
23. Gupta et al. (2023)	Quantitative	Online experiment	542 shopping app users
24. Hao and Huang (2023)	Quantitative	**Study 1:** Online experiment **Study 2:** Online experiment	**Study 1:** 191 livestream shoppers from a research panel **Study 2:** 194 livestream shoppers from a research panel
25. He and Oppewal (2018)	Quantitative	**Study 1:** Online experiment **Study 2:** Online experiment	**Study 1:** 405 MTurk users **Study 2:** 871 MTurk users
26. Hmurovic et al. (2023)	Quantitative	**Study 1:** Online experiment **Study 2a:** Online experiment **Study 2b:** Online field experiment **Study 3:** Online field experiment	**Study 1:** 497 MTurk users **Study 2a:** 125 MTurk users **Study 2b:** 18,157 observations **Study 3:** 9,378 email subscribers
27. Huang et al. (2020)	Quantitative	Online experiment	188 MTurk users
28. Jee and Hyun (2023)	Quantitative	Online experiment	640 participants from a research panel
29. Ju and Ahn (2016)	Quantitative	Online experiment	279 participants from a research panel
30. Kim et al. (2020a)	Quantitative	**Study 1:** Online experiment **Study 2:** Online experiment	**Study 1:** 98 MTurk users **Study 2:** 223 participants from a research panel
31. Kim et al. (2020b)	Quantitative	**Study 1:** Online experiment **Study 2:** Online experiment	**Study 1:** 207 UG students **Study 2:** 210 UG students
32. Koch (2015)	Quantitative	Online field	119 participants from a

Article	Quantitative / Qualitative / Mixed	Data Collection Strategy	Sample Size
		experiment	research panel
33. Koch and Benlian (2015a)	Quantitative	Online experiment	118 participants from a research panel
34. Koch and Benlian (2015b)	Quantitative	Online field experiment	119 participants from a media company
35. Koh and Seah (2023)	Quantitative	Lab experiment	195 adult volunteers
36. Kordrostami et al. (2022)	Quantitative	**Study 1:** Online experiment **Study 2:** Secondary analysis of data	**Study 1:** 148 MTurk users **Study 2:** Data from Amazon corresponding to 443 fertilizer products
37. Kowalczyk et al. (2020)	Quantitative	Online experiment	461 MTurk users
38. Lamis et al. (2022)	Mixed	Online survey with a qualitative follow-up interview	1,093 individuals with flash sale purchase experience followed by 10 interviews
39. Lee et al. (2014)	Quantitative	Lab experiment	100 UG students
40. Lee et al. (2015)	Quantitative	Online experiment	634 university students
41. Lee et al. (2018)	Quantitative	Lab experiment	150 UG students
42. Lee et al. (2023)	Quantitative	Online experiment	108 UG and PG students
43. Li et al. (2021)	Quantitative	**Study 1, 3:** Not TMSM-related **Study 2:** Online experiment	**Study 1, 3:** Not TMSM-related **Study 2:** 192 participants from a research panel
44. Li et al. (2023)	Quantitative	**Study 1a:** Online experiment **Study 1b:** Not TMSM-related **Study 2:** Online experiment	**Study 1a:** 98 livestream shoppers from a research panel **Study 1b:** Not TMSM-related **Study 2:** 124 livestream shoppers from a research panel
45. Luo et al. (2019)	Quantitative	Online field experiment	20,495 observations
46. Luo et al. (2021)	Quantitative	Online survey	415 participants from a research panel
47. Maojie (2023)	Quantitative	Online survey	275 participants
48. Moser et al. (2019)	Mixed	**Study 1:** Systematic content analysis **Study 2:** Online survey	**Study 1:** 200 top e-commerce websites in the US **Study 2:** 151 impulse buyers from a research panel
49. Mou and Shin (2018)	Quantitative	Eye-tracking experiment	41 university students

Article	Quantitative / Qualitative / Mixed	Data Collection Strategy	Sample Size
50. Mukherjee and Lee (2016)	Quantitative	**Study 1:** Online experiment **Study 2, 3:** Not TMSM-related	**Study 1:** 443 MTurk users **Study 2, 3:** Not TMSM-related
51. Noone and Lin (2020)	Quantitative	Online experiment	256 participants from a research panel
52. Park (2023)	Quantitative	Online experiment	130 participants
53. Park et al. (2017)	Quantitative	Online experiment	282 participants from an email list of tourists
54. Park et al. (2020)	Quantitative	Secondary analysis of data	Data from Bon-Ton with a focus on 199 stock keeping units over a window of 18 months
55. Park et al. (2022)	Quantitative	**Study 1:** Online experiment **Study 2:** Online experiment **Study 3:** Online experiment	**Study 1:** 112 MTurk users **Study 2:** 191 MTurk users **Study 3:** 181 MTurk users
56. Peng et al. (2019)	Quantitative	Online experiment	570 participants from a research panel
57. Peinkofer et al. (2016)	Quantitative	Online experiment	294 MTurk users
58. Peschel (2021)	Quantitative	Online survey	1,355 participants from a research panel
59. Qu et al. (2023)	Quantitative	Online survey	376 livestream shoppers
60. Sergeeva et al. (2023)	Quantitative	Online survey	401 participants from a research panel
61. Song et al. (2017)	Quantitative	Lab experiment	134 UG and PG students
62. Song et al. (2019a)	Quantitative	Online experiment	1,599 MTurk users
63. Song et al. (2019b)	Quantitative	Online experiment	140 participants from a research panel
64. Song et al. (2020)	Quantitative	Online experiment	760 MTurk users
65. Song et al. (2021)	Quantitative	Online experiment	134 MTurk users
66. Sun et al. (2022)	Quantitative	**Study 1:** Online experiment **Study 2:** Online experiment	**Study 1:** 297 participants from a research panel **Study 2:** 767 college students
67. Teubner and Graul (2020)	Mixed	Online experiment with a qualitative post-experimental	250 participants from a research panel

Article	Quantitative / Qualitative / Mixed	Data Collection Strategy	Sample Size
		question	
68. Trivedi et al. (2023)	Quantitative	Lab experiment	154 participants
69. Vannisa et al. (2020)	Quantitative	Online survey	376 flash sale users
70. Wang et al. (2021)	Quantitative	**Study 1:** Online experiment **Study 2:** Online field experiment	**Study 1:** 400 participants from a research panel **Study 2:** 250 UG students
71. Wang et al. (2023)	Quantitative	**Study 1:** Lab experiment **Study 2:** Lab experiment	**Study 1:** 124 college students **Study 2:** 82 college students
72. Wrabel et al. (2022)	Quantitative	Online experiment	615 MTurk users
73. Wu and Lee (2016)	Quantitative	**Study 1:** Online experiment **Study 2:** Online experiment **Study 3:** Online experiment **Study 4:** Online experiment	**Study 1:** 120 MTurk users **Study 2:** 60 MTurk users **Study 3:** 72 MTurk users **Study 4:** 238 MTurk users
74. Wu et al. (2021)	Quantitative	Online field experiment	182 UG students
75. Xu et al. (2023)	Quantitative	Survey (pen-and-paper, online)	208 participants (college students, company employees)
76. Yi et al. (2023)	Quantitative	**Study 1:** Online field experiment **Study 2:** Eye-tracking experiment	**Study 1:** 15,330 visits (14,900 low goal specificity, 430 high goal specificity) **Study 2:** 185 participants from a university
77. Zhang and Phang (2023)	Quantitative	Online survey	251 participants from a research panel
78. Zhao et al. (2021)	Quantitative	**Study 1-3:** Not TMSM-related **Study 4:** Online experiment	**Study 1-3:** Not TMSM-related **Study 4:** 251 UG students

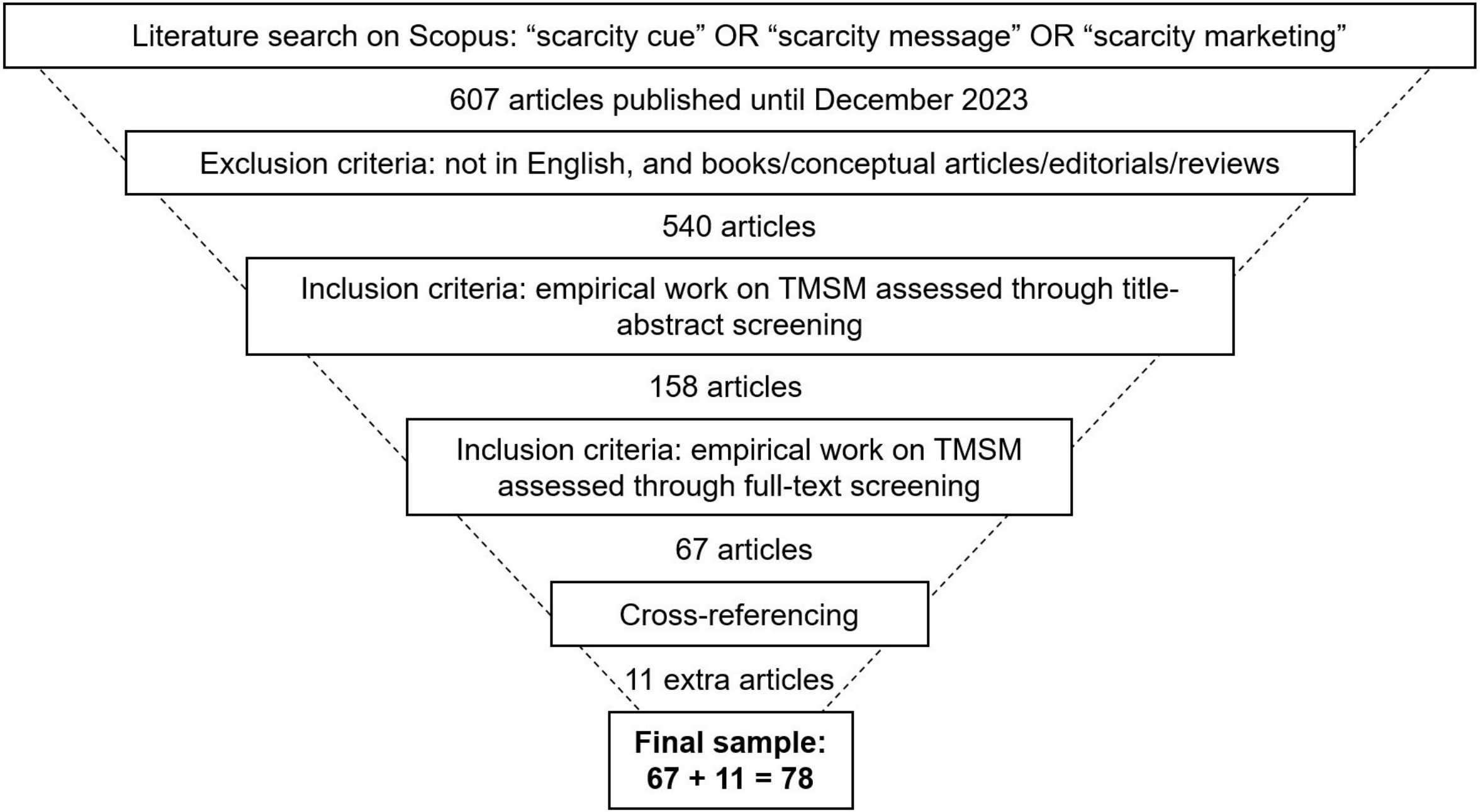
Source: Authors' own work

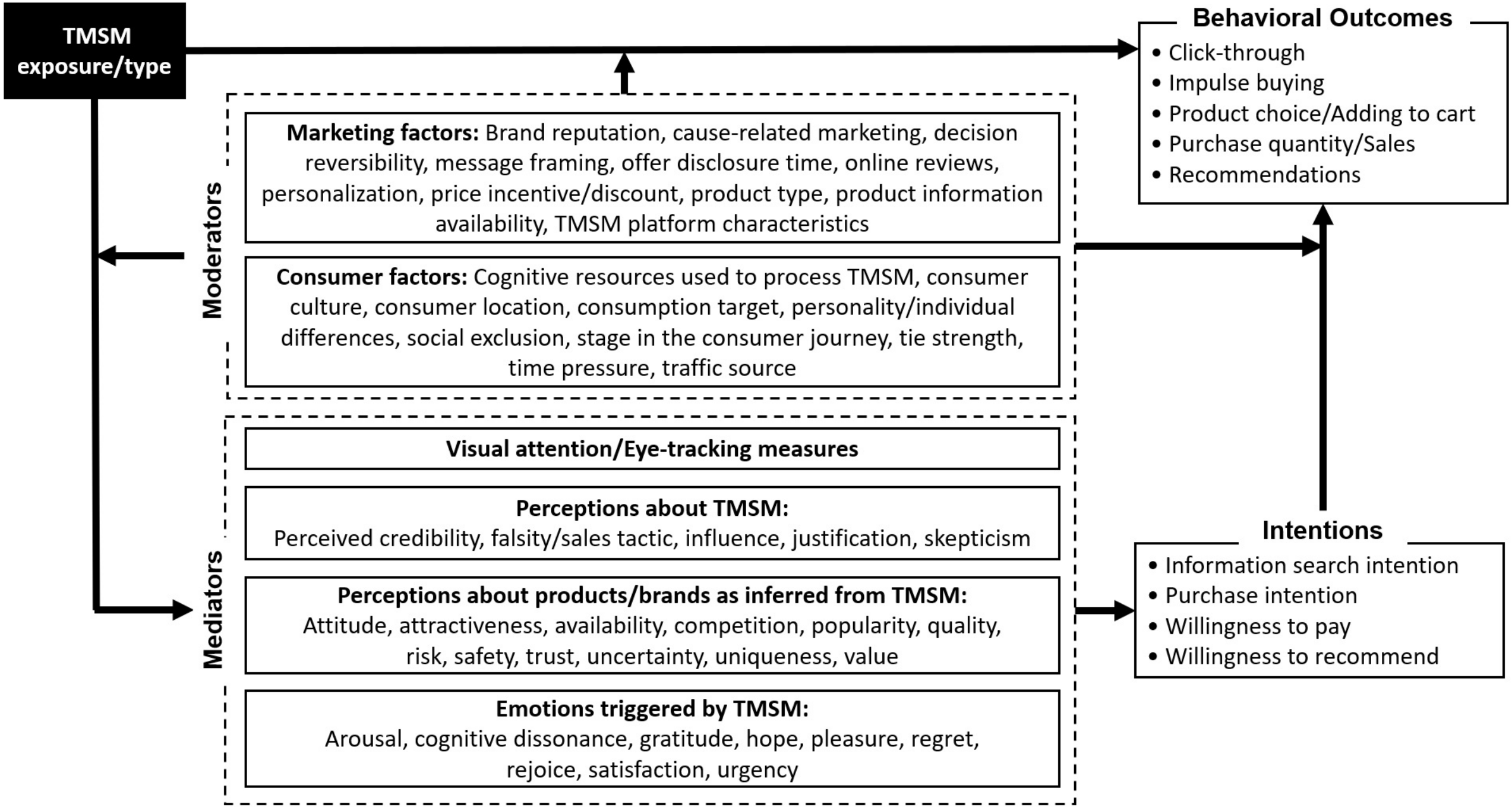
Table 4: Overview of future research avenues and research questions

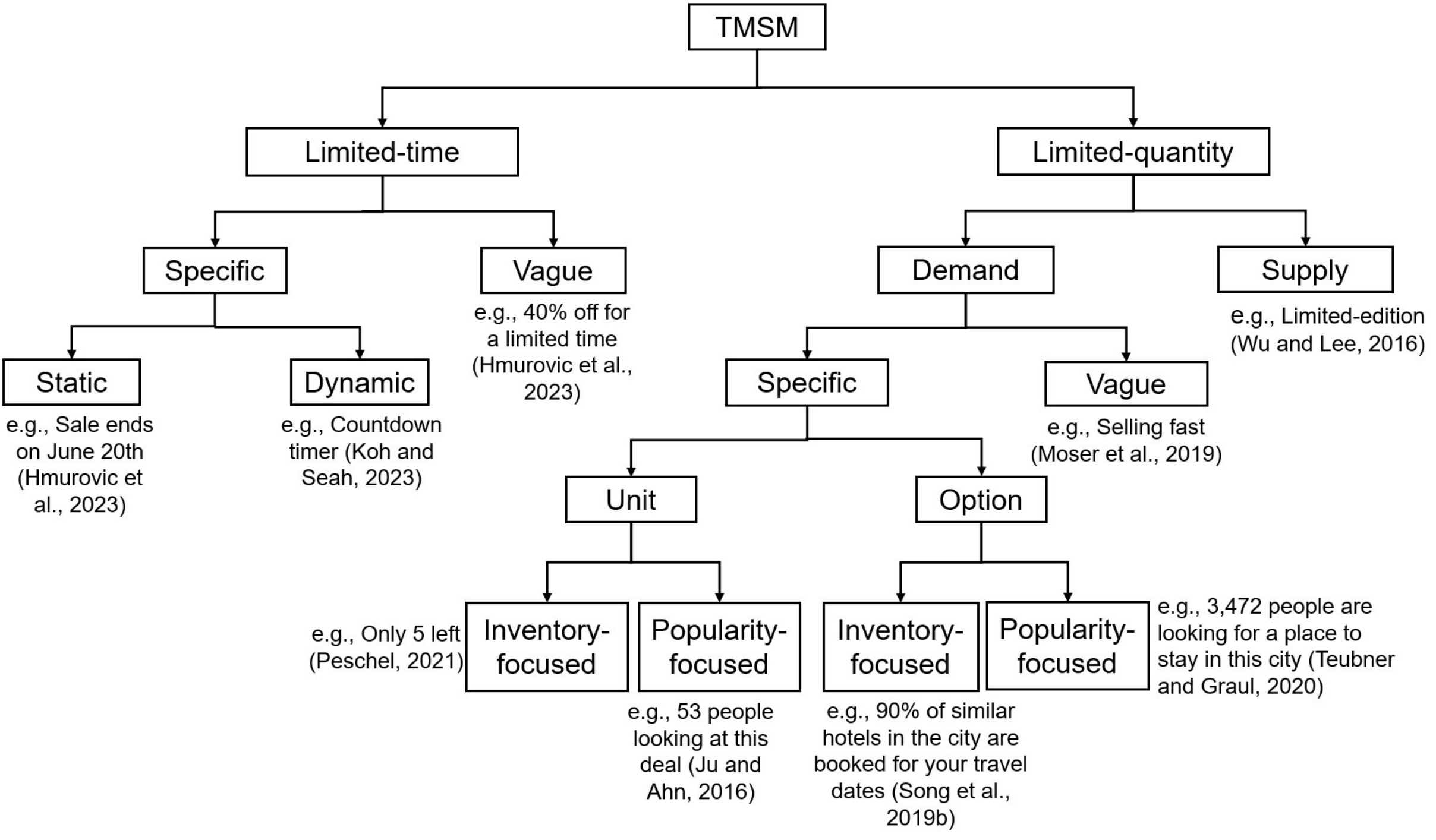
Future Research Avenue	Specific Research Questions within the Research Avenue	Theoretical Contribution	Managerial Implication
Research Avenue 1: Using TMSM to meet consumers' interests (stemming from the findings of RQ 1)	• How do TMSM affect consumer well-being? • How do TMSM differ in triggering planned and unplanned purchases? • How do consumers reconcile positive and negative affect while processing TMSM? • What role does perceived authenticity of TMSM play in affecting consumer behavior?	The current literature is lopsided, focusing more on the interests of marketers rather than consumers. This research avenue will address the theoretical lopsidedness.	This research avenue can guide marketers on ways to use TMSM better and more transparently without jeopardizing consumer well-being.
Research Avenue 2: Using TMSM to meet marketers' interests (stemming from the findings of RQ 1)	• How do TMSM affect eWOM intentions and behaviors? • How do TMSM with money-back guarantee affect willingness to undo purchases? • How do TMSM affect consumers' offline perceptions, intentions and behaviors? • How do TMSM affect consumers' perceptions, intentions and behaviors over time?	This research avenue will uncover the effects of TMSM on hitherto-unexplored marketing outcomes (e.g., eWOM), offline behaviors, the evolution of brand loyalty, and the development of repeat purchasing tendencies.	This research avenue can guide marketers on TMSM use so that the messages not only trigger purchases but also help improve the consumer journey of omnichannel shoppers across both offline and online settings over time.
Research Avenue 3: Demystifying the role of TMSM types (stemming from the findings of RQ 2)	• Which types of TMSM are better than others in balancing marketers' interest in conversion and consumers' priority of well-being? • How does the coexistence of multiple TMSM types affect marketers' interest in conversion and consumers' priority of well-being?	This research avenue is driven by the proposed TMSM typology, which serves as a framework to facilitate a systematic comparison of different TMSM types as well as their combinations.	This research avenue can help identify TMSM types and their combinations that are ideal in meeting marketers' interest in conversion without jeopardizing consumers' priority of well-being.
Research Avenue 4: Studying	• How do various TMSM types in conjunction with price discounts and eWOM	This research avenue will extend the	This research avenue will offer implications for

TMSM in light of contextual nuances (stemming from the findings of RQ 3)	affect marketers' interest in conversion and consumers' priority of well-being? • How do nuances in the presentation of TMSM (e.g., personalization cues) affect marketers' interest in conversion and consumers' priority of well-being? • What role do TMSM play in emerging e-commerce contexts, such as livestream shopping and virtual reality shopping? • How do TMSM vary in affecting consumer behavior across countries and cultures?	scholarly understanding of aspects of TMSM that work in specific contexts but fail in others.	ideal ways to present TMSM to consumers in specific contexts.
We recommend methodological plurality in exploring each of these research avenues (stemming from the findings of RQ 3).			

Source: Authors' own work


Literature search on Scopus: “scarcity cue” OR “scarcity message” OR “scarcity marketing”
607 articles published until December 2023
Exclusion criteria: not in English, and books/conceptual articles/editorials/reviews
540 articles
Inclusion criteria: empirical work on TMSM assessed through title-abstract screening
158 articles
Inclusion criteria: empirical work on TMSM assessed through full-text screening
67 articles
Cross-referencing
11 extra articles
Final sample:
67 + 11 = 78


TMSM exposure/type
Behavioral Outcomes
• Click-through
• Impulse buying
• Product choice/Adding to cart
• Purchase quantity/Sales
• Recommendations
Moderators
Marketing factors: Brand reputation, cause-related marketing, decision reversibility, message framing, offer disclosure time, online reviews, personalization, price incentive/discount, product type, product information availability, TMSM platform characteristics
Consumer factors: Cognitive resources used to process TMSM, consumer culture, consumer location, consumption target, personality/individual differences, social exclusion, stage in the consumer journey, tie strength, time pressure, traffic source
Mediators
Visual attention/Eye-tracking measures
Perceptions about TMSM:
Perceived credibility, falsity/sales tactic, influence, justification, skepticism
Perceptions about products/brands as inferred from TMSM:
Attitude, attractiveness, availability, competition, popularity, quality, risk, safety, trust, uncertainty, uniqueness, value
Emotions triggered by TMSM:
Arousal, cognitive dissonance, gratitude, hope, pleasure, regret, rejoice, satisfaction, urgency
Intentions
• Information search intention
• Purchase intention
• Willingness to pay
• Willingness to recommend


TMSM
Limited-time
Limited-quantity
Specific
Vague
e.g., 40% off for a limited time (Hmurovic et al., 2023)
Demand
Supply
e.g., Limited-edition (Wu and Lee, 2016)
Static
e.g., Sale ends on June 20th (Hmurovic et al., 2023)
Dynamic
e.g., Countdown timer (Koh and Seah, 2023)
Specific
Vague
e.g., Selling fast (Moser et al., 2019)
Unit
Option
e.g., Only 5 left (Peschel, 2021)
Inventory-focused
Popularity-focused
e.g., 53 people looking at this deal (Ju and Ahn, 2016)
Inventory-focused
Popularity-focused
e.g., 90% of similar hotels in the city are booked for your travel dates (Song et al., 2019b)
e.g., 3,472 people are looking for a place to stay in this city (Teubner and Graul, 2020)

Appendix

Table A1: Summary of the articles included in the systematic literature review

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
1. Abbott et al. (2023)	To investigate how personality characteristics predict impulse buying in response to scarcity messages.	Scarcity messages affect consumer behavior differently, depending on individuals' Big Five personality traits.
2. Akram et al. (2018)	To investigate how situational factors, such as scarcity, predict impulse buying in social commerce, as well as the moderating role of hedonic shopping value.	Scarcity positively predicts impulse buying. Hedonic shopping value dimensions, including social shopping, relaxation shopping, value shopping, and adventure shopping, moderate this relationship.
3. Akram et al. (2023)	To investigate how scarcity moderates the relationship between web browsing and purchase intention in m-commerce.	Scarcity moderates the relationship between web browsing (including both hedonic and utilitarian dimensions) and purchase intention in m-commerce.
4. Baek and Yoon (2020)	To investigate the effect of time urgency in mobile reward apps. Study 1 examined the interaction effect between goal progress framing (to-go framing, such as "2 more stamps to go," vs. to-date framing, such as "8 stamps collected so far") and time urgency (high vs. low) on consumer responses and the mediating role of perceived goal importance. Study 2 examined the boundary condition of initial progress level (high vs. low).	Study 1 showed that under urgent conditions (e.g., an offer with an expiration date), a to-go (vs. to-date) reward elicits stronger purchase intentions. However, there is no difference in the control condition (an offer without an expiration date). Perceived goal importance mediates the interaction effect. Study 2 showed that under high progress levels, high urgency causes to-go (vs. to-date) rewards to elicit more positive consumer responses. The difference disappears in the low urgency condition. Moreover, under low progress levels, high urgency causes to-date (vs. to-go) rewards to elicit more positive consumer responses. The difference once again disappears in the low urgency condition.
5. Banerjee and Pal (2020)	To investigate how scarcity message type influences luxury hotel booking intention, and whether there is an interaction effect between scarcity message type and online purchase frequency.	Limited-time (vs. limited-quantity) scarcity messages induce higher booking intention. Frequent (vs. occasional) online purchasers exhibit higher booking intention. However, there is no interaction effect between scarcity message type and online purchase frequency.
6. Bozkurt and Gligor (2019)	To investigate how individuals' social exclusion affects their	Study 1 showed that rejected (vs. accepted) individuals have greater

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
	responses to two promotional cue types: scarcity and popularity. Two studies were conducted with different samples and products for better generalizability.	preference for products promoted by scarcity messages (relative to popularity cues). Need for uniqueness serves as a mediator. According to Study 2, rejected (vs. accepted) individuals have an increased need for uniqueness. This entices them to choose products promoted by scarcity messages.
7. Broeder and Wentink (2022)	To investigate how limited-time promotions affect purchase intention, with competitive arousal and perceived scarcity as mediators and culture as a moderator.	Limited-time promotions create perceived scarcity and subsequently competitive arousal. This in turn increases purchase intention. The indirect effect emerged only for the Italian participants (an individualistic-masculine society) but not for the Dutch participants (an individualistic-feminine society).
8. Chen and Yao (2018)	To investigate how situational factors including scarcity predict impulse buying behaviors.	Scarcity predicts normative evaluation and positive affect, which in turn predict impulse buying behaviors.
9. Chen and Zhang (2023)	To investigate how scarcity moderates the effect of livestream shopping marketing elements (namely, broadcaster competence, online crowding, and information diagnosticity) on consumers' purchase intention.	Scarcity moderates the effect of these three livestream shopping marketing elements on perceived price attractiveness and perceived uncertainty, both of which predict purchase intention.
10. Choi and Qu (2023)	To investigate how scarcity messages are related to customer loyalty across Korea and China.	In the Korean sample, scarcity messages increased both utilitarian and hedonic values as well as the urge to buy impulsively, which in turn led to satisfaction and loyalty. In the Chinese sample, scarcity messages only influenced hedonic value, which increased the urge to buy impulsively. Both utilitarian and hedonic values predicted satisfaction, which in turn determined loyalty.
11. Chung et al. (2017)	To investigate how situational factors, including scarcity, predict shopping values as well as the urge to buy impulsively.	Perceived scarcity moderates the relationship between impulsiveness and both hedonic and utilitarian shopping values, which then predict the urge to buy impulsively.
12. Coulter and Roggeveen (2012)	To investigate how the number of buyers, purchase limit, and time-to-expiration affect purchase decisions on group buying	According to Study 1, the effect of previous buyer numbers on purchase intention is greater when (a) time-to-expiration is short rather than long,

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
	websites. Two studies were conducted using different methodologies.	and (b) when a purchase limit is present rather than absent. In explaining the underlying process, Study 2 finds support for mediation through perceived value and regret.
13. Courty and Ozel (2019)	To investigate the value of scarcity signals in the context of flight booking.	Scarcity signals benefit only a small range of consumers, and even then, to a limited extent. They have a negligible effect on seller revenue and consumption.
14. Cremer (2018)	To investigate how limited-quantity and limited-time scarcity messages affect sales of physical information goods, and how the relationship is moderated by price.	Quantity-based scarcity results in an increase in the quantity purchased. Price serves as a significant moderator, especially for limited-quantity scarcity messages.
15. Cremer and Loebbecke (2021)	To investigate how scarcity messages affect online sales of printed books.	Scarcity messages with low inventory numbers deter sales early in the consumer journey but encourage conversions later in the purchase process. The greater the discount offered on the digital version relative to the physical book, the weaker is the impact of low inventory numbers. The higher the past quality perception, the weaker is the impact of low inventory numbers. The longer the time since launch, the stronger is the impact of low inventory numbers. The impact of low inventory numbers is weaker for the sales of utilitarian (vs. hedonic) goods.
16. Das et al. (2018)	To investigate how popularity vs. scarcity messages and regulatory focus affect consumer perceptions of risk, product uniqueness, and purchase intentions. Three studies were conducted.	According to Study 1, a best-seller cue works better for prevention-focused individuals, whereas a limited-edition cue works better for promotion-focused individuals. According to Study 2, a utilitarian product aligns with prevention goals and hence a popularity cue works better. In contrast, a hedonic product aligns with promotion goals and hence a scarcity cue works better. Study 3 showed that promotion-focused consumers prefer limited-edition (vs. best-seller) cues because limited-edition increases their perceptions of uniqueness. Conversely, prevention-focused

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
		consumers prefer best-seller (vs. limited-edition) cues because best-seller decreases their risk perceptions.
17. Drossos et al. (2019)	To investigate how two persuasion techniques (scarcity and social proof), coupled with three different types of site visitors (direct visitors, search engines, price comparison engines) affect website conversions.	Both scarcity and social proof persuasion techniques boost website conversions, regardless of the channel.
18. Eisenbeiss et al. (2015)	To investigate how time scarcity and discount interact with product type (hedonic vs. utilitarian) in the context of deal-of-the-day promotions. Study 1 was a lab experiment, while Study 2 involved analysis of secondary data.	According to Study 1, the positive effect of time scarcity is stronger for hedonic products. According to Study 2, the positive effect of discount is stronger for utilitarian products. However, there is no interaction effect between time scarcity and product type.
19. Elisa et al. (2022)	To investigate how scarcity is related to impulsive purchases of healthcare products in the context of the pandemic.	Scarcity positively predicts impulsive purchases of healthcare products. Social media use moderates the effect. Perceived value acts as a mediator.
20. Fogel and Setton (2022)	To compare the scarcity message types of high-demand, low-stock (i.e., limited-quantity), limited-time, and countdown timer with regular advertising without any scarcity message in terms of consumers' functional attitude, symbolic attitude, persuasion knowledge, and advertising skepticism.	High-demand scarcity messages result in greater functional attitudes and greater symbolic attitudes than regular advertising. Limited-time scarcity messages result in greater symbolic attitudes than regular advertising. High-demand scarcity messages are characterized by lower advertising skepticism than regular advertising.
21. Guo et al. (2017)	To investigate the mediating role of arousal in explaining how limited-time and limited-quantity scarcity messages relate to impulsive purchases.	Both limited-quantity and limited-time scarcity are positively related to arousal, which ultimately predicts impulsive purchases.
22. Guo et al. (2023)	To investigate how scarcity promotion in livestream shopping, impulsiveness, and product involvement interact to affect information search about the product.	Limited-quantity scarcity moderates the effect of involvement on information search. As limited-quantity scarcity increases, the positive association between involvement and information search weakens. This moderating effect is stronger for impulsive individuals.
23. Gupta et al.	To investigate how user	Scarcity messages and video product

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
(2023)	satisfaction with mobile shopping apps and impulse buying intention predict impulse buying behavior, as moderated by video product presentation and scarcity messages.	presentation significantly moderate the effect of impulse buying intention on impulse buying behavior. Scarcity has a more positive impact on males.
24. Hao and Huang (2023)	To investigate the effect of time scarcity in live streaming e-commerce on impulse buying, with perceived urgency as a mediator and product type as a moderator. Two studies were conducted with different sets of products.	According to Study 1, time scarcity predicts perceived urgency and impulse buying. It interacts with product type to affect perceived urgency. According to Study 2, perceived urgency mediates the effect of time scarcity on impulse buying only for utilitarian products, but not for hedonic products.
25. He and Oppewal (2018)	To investigate how stock and sales information affect consumer choice. Two studies were conducted. The second replicated the first, with the additional consideration of brand familiarity.	According to Study 1, the effect of sales information on consumer choice is more prominent than that of stock information (limited-quantity scarcity). Perceived popularity and quality mediate the effect. Study 2 finds support for the moderating role of brand familiarity.
26. Hmurovic et al. (2023)	To investigate how time scarcity activates persuasion knowledge, and the extent to which providing justifications for the time restrictions helps promote consumer interest online. Four experimental studies were conducted in different settings.	According to Study 1, when an online retailer provides an exogenous justification for a limited-time offer, the spontaneous activation of persuasion knowledge decreases. The difference in persuasion knowledge explains purchase intentions for the product. According to Study 2a, including a retailer-exogenous explanation for a limited-time promotion's time limitation increases perceived justification, which in turn triggers less activation of persuasion knowledge. According to Study 2b, a field experiment on Facebook, limited-time promotions with justification increase consumers' engagement with a Facebook ad, but only when the time until the deal's expiry is short. According to Study 3, individuals receiving limited-time deals with justification are more likely to

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
		engage with the promotions compared with those receiving promotions not limited by time.
27. Huang et al. (2020)	To investigate the effect of scarcity message type (demand-framed vs. supply-framed) and consumers' sense of power on purchase intentions, with perceived risk as a mediator.	Demand-framed (vs. supply-framed) scarcity leads to higher purchase intentions among those with a high sense of power. The difference is attenuated among those with a low sense of power. Perceived risk mediates the effect for individuals with a high sense of power but not for those with a low sense of power.
28. Jee and Hyun (2023)	To investigate how demand-framed scarcity (high vs. low) and numeracy framing (frequency vs. percentage) in the context of sport tickets affect perceived availability and estimated likelihood of finding a better deal.	Percentage-scarcity frames result in lower perceived availability and lower estimated likelihood of finding a better deal compared with frequency-scarcity frames. The effect is greater when demand is high.
29. Ju and Ahn (2016)	To investigate how scarcity moderates the effect of social presence and music tempo on impulse purchase behaviors in social commerce.	Social presence and music tempo positively affect pleasure and arousal, which in turn promote impulse purchase behaviors. Scarcity exerts a negative moderation effect on the relationship between music tempo and pleasure.
30. Kim et al. (2020a)	To investigate how demand-framed and supply-framed scarcity messages with price promotions affect consumer decisions and cognitive dissonance. Two experiments were conducted with different designs.	According to Study 1, booking likelihood is enhanced by supply-framed scarcity, especially at a discounted price, but not by demand-framed scarcity. Cognitive dissonance occurs when people choose a hotel deal with demand-framed scarcity. The intention to undo is reduced when multiple scarcity messages are provided. Study 2, however, did not replicate the findings of Study 1.
31. Kim et al. (2020b)	To investigate the role of construal level in determining individuals' response to limited-time offers. Two studies were conducted.	Individuals with low construal level are more likely to favor limited-time offers. To identify factors that can positively influence high-construal-level consumers, Study 1 tested deadline type (implicit/explicit), and Study 2 employed a countdown timer. While deadline type did not turn out to be influential, the presence of a countdown timer was helpful.

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
32. Koch (2015)	To investigate the role of scarcity and personalization on social sharing of online promotional campaigns.	Scarcity affects social sharing regardless of personalization. Personalization cues enhance social sharing when scarcity is absent, but their effect is nullified when scarcity is present.
33. Koch and Benlian (2015a)	To investigate how scarcity and social proof affect online referral propensity.	Scarcity affects online referral propensity regardless of the presence of social proof. Nonetheless, social proof amplifies scarcity's effect on referral propensity. Perceived value serves as a mediator. Social proof moderates the mediation.
34. Koch and Benlian (2015b)	To investigate how demand-framed scarcity messages and personalization affect referral behaviors in viral marketing campaigns.	Demand-framed scarcity messages affect referral propensity regardless of personalization. Nonetheless, personalization cues are effective in the absence of scarcity. Perceived value acts as a mediator.
35. Koh and Seah (2023)	To investigate the effectiveness of e-commerce dark patterns, including scarcity messages, on consumption decisions as a function of demographic traits.	Dark patterns in e-commerce prompt product selection. Limited-time cues are particularly effective in inducing consumption. Older people are more susceptible to the dark patterns.
36. Kordrostami et al. (2022)	To investigate how scarcity messages and online reviews affect consumer decisions through an online experiment (Study 1), and real-world data from Amazon (Study 2).	Study 1 showed that when review volume is high, the presence of a scarcity message weakens the effect of review valence. Study 2 showed that when review volume is high, a scarcity message reduces the effect of review valence. However, when review volume is low, the presence of a scarcity message strengthens the effect of review valence.
37. Kowalczyk et al. (2020)	To investigate how scarcity type (limited-quantity vs. stock-out) and offer disclosure (ex-post on the product page vs. ex-ante on the multiple-items page where different products are visible) affect consumer choices.	When scarcity messages are announced ex-post, consumers buy more items when confronted with a limited-quantity cue on the focal size than when confronted with a stock-out of non-focal sizes. Moreover, consumers buy more items when confronted with a stock-out of non-focal sizes announced ex-ante (vs. ex-post).
38. Lamis et al. (2022)	To identify scarcity and flash sale characteristics that influence impulse buying.	Arousal is heightened by both limited-quantity and limited-time scarcity, as well as flash sale characteristics such as entertainment.

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
		Arousal predicts impulse buying.
39. Lee et al. (2014)	To investigate how scarcity messages and cognitive load affect product evaluations, with company reputation as a moderator.	Consumers with a low cognitive load are likely to perceive scarcity as a sales tactic. However, when cognitive load is high, consumers are likely to fall back on the "scarce = good" heuristic. Company reputation acts as a moderator. A company's poor reputation leads consumers to infer that false scarcity messages are used to sell defective items.
40. Lee et al. (2015)	To investigate the effect of scarcity type on Korean and Chinese consumers, as well as the moderating role of message framing and need for cognitive closure.	Chinese consumers' impulse buying is more likely to be affected by limited-time (vs. limited-quantity) scarcity messages. There is also a significant three-way interaction among scarcity messages, message framing, and country on impulse buying.
41. Lee et al. (2018)	To investigate how scarcity messages affect product evaluations as a function of the perceptions of truth/falsity of the scarcity claims and decision reversibility.	Scarcity has a positive effect on product evaluation when decision reversibility is high. The effect is mediated by an inference process, whereby consumers perceive scarcity messages to signal either product value or manipulative intent.
42. Lee et al. (2023)	To investigate the effect of scarcity message type, sender type, and their interaction on purchase intention in Instagram as a distribution channel.	Limited-quantity cues induce a higher purchase intention than limited-time cues. Customer-sent promotions induce a higher purchase intention than corporate-sent promotions. However, there is no interaction effect between scarcity message type and sender type.
43. Li et al. (2021)	To investigate the extent to which consumers consider scarce hospitality businesses less safe in the aftermath of the COVID-19 pandemic. Three studies were conducted. Of these, Study 1 and Study 3 consider in-person dining scenarios, which are irrelevant to TMSM. Only Study 2 is relevant.	According to Study 2, scarcity messages decrease safety perception and purchase intention. However, the negative effect of scarcity on consumer preferences is reduced when external information (e.g., online reviews) refutes scarcity-driven inferences.
44. Li et al. (2023)	To investigate how scarcity promotions and cause-related events affect impulse buying intention in livestream shopping, with arousal and moral elevation as mediators. Of the three studies	According to Study 1a, both limited-quantity and limited-time scarcity promotions result in impulse buying intention. Arousal mediates the relationship. According to Study 2, scarcity

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
	conducted, Study 1a and Study 2 are relevant to TMSM.	promotions and cause-related events interact to affect impulse buying intention. In the presence of scarcity messages, cause-related marketing does not affect consumers' impulse buying intention.
45. Luo et al. (2019)	To investigate when (with vs. without carts) and how (scarcity vs. price promotion) to target consumers for higher purchase rates in e-commerce.	E-commerce cart targeting (ECT) has a substantial effect on consumer purchases. ECT design with a price incentive amplifies the effect. In contrast, a scarcity message attenuates the effect. While the scarcity nudge is more effective in the early shopping stage without carts, the price incentive is more effective in the late shopping stage with carts.
46. Luo et al. (2021)	To investigate how scarcity type predicts impulse purchase intent for FMCG and non-FMCG products.	Both limited-quantity and limited-time scarcity messages predict downward anticipated regret more strongly than upward anticipated regret. Anticipated regret is predicted more strongly by scarcity messages of FMCG vis-à-vis non-FMCG. Upward anticipated regret negatively predicts impulse buying intentions, whereas downward anticipated regret is a positive predictor. The relationship between anticipated regret and impulse buying intentions is moderated by personal impulsivity.
47. Maojie (2023)	To investigate how scarcity moderates the effect of livestream commerce anchor characteristics (professionalism, interactivity, and popularity) on consumers' premium purchase intention through perceived value.	Anchor characteristics in livestream commerce predict consumers' perceived value, which in turn is related to their premium purchase intention. Limited-time and limited-quantity scarcity positively moderate the relationship between perceived value and premium purchase intention.
48. Moser et al. (2019)	To investigate features that e-commerce sites use to encourage impulse buying (Study 1), and tools consumers desire to curb their online spending (Study 2).	Study 1 showed that e-commerce sites contain several features, including scarcity messages, that encourage impulsive buying. Study 2 showed that consumers would love to have access to tools that (a) encourage deliberation and avoidance, (b) enforce spending

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
		limits and postponement, (c) increase checkout effort, (d) make costs more salient, and (e) reduce product desire.
49. Mou and Shin (2018)	To investigate how social popularity and time scarcity influence consumer perceptions and visual attention.	Social popularity was important for consumers' trust, perceived product quality, and perceived value. Time scarcity was only important for perceived product quality and perceived value. While social popularity resulted in greater fixation counts, time scarcity prompted greater fixation attention.
50. Mukherjee and Lee (2016)	To understand the effect of scarcity appeals on product evaluation in online (Study 1), print (Study 2), and store (Study 3) advertising. Study 1, which is the only study related to TMSM, examined how the presence of scarcity messages and the expectation of scarcity due to demand influence product evaluation.	According to Study 1, the positive effect of scarcity messages on product evaluation is attenuated when consumers have low (vs. high) expectation of scarcity due to demand.
51. Noone and Lin (2020)	To investigate the effect of price promotions-limited-time scarcity and demand-driven limited-quantity scarcity on booking intentions as a function of booking lead-time.	When booking lead-time is long, both scarcity message types drive consumers' perceptions of competition and price uncertainty. These in turn amplify anticipated regret, ultimately promoting booking intentions. However, when booking lead-time is short, the use of scarcity messages makes little difference.
52. Park (2023)	To investigate how the level of scarcity in C2C second-hand trading platforms and consumers' environmental consciousness affect impulse buying intention through the ease of justification.	Consumers with low environmental consciousness show a higher impulse buying intention when scarcity level is high (vs. low). However, consumers with high environmental consciousness do not show a significant difference as a function of scarcity level. Ease of justification mediates the relationship only for those with low environmental consciousness.
53. Park et al. (2017)	To investigate the effect of scarcity, popularity, and online ratings on booking intentions.	Popularity and online ratings positively affect booking intentions. Specifically, when the scarcity is low, high popularity results in greater booking intentions.
54. Park et al.	To investigate the effect of	Disclosing scarcity messages to

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
(2020)	scarcity messages on products' daily sales.	signal impending stockouts decreases daily sales.
55. Park et al. (2022)	To investigate the role played by childhood socioeconomic status and materialism in the effect of scarcity information on hotel booking. Three studies were conducted.	According to Study 1, individuals show a preference for a hotel room option if they know that the room is scarce. This preference is stronger for those with low childhood socioeconomic status (Study 2) and low materialistic traits (Study 3).
56. Peng et al. (2019)	To investigate the role of limited-time scarcity and product involvement in the relationship between perceived value and purchase intention.	Time pressure has a negative regulating effect on the relationship between perceived value and purchase intention. Perceived value predicts purchase intention under high time pressure, particularly for high-involvement products.
57. Peinkofer et al. (2016)	To investigate the impact of online inventory availability disclosure on consumer perceptions in the context of stockouts.	Inventory availability level negatively affects expected consumer competition. Sales-proneness enhances the effect. The relationship between inventory availability level and shopping satisfaction is mediated by expected consumer competition.
58. Peschel (2021)	To investigate how weight and income affect responses to scarcity messages.	Scarcity messages affect obese populations with lower incomes more strongly than those with higher incomes or normal weights.
59. Qu et al. (2023)	To investigate how anticipated emotions mediate the relationship between impulse buying tendency and scarcity-induced purchase decisions in livestream commerce.	The anticipated emotions of regret and rejoice mediate the relationship between impulse buying tendency and scarcity-induced purchase decisions.
60. Sergeeva et al. (2023)	To investigate the effect of age, gender, education, and neuroticism on the perceived influence of scarcity messages.	Consumers consider scarcity messages to be influential for their decision-making. Individuals with a level of education higher than a bachelor's degree perceive the influence of countdown timers to be significantly lower compared with people with lower education levels.
61. Song et al. (2017)	To investigate how tie strength, scarcity level, and shopping stage affect purchase intention.	At low scarcity levels, weak tie recommendations are more persuasive for consumers in the initial shopping stage, while strong tie recommendations are more persuasive in later stages. These differences are attenuated at high scarcity levels.
62. Song et al.	To investigate how referral	Offering referral reward programs

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
(2019a)	reward programs with scarcity messages affect consumers' intention to recommend bank credit cards.	with scarcity messages increases behavioral intentions to recommend. Limited-quantity scarcity messages have the highest positive impact.
63. Song et al. (2019b)	To investigate how unit and option scarcity messages, along with booking lead-time, affect consumer booking intentions.	When booking lead-time is long, unit (vs. option) scarcity messages are more effective as they induce higher perceptions of credibility and sell-out risk. When booking lead-time is short, the difference between the two message types is attenuated.
64. Song et al. (2020)	To investigate how referral reward programs utilizing scarcity messages influence bank credit holders' referrals to and adoptions by close or distant friends.	Offering referral reward programs with quantity scarcity increases the overall number of referrals to and adoptions by close and distant friends. As quantity scarcity is relaxed, the percentages of referrals to and adoptions by close friends decrease.
65. Song et al. (2021)	To investigate the effect of scarcity message type on willingness to purchase, with perceived competition as a mediator and social cue messages as a moderator.	In the presence of limited-quantity scarcity, social cue messages enhance perceived competition and consequently purchase intention. However, in the presence of limited-time scarcity, social cue messages have no such effect.
66. Sun et al. (2022)	To investigate how various types of scarcity messages in mobile coupons affect smartphone users' purchase intentions, as well as the moderating effect of product type and location. Study 1 considered consumers to be at home, while Study 2 delved into the at-home vs. in-store comparison.	According to Study 1, only quantity and vague scarcity messages influence smartphone users' purchase intentions. Limited-time scarcity messages did not significantly differ from the non-scarcity condition. According to Study 2, limited-quantity scarcity messages are the most effective way to encourage smartphone users' purchase intentions when they are at home, but limited-time scarcity messages work better when individuals are in stores. In addition, vague scarcity is an effective way to encourage consumers to purchase high-involvement products when they are at home as well as low-involvement products when they are in stores.
67. Teubner and Graul (2020)	To investigate how scarcity messages on B2C hotel-based and C2C peer-based hospitality	Both supply-framed and popularity-framed scarcity messages promote scarcity perceptions and, in turn,

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
	platforms affect consumer perceptions and booking intentions. Prior to the main study, scarcity messages available on Booking.com (B2C) and Airbnb (C2C) were also explored.	booking intentions. Supply-framed cues are more effective. Furthermore, two distinct effect paths are revealed from scarcity perceptions to booking intentions. One is through perceived urgency (the get-it-before-it's-gone effect), while the other is through perceived value (the must-be-good effect). The effect of perceived urgency on booking intention is higher for hotels than for peer-to-peer accommodations. The qualitative comments reveal that scarcity messages pressurize purchases and make individuals feel that they have little option.
68. Trivedi et al. (2023)	To investigate the effect of short-lived surprise deals offered on aspirational out-group brands on consumer repurchase intention, the moderating role of self-enhancement goals, and the mediating role of peak-transcendent customer experience as well as hope.	Online short-lived surprise deals promote purchase intention. The relationship is not moderated by self-enhancement goals. Purchase intention predicts repurchase intention from the same website. Hope of finding a similar deal on the website is critical for generating repurchase intention.
69. Vannisa et al. (2020)	To investigate how perceived perishability (limited-time) and perceived scarcity (limited-quantity) predict shopping enjoyment and impulse buying.	Both perceived perishability and perceived scarcity positively predict attitude toward flash sales. This, in turn, is positively related to shopping enjoyment and impulse buying.
70. Wang et al. (2021)	To investigate the extent to which time-restricted offers on social media determine click-throughs, as well as the moderating role of offer exclusivity. Two studies were conducted. Study 1 was a scenario-based experiment, while Study 2 was a field experiment.	According to Study 1, time-restricted offers result in positive offer evaluation, which then induces click-through intention. In particular, limited-time scarcity enhances click-through intention through offer evaluation when the offer is not exclusive. According to Study 2, time-restriction positively affects actual click-through when the offer is not exclusive.
71. Wang et al. (2023)	To investigate the effect of sales volume and limited-quantity scarcity on intertemporal choice in an online consumption context. Two studies were conducted. Study 2 replicated Study 1 while	Limited-quantity scarcity had no main effect in either study. Nonetheless, Study 2 found a significant three-way interaction among sales volume, limited quantity, and dynamic changes in

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
	additionally considering dynamic changes in sales.	sales.
72. Wrabel et al. (2022)	To investigate the effect of limited-quantity scarcity messages on purchase decisions in the presence of textual online reviews.	Limited-quantity scarcity lowers individuals' processing of textual review information. This in turn increases perceived product value and has considerable negative consequences for the final purchase decision if the scarcity message is displayed next to a low-quality product.
73. Wu and Lee (2016)	To investigate the impact of the consumption target on the relative effectiveness of scarcity and popularity cues. Study 1 sought to demonstrate the basic cue type-consumption target interaction effect. The psychological mechanisms were examined via perceived product uniqueness (in Study 2, self-purchase), and perceived consumption risk (in Study 3, other purchase). Study 4 examined the effect of price level as a moderator.	Study 1 shows a significant cue type-consumption target interaction effect on both product attitudes and purchase intentions. Study 2 shows that for self-purchases, scarcity (vs. popularity) cues enhance consumers' purchase intentions. Study 3 shows that when purchasing a product for other people, popularity (vs. scarcity) cues enhance consumers' purchase intentions. According to Study 4, the scarcity-for-me effect is significant only at the high price point, but the popularity-for-others effect is significant only at the low price point.
74. Wu et al. (2021)	To investigate how limited-quantity and limited-time scarcity messages affect impulse purchase with arousal as a mediator.	Both limited-quantity and limited-time scarcity messages increase perceived arousal, which then lead to impulse purchases. Personal impulsiveness positively predicts impulse purchases.
75. Xu et al. (2023)	To investigate how time and quantity pressure tactics affect impulse buying intention in online group buying.	Time pressure is a positive predictor of arousal, while quantity pressure is a negative predictor of pleasure. Both pleasure and arousal are positively related to impulse buying intention.
76. Yi et al. (2023)	To investigate the effect of product popularity and time restriction on consumers' product approach behavior as their shopping goals become more concrete. Two studies were conducted: a field experiment and a lab experiment.	According to Study 1, consumers without concrete shopping goals are attracted by popularity cues and time restrictions but the effect disappears for those with concrete shopping goals. According to Study 2, popularity has a stronger effect on purchase

Article	Key TMSM-Related Objectives	Key TMSM-Related Findings
		intention when shopping goals are less concrete, and time restriction is high. Consumers with concrete goals pay more attention to the popularity cue in the presence of high time restriction than low time restriction.
77. Zhang and Phang (2023)	To investigate how consumers' perceived scarcity, perceived uniqueness, perceived value, and need for uniqueness are related to their purchase intention toward luxury fashion non-fungible tokens.	Perceived scarcity and need for uniqueness are positively related to perceived uniqueness, which in turn predicts perceived value. Perceived value mediates the relationship between perceived uniqueness and purchase intention.
78. Zhao et al. (2021)	To investigate the effect of a variety of factors, including scarcity messages, on online shopping cart abandonment. Only Study 4 is relevant to TMSM.	According to Study 4, reminding consumers to clean items in their online shopping carts polarizes liking and purchase intention toward the most-favorite and the least-favorite items. This polarization is magnified when the items are scarce. Anticipated regret mediates the effect.

Source: Authors' own work

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