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ORIGINAL EMPIRICAL RESEARCH

Product recall effectiveness and consumers' participation in corrective actions

Sascha Raithel[1] · **Stefan J. Hock**[2] · **Alexander Mafael**[3]

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Abstract

Firms struggle to respond to product recalls and achieve high recall effectiveness, i.e., the percentage of affected consumers who participate in corrective actions. We present the first comprehensive study of recall effectiveness that analyzes a broader set of product categories, identifies managerially relevant drivers, outlines boundary conditions, and demonstrates the underlying psychological processes. Specifically, three studies investigate the impact of remedy choice, incident likelihood, and their interaction with firm reputation on recall effectiveness. In Study 1 (unique secondary data set), we show that remedy choice and incident likelihood each interact with the firm's reputation to influence recall effectiveness. In two subsequent experiments, we not only test the findings of the secondary data in a causal setting but also examine the underlying psychological process. We find that offering full remedy leads to higher recall effectiveness for high reputation firms and that recall effectiveness is higher for recalls with a high incident likelihood, but only for high reputation firms. In both cases, firms not only make consumers feel like they would benefit more from participating in the recall, but they also make them feel more comfortable in their ability to participate in the recall. These nuanced findings enable us to derive actionable guidelines for firms to increase recall effectiveness.

Keywords Product recall · Product recall effectiveness · Recall compliance · Health belief model

In 2022, the Consumer Product Safety Commission (CPSC) issued almost 300 distinct product recalls featuring over 40 million consumer products, such as furniture, toys, clothing, appliances, household items, or outdoor products, among others.[1] Yet, recall effectiveness, a key indicator of a successful product recall, is only 6% (CPSC 2018). This extremely low number can have devastating consequences. For instance, IKEA recently agreed to pay $46 million to the parents of a toddler crushed to death by one of their MALM dressers (The New York Times, 2020). Each year, defective consumer products are involved in the deaths of an estimated 23,000 Americans and cause injuries to 31 million others. These injuries, deaths, and associated property damages cost the American public more than $1 trillion annually (CPSC 2023). How can firms improve the recall effectiveness of their consumer products, thereby avoiding litigation costs and reputation damage as well as enhancing societal well-being?

Sascha Raithel, Stefan J. Hock and Alexander Mafael contributed equally to this work.

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✉ Sascha Raithel
sascha.raithel@fu-berlin.de

Stefan J. Hock
stefan.hock@uconn.edu

Alexander Mafael
alexander.mafael@hhs.se

[1] Freie Universität Berlin, Arnimallee 11, 14195 Berlin, Germany

[2] University of Connecticut, 2100 Hillside Road, Storrs, CT 06269, USA

[3] Stockholm School of Economics, Center for Retailing, Saltmätargatan 13-17, SE-113 83 Stockholm, Sweden

[1] The CPSC jurisdiction includes any product (e.g., cribs, coffee makers, toys, lawn mowers) which is not covered by the law of another agency. The list of products outside the jurisdiction of CPSC (e.g., aircraft, trucks, cars, tires, boats, medical devices, food, tobacco products, guns, cosmetics, and drugs) is available here: https://www.cpsc.gov/Regulations-Laws--Standards/Products-Outside-CPSCs-Jurisdiction.

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A literature review on product recall effectiveness only yielded 17 quantitative articles (see Web Appendix A). One stream (three articles) uses recall effectiveness as an independent variable. A second stream (one article) uses recall effectiveness as a moderator. A third stream (13 articles), most relevant to our research, uses recall effectiveness as a dependent variable. Based on this literature review, we identify three significant gaps that limit our understanding of how firms can increase recall effectiveness for consumer products, and thus require particular attention.

First, and most importantly, there are additional factors in the consumer-product context that managers can influence strategically. Yet, their impact on recall effectiveness is unknown. Second, while previous research shows that reputation shapes customers' response to product recalls (e.g., Germann et al., 2014) it does not shed light on its impact on recall effectiveness. Third, while previous research has repeatedly called for the study of mediating processes (e.g., Cleeren et al., 2017), there is currently very little work examining them.

In light of these gaps, the purpose of our research is to identify managerially relevant drivers of recall effectiveness, outline boundary conditions, and demonstrate the underlying psychological processes. Specifically, we seek to answer the following questions:

(1) *How do remedy and incident likelihood influence recall effectiveness?*
(2) *How does firm reputation moderate these effects?*
(3) *What are the underlying psychological processes?*
(4) *How does firm reputation moderate these processes?*

Thereby, we contribute to the literature the following three ways. First, prior research suggests that remedy, the corrective or compensation measure that firms provide for the defective products (Liu et al., 2016), and incident likelihood, the likelihood that consumers will experience harm if they continue to use the defective product, are key factors for product recall management (e.g.,Chen et al., 2009; Dawar & Pillutla, 2000; Mafael et al., 2022; Raithel & Hock, 2021). Even though these two factors are an integral part of every standardized CPSC recall announcement, their impact on recall effectiveness remains unknown. We find that recall effectiveness improves, on average, by 11.4% if firms offer full instead of partial remedy (all else equal). While previous research has examined the impact of different kinds of hazards[2] (e.g., Hoffer et al., 1994; Malec et al., 2021; Rupp & Taylor, 2002; Seys et al., 2017; Yu & Hooker, 2019, 2020) on recall effectiveness, the impact of incident likelihood on recall effectiveness also remains unknown. By extending Hall and Johnson-Hall (2021), our results show that incident likelihood alone does not have an impact on recall effectiveness for consumer products.

Second, we demonstrate the moderating role of firm reputation, which is a key factor during times of crisis in general (for an overview, see Bundy et al., 2021, p. 1110) and product-harm crisis in particular (Germann et al., 2014; Mafael et al., 2022; Raithel & Hock, 2021). Reputation, which is defined as the extent to which a firm is highly esteemed, worthy, or meritorious and held in high regard by evaluators (Dollinger et al., 1997), interacts with remedy, such that it is more important for firms with high (vs. low) reputation to offer full remedy. Similarly, reputation interacts with incident likelihood, such that recall effectiveness is higher for recalls with a high incident likelihood, but only when a high reputation firm is involved. These nuanced findings enable us to derive actionable guidelines for firms.

Third, we show that the impact of remedy and incident likelihood on recall effectiveness is mediated by perceived benefits and self-efficacy, which are two essential factors for individuals to take action to prevent a detrimental outcome (e.g., Hita et al., 2023; Zhou et al., 2021), yet research on recall effectiveness has not yet examined them (Pagiavlas et al., 2022). Their mediating role is also moderated by firm reputation. When high reputation firms fully compensate consumers or the incident likelihood is high, firms not only make consumers feel like they would benefit more from participating in the product recall, but they also make them feel more comfortable in their ability to follow the advised action of the product recall.

Theoretical background and hypothesis development

Consumer participation in corrective actions: The original health belief model

The HBM seeks to explain why people do not participate in programs to prevent and detect diseases (Hochbaum, 1958). Recently, it has been used to predict a variety of preventive behaviors, such as adherence to COVID-19 guidelines (Hita et al., 2023) or compliance with a product safety campaign (Pagiavlas et al., 2022). As defective products pose a health threat to consumers and are accompanied by guidelines to prevent harm, we propose that the HBM also offers a theoretical foundation to conceptualize consumers' likelihood to participate in the recall.

The original HBM suggests six factors that underlie people's beliefs that taking corrective action is likely to prevent

[2] Previous research uses hazard (e.g., Rupp & Taylor 2002), risk (e.g., Yu & Hooker 2019), and severity (e.g., Malec et al., 2021) interchangeably. This variable typically describes the hazard as a binary (e.g., low vs. high) or categorical variable (e.g., class 1, 2, or 3) depending on how dangerous the defect is for consumers.

harm: (1) perceived benefits (i.e., beliefs about advised action leading to benefits outweighing costs), (2) perceived self-efficacy (i.e., confidence in one's ability to take action), (3) perceived barriers (i.e., beliefs about the tangible costs of engaging in the advised action), (4) perceived susceptibility (i.e., beliefs about the chances of experiencing a harmful situation), (5) perceived severity (i.e., beliefs about how serious the consequences are), and (6) cues to action (i.e., strategies to activate consumer engagement with the advised action).

Modifying the health belief model to the product recall context

The original HBM assumes that these six factors act in *parallel* to each other. To account for the specifics of the product recall context, we divert from that reasoning and propose two modifications and one extension. First, the recall announcement serves as the initial cue to action, informing consumers that their product is potentially defective and they need to act to prevent harm. Cues to action are necessary to create awareness of the threat and trigger appropriate corrective behavior (Janz & Becker, 1984). We follow this reasoning and consider the recall announcement issued by the CPSC as the external cue to action. This allows us to theorize how remedy and incident likelihood, both highlighted in every standardized CPSC recall announcement, serve as cues to action and influence recall effectiveness.

Second, the original HBM does not account for the impact of institutional characteristics on individuals' likelihood of participating in preventive measures. However, reputation is often used as a heuristic when making judgments about actors and events (Fiske & Neuberg, 1990) and shapes consumers' response to firms' corrective actions (e.g., Capelos et al., 2016; Cairns et al., 2013; Germann et al., 2014; Jorm et al. 1997; Mafael et al., 2022; Raithel & Hock, 2021). For instance, Capelos et al. (2016) show that the reputation of an organization has a positive effect on individuals' likelihood to comply with corrective actions. Based on these findings, we extend the original HBM with firm reputation and show how it moderates the (i) main effects of remedy and incident likelihood and (ii) mediating processes.

Third, we propose that consumers' perceived benefits and self-efficacy of complying with the recall mediate the impact of remedy and incident likelihood on recall effectiveness. The HBM predicts that people weigh the benefits and costs of participating in corrective actions (Janz & Becker, 1984) and assess their self-efficacy to engage with a treatment (Zhou et al., 2021). In other words, consumers need to appreciate the benefit of participating in the recall and must feel that they are able to do what the recall asks them to do. In summary, our research modifies and extends the HBM to capture the characteristics of consumers' compliance with corrective actions. Figure 1 displays the conceptual framework and corresponding hypotheses.

The impact of remedy on recall effectiveness (H1)

There is limited research on the role of remedy, despite being a vital component of recalls (Liu et al., 2016). Both the literature (e.g., Liu et al., 2016; Raithel & Hock, 2021)

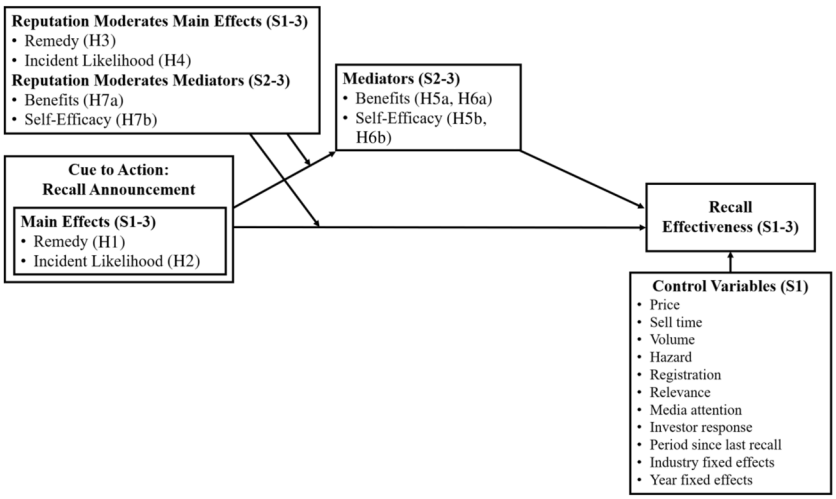

Fig. 1 Conceptual framework. Notes: S1: Study 1 (secondary data) utilizes control variables to examine the main effects of remedy (H1) and incident likelihood (H2) and their interaction with reputation (H3: remedy* reputation; H4: incident likelihood*reputation). S2: Study 2 (experiment) examines if perceived benefits (H5a) and self-efficacy (H5b) mediate the relationship between remedy and recall effectiveness and how reputation moderates these mediators (H7a, b). It does not use the control variables displayed above. S3: Study 3 (experiment) examines if perceived benefits (H5b) and self-efficacy (H6b) mediate the relationship between incident likelihood and recall effectiveness and how reputation moderates these mediators (H7a, b). It does not use the control variables displayed above.

and regulatory agencies (e.g., CPSC, NHTSA) generally distinguish between partial (e.g., do-it-yourself repair kit) and full remedy (e.g., replacement). For full remedies, firms are responsible for correcting the defective product. For partial remedies, on the other hand, some of the responsibility is shifted to consumers. In the automotive (food) industry, partial remedies are most prevalent (full remedies are the standard). For consumer products, however, firms can typically choose between partial and full remedy. There is some evidence that full remedy is likely to serve as a stronger cue to action. For example, Mafael et al. (2022) find that offering full remedy is the dominant strategy for firms to restore satisfaction. Similarly, offering full remedy helps to restore consumers' trust and thereby may positively affect the likelihood that consumers engage with the firm in the future (Siegel & Vitaliano, 2007). While none of these studies investigate the influence of remedy on recall effectiveness, they offer some insights into how remedy might influence recall effectiveness. Specifically, offering *full* remedy is more likely to increase recall effectiveness compared to partial remedy, because it provides consumers with a level of compensation that restores the imbalance resulting from receiving a defective product (Mafael et al., 2022). In contrast, *partial* remedy shifts the responsibility of fixing the product to the consumer, which disincentivizes returning the product and serves as a weaker cue to action.

H1 Full (vs. partial) remedy increases product recall effectiveness.

The impact of incident likelihood on recall effectiveness (H2)

A defective product creates a risk for consumers (Muralidharan et al., 2019). Firms can work with regulating agencies to recall a product earlier in the investigation or they can delay it until there is no other option (Chen et al., 2009). This results in a fundamental strategic decision, that is, whether to recall the product proactively (i.e., before any incident occurred) or reactively (i.e., after incidents have been reported). Research suggests that a swift response to the discovery of a defective product is a key element of an effective recall when the firm aims to protect brand equity and attenuate the negative effects on future purchase intentions (Dawar & Pillutla, 2000). Raithel and Hock (2021) therefore argue that proactive recalls signal higher firm investments in the recall. In contrast, Hall and Johnson-Hall (2021) argue that a reactive recall could be a sign of better preparation by the firm. Further, evaluators may interpret a proactive recall as a signal of severe hazard and future financial damages, and, thus, react more negatively to a proactive recall (Chen et al., 2009). As the number of incidents is communicated publicly in the official recall announcement and frequently picked up by the media, it serves as another powerful cue to action for consumers: How likely is it that they will be negatively affected by the defective product if they do not participate in the recall? Yet, existing research has not examined the effect of incident likelihood on recall effectiveness. A reactive (proactive) recall has a higher (lower) incident likelihood, which signals to consumers that they have a higher (lower) probability of being harmed (Hora et al., 2011; Siomkos & Kurzbard, 1994). Consequently, they are more (less) likely to participate in the product recall.

H2 High (vs. low) incident likelihood increases product recall effectiveness.

The moderating role of firm reputation

A huge body of research emphasizes the importance of a firm's reputation during times of crisis in general (Bundy et al., 2021). During times of product-harm crisis, in particular, prior research suggests that the recalling firm's reputation shapes consumers' perception of and response to corrective actions (e.g.,Germann et al., 2014; Mafael et al., 2022; Raithel & Hock, 2021). Specifically, reputation has a positive effect on consumers' perceptions that the firm can address the issue at hand and the likelihood of complying with corrective actions (Capelos et al., 2016). Moreover, crisis management literature recognizes firm reputation as one of the key factors of individuals' response to both the crisis itself and the firm's response to the crisis (e.g., Coombs, 2006), especially in negative situations (e.g., Zayalova et al., 2016). Importantly, reputation is often used as a heuristic when making judgments about actors and events and thus, influences actions derived from these judgments (Fiske & Neuberg, 1990). Next, we detail how reputation moderates the influence of remedy and incident likelihood on recall effectiveness.

The moderating role of firm reputation on remedy (H3) For *high reputation* firms, we expect a differential impact of partial versus full remedy on recall effectiveness. Consumers associate high reputation firms with superior quality (Rindova et al., 2005). The high reputation provides a halo effect during times of crises (Coombs & Holladay, 2006), leading consumers to believe that the product defect is not as bad, especially when the firm only offers partial remedy. However, if the firm offers *full* remedy, it signals that the failure is much worse than expected (Chen et al., 2009), and consumers are more likely to act and comply with the recall.

On the contrary, we do not expect the same differential impact of partial versus full remedy on recall effectiveness for *low reputation* firms. When confronted with recalls from *low reputation* firms, consumers are more inclined to take the defect seriously and participate in the recall irrespective

of remedy type, because the occurrence of a defect is in line with lower expectations towards the firm and the quality of its products (Rindova et al., 2005).

H3 Firm reputation moderates the positive impact of full (vs. partial) remedy on product recall effectiveness positively, such that full (vs. partial) remedy increases recall effectiveness more (less) for high (low) reputation firms.

The moderating role of firm reputation on incident likelihood (H4) Even though a recall announcement states the product defect itself, its potential consequences to consumers, and the number of reported incidents in a standardized format, there is still an element of ambiguity. Specifically, consumers' perceptions of this signal are also influenced by the firm's reputation.

We expect a differential impact of incident likelihood on recall effectiveness for *high reputation* firms. When incident likelihood is *high* and firm reputation is *high*, customers may interpret the fact that several incidents have already occurred as a strong signal to participate in the recall. They hold the firm in high regard and may assume that the occurrence of incidents with high quality products is particularly severe (Germann et al., 2014). Leavitt (1979) and Hoffer et al. (1994) provide evidence that compliance is influenced by differences in perceived severity. Thus, customers may perceive the same incident likelihood as more threatening if the recall is issued by a high reputation firm. Conversely, when incident likelihood is *low* and firm reputation is *high*, there is less need for customers to revisit their beliefs about the firm, because high reputation firms benefit from a buffering effect. Customers are more likely to discount the recall as an exception (Hess 2008), thereby feeling less of a need to comply with the recall.

On the contrary, we do not expect the same differential impact of incident likelihood on recall effectiveness for *low reputation* firms. When incident likelihood is *high* and firm reputation is *low*, consumers may believe that the firm is not able to deal with the defective product adequately given the lower quality expectations (Rindova et al., 2005). In other words, consumers do not believe that participating in the recall will be helpful. This argument mirrors findings from health psychology that patients are less likely to seek help if they perceive that the medical professional lacks the competence to treat them adequately (Jorm et al., 1997). When incident likelihood is *low* and firm reputation is *low*, the recall appears less dangerous, and thus participation is less likely (Pagiavlas et al., 2022).

H4 Firm reputation moderates the positive impact of high (vs. low) incident likelihood on recall effectiveness positively, such that high (vs. low) incident likelihood increases recall effectiveness more (less) for high (low) reputation firms.

The mediating roles of perceived benefits and self-efficacy, and the moderating role of firm reputation

As mentioned previously, the HBM offers perceived benefits, self-efficacy, barriers, susceptibility, and severity as potential mediators. We focus our theorizing on perceived benefits and self-efficacy as the two focal mediators for the following two reasons. First, even though prior research in other health-related contexts have deemed them important (e.g., Carpenter, 2010; Hita et al., 2023; Ritchie et al., 2021; Zhou et al., 2021), prior research on recall effectiveness has neglected them (Pagiavlas et al., 2022). Second, a meta-analysis in the health context found that perceived barriers, susceptibility, and severity appear to be the least strongly associated variables of the HBM (Ritchie et al., 2021).[3]

Perceived benefits and self-efficacy mediate the impact of remedy on recall effectiveness (H5) Offering full repair, replacement, or refund has a positive impact on perceived benefits and self-efficacy because the benefits are obvious to consumers (i.e., the issue is completely resolved) and they are more confident in their ability to participate in the recall (i.e., the firm is fully responsible for fixing the issue). Consequently, consumers are more likely to participate in the recall because they receive an unambiguous signal that the firm will take care of the defect (Liu et al., 2016). In contrast, partial remedies have a negative impact on perceived benefits and self-efficacy, because they often require consumers' time (e.g., consumers may have to use a repair kit) and pose economic (i.e., risk of damaging product) and safety risks (i.e., injury) to consumers. Carpenter (2010) shows that reducing perceived benefits by adding costs, making the process inconvenient, and creating discomfort related to carrying out a specific behavior (i.e., lowering self-efficacy) decrease the likelihood of engaging in preventive actions. Schwarzer and Fuchs (1996) argue that consumers' self-efficacy is further decreased if there is a chance that the product will not be repaired successfully.

H5 The relationship between remedy and recall effectiveness is mediated by perceived (a) benefits and (b) self-efficacy, such that full (vs. partial) remedy increases perceived benefits and self-efficacy more (less).

Perceived benefits and self-efficacy mediate the impact of incident likelihood on recall effectiveness (H6) High (vs. low) incident likelihood indicates that more people

[3] We thank the review team for suggesting to only provide formal hypotheses for perceived benefits and self-efficacy. Nevertheless, we still explore the remaining three mediators barriers, susceptibility, and severity empirically for completion purposes, because they are also the part of the HBM.

have already been harmed by the defective product. This imminent threat may motivate consumers to participate in the recall. Indeed, a meta-analysis of experimental studies by Sheeran et al. (2014) demonstrated "that when interventions successfully increase risk perceptions […], subsequent increases in behavioral intentions and health behavior change are produced" (Ferrer and Klein 2015, p. 89). Consequently, consumers perceive participating in the recall to be more beneficial, because they eliminate the imminent threat (Joseph et al., 2009).

Perceived self-efficacy should also be higher if the incident likelihood is high (vs. low). Supporting this argument, Kim et al. (2020) show that illness perceptions are associated with self-efficacy, such that people who believe that they are likely to suffer from an illness have higher self-efficacy and, consequently, are more likely to adhere to treatments. Thus, a high incident likelihood should increase self-efficacy because it signals that harm is more probable.

H6 The relationship between incident likelihood and recall effectiveness is mediated by perceived (a) benefits and (b) self-efficacy, such that full (vs. partial) remedy increases perceived benefits and self-efficacy more (less).

Firm reputation moderates the mediating impact of perceived benefits and self-efficacy (H7) Previously, we proposed that the impact of remedy (H5) and incident likelihood (H6) on recall effectiveness is mediated by perceived benefits (a) and self-efficacy (b). However, HBM researchers strongly recommend exploring moderators of the indirect effects (e.g., Carpenter, 2010; Jones et al., 2015). We follow their suggestion and investigate the impact of firm reputation, which is a key factor during times of crisis in general (for an overview, see Bundy et al., 2021, p. 1110) and product-harm crisis in particular (Germann et al., 2014; Mafael et al., 2022; Raithel & Hock, 2021). We expect that firm reputation moderates consumers' perceived benefits and self-efficacy, such that they are more likely to participate in the recall when a high reputation firm offers full remedy or incident likelihood is high.

Following the rationale of H3 and H4, consumers perceive *high reputation* firms as more trustworthy and capable of fixing the issue. Thus, consumers are more likely to believe that they benefit from participating in the recall and that they are more capable of following the advised action. On the other hand, for *low reputation* firms, the occurrence of a defect is in line with lower expectations of consumers towards the firm and the quality of its products (Rindova et al., 2005). Consequently, consumers are less likely to believe that they benefit from participating in the recall and that they are less capable of following the advised action.

H7 Firm reputation moderates the mediating effects of perceived (a) benefits, and (b) self-efficacy, such that the respective indirect effect becomes more (less) positive when firm reputation is high (low).

Overview of studies

In Study 1 (secondary data), we test all drivers of recall effectiveness from our conceptual framework and demonstrate that recall effectiveness is higher if firms offer full (vs. partial) remedy and for recalls with a high (vs. low) incident likelihood. Importantly, we find evidence that firm reputation interacts with remedy and incident likelihood, such that it is more important for firms with high reputation to offer full remedy and that recall effectiveness is higher for recalls with a high incident likelihood, but only when a high reputation firm manufactured the product. In the two subsequent experiments, we not only test the findings of the secondary data in a causal setting but also use the HBM to examine the underlying process. We show that the impact of remedy (Study 2) and incident likelihood (Study 3) on recall effectiveness is not only mediated by perceived benefits and self-efficacy, but also moderated by firm reputation. In other words, when high reputation firms fully compensate consumers or the incident likelihood is high, firms not only make consumers feel like they would benefit more from participating in the product recall but also make them feel more comfortable in their ability to follow the advised action of the product recall, which in turn increases consumers' likelihood of recall participation.

Study 1: Secondary data for recall effectiveness

Data sources, measures, and sample

The field study analyzes recall effectiveness of the CPSC. The CPSC releases a standardized recall announcement together with the affected firm if the CPSC, the firm, a consumer, or any other supply chain member identifies a significant product hazard. The primary two objectives of any recall are to (a) locate and remove defective products as quickly as possible and (b) "communicate accurate and understandable information in a timely manner to the public about the product defect, the hazard, and the corrective action" (CPSC 2012: 18). Each recall announcement includes the exact recall date, product details, hazard, remedy, incidents and injuries, number of units recalled, time frame during which the product has been sold, and price.

Recall effectiveness and sample We created an initial data set of N = 338 CPSC product recalls from January 2001 to

December 2013.[4] The percentage of successfully recalled products is not publicly available. The Freedom of Information Act (FOIA), 5 U.S.C. §552, requires federal agencies to disclose certain records in response to a written request. We filed a FOIA request and received recall effectiveness data for a subset of 217 recall events, featuring 89 different products (see Web Appendix B).[5] The remaining 121 firms claimed Section 6(a) of the CPSA, marking information as confidential, which could lead to a potential sample selection bias. The methodology section below describes how we address it. Each progress report includes the number of affected products that are with consumers as well as the number of corrected products.[6] We calculate recall effectiveness as the ratio of the number of corrected and affected products. Values of this variable range from 0 to 100%. For instance, if 100,000 units are affected and 50,000 units were corrected, the recall effectiveness is 50% (=50,000 / 100,000).

Remedy Following Chen et al. (2009), Liu et al. (2016), Mafael et al. (2022), and Raithel and Hock (2021), and based on the CPSC recall report, we construct the dummy variable *Remedy* that has a value of 1 if the firm offered full remedy (i.e., is responsible for fixing the issue, such as a free repair, exchange, or refund) and 0 if the firm offered partial remedy (i.e., shifts (some of) the responsibility for fixing the issue to their customers, such as free repair kits).

Incident likelihood measures the likelihood of future incidents if the defective product is not corrected. We measure this variable by calculating the ratio between (i) the natural logarithm of the number of consumer safety incidents which have been reported to the CPSC before the product recall was announced and (ii) the natural logarithm of the number of recalled units (i.e., recall volume). This variable's values can range from 0 to 1.[7]

Firm reputation is measured by *Fortune* magazine's reputation score one year before the recall. This measure has been used in prior product recall research (e.g., Raithel & Hock, 2021). The survey is conducted each year among high-ranking executives, directors, and financial analysts in the US that addresses quality, innovativeness, investment value, financial soundness, employer-related aspects, community and environmental responsibility, and corporate assets.[8]

The model includes several control variables:

Product price is the natural logarithm of the maximum retail price in US dollars (from CPSC). With an increasing financial value of the product (and thus increasing financial threat if the product is malfunctioning), customers' willingness to return the product should be higher.

Product sell time is the natural logarithm of days the products have been sold before the recall (from CPSC). The longer the product is being sold, the more difficult it is to trace all units.

Product volume is the natural logarithm of the number of recalled units (from CPSC). With increasing product volume, it becomes more difficult (Hall & Johnson-Hall, 2021) and costly for firms (Raithel et al., 2021) to trace all units and achieve high recall effectiveness.

Hazard high / hazard medium Following Raithel and Hock (2021), we code two dummy variables for *Hazard* (from CPSC). *Hazard High* is 1 if a very serious injury is likely or death is possible (e.g., fire), *Hazard Medium* is 1 if a major injury is possible but death is very unlikely (e.g., laceration). Hazard Low (if only a minor injury or no injury is possible (e.g., bruise)) serves as baseline condition. Since a higher failure hazard poses a greater threat to customers' health, recall effectiveness is expected to be higher (Hoffer et al., 1994; Rupp & Taylor, 2002).

[4] The sample includes only observations for which data on relevant covariates (see below) required for model estimation are available. We have also eliminated overlapping recall events within a firm (i.e., two or more recalls within 100 days) to minimize confounding effects from multiple events, alleviating concerns about the possibility that a prior recall might affect decisions on, for instance, remedy offer following another product recall.

[5] FOIA requests on recall effectiveness take a very long time and the outcome is uncertain. The request for 2001 to 2013 data took over two years, because the CPSC must contact each firm separately and wait for their response. In the summer of 2021, we filed another FOIA request to obtain data for 2014 onwards (N=294). The request not only takes very long again, but most firms claim Sect. 6(a). By May 2023, usable data of only seven recalls has been shared with us.

[6] The number of corrected products includes only observable corrections. The actual number of corrected products is potentially higher, because, for example, some consumers might have disposed of the defective product without informing the distributor or manufacturer. The recall effectiveness variable might therefore include some measurement error to some unknown degree.We thank an anonymous reviewer for pointing to this limitation. We address it with the controlled experiments.

[7] Prior research (e.g., Chen et al., 2009; Raithel & Hock 2021) uses a binary proxy (no incidents vs. minimum of one incident). For robustness, we also use this binary measure as well as alternative measures (number of incidents without, number of injuries with/without scaling by recall volume). Across the five alternative specifications for *Incident Likelihood* (*Incidents with 0: no incidents, 1: min. one incident; Injuries with 0: no injuries, 1: min. one injury; ln(Incidents), ln(Injuries), ln(Injuries) / ln(Volume)*), all significant effects replicate with $p<.05$ with two exceptions (in three alternative models, the interactions *Injuries (bin)*Reputation*, *Incidents (bin)*Reputation*, and *ln(Injuries)*Reputation* have *p*-values of .111, .113, and .061).

[8] Although the *Fortune* reputation ranking is most commonly used reputation measure in research, it has received criticism concerning its dimensionality and the fact that it does not survey other stakeholders, such as consumers (Raithel & Schwaiger 2015). To safeguard internal validity of our findings, we survey consumers and apply a different reputation measure in the subsequent two experiments. We thank an anonymous reviewer for pointing out this issue.

Percentage product registration 581 U.S.-based, "CloudResearch approved participants" (approval rate > 80%, < 5,000 studies completed) participated in the study (M_{age} = 38.96, 57% female). To avoid fatigue, each participant only rated 15 different products. Each product was rated by at least 100 participants. We asked participants if they had ever registered the product (e.g., bicycle). The answer choices were "I never purchased one before," "I have purchased and registered one before," and "I have purchased one before but did not register it." The more products are registered, the easier products can be traced, which increases recall effectiveness.

Product relevance 148 U.S.-based, "CloudResearch approved participants" (approval rate > 80%, < 5,000 studies completed) participated in the study (M_{age} = 32.04, 43% female). To avoid fatigue, each participant only rated 20 different products (e.g., how frequently do you use a bicycle (1 = not at all, 7 = very)). Each product was rated by at least 64 participants. Consumers who use a product more (vs. less) frequently are more (vs. less) dependent on the proper functioning of the recalled product. Thus, they could either have a higher incentive to participate in the recall because they need a working product or a lower incentive because they do not have an alternative while their defective product is being fixed or replaced (e.g., child car seat).

Media attention is the natural logarithm of Associated Press (AP) articles mentioning the product recall on the announcement day (from Factiva). It controls for recall salience, which could covary positively with customer awareness of the recall and, thus, recall participation.

Investor response is the abnormal stock return (difference between actual and expected stock return) on the recall announcement day (from CRSP) and controls for investors' sentiment and expected financial implications of the recall (e.g., Chen et al., 2009; Raithel & Hock, 2021).

Period since last recall is the natural logarithm of days since the announcement of the firm's last product recall before the current recall. To avoid the impact of outliers, the maximum value is capped at 1,000 days.

Industry fixed effects control for product category-specific recall effectiveness. For example, it is easier to track electronic devices, such as smartphones, as opposed to furniture.

Year fixed effects control for changes in technology (e.g., faster dissemination of product recall information through social media, advanced product tracking) as well as general regulator activities (e.g., in 2012, the OECD launched the global recall portal, which also covers CPSC recalls, new product safety standards, and product safety awareness campaigns).

Correction for sample self-selection

Firms can decide not to share any recall effectiveness data. To correct this potential bias, we adopt a Heckman-type correction (Heckman, 1979), which has been applied in the product recall context before (e.g., Liu et al., 2016). It involves a selection equation (sample self-selection) and one outcome equation (recall effectiveness). The selection equation is a binomial probit model, which models the (assumed) exogenous factors (exclusion restrictions) influencing sample self-selection. We follow the recommendations of Certo et al. (2016) to test for potential sample selection, test the (empirical) validity of exclusion restrictions, and report the results.

We identified three potential exclusion restrictions that have a bearing on firms' decision to share recall effectiveness data but are unlikely to have a direct impact on recall effectiveness. We use (1) the natural logarithm of the cumulative number of prior injuries. The risk of costly litigation should increase the firm's motivation and ability to collect and share information about recall compliance. For example, IKEA has started to collect contact information from consumers who buy specific products (Real Homes 2021) after the firm was fined $46 million in a lawsuit related to a prior product recall (The New York Times, 2020). Consumers, on the other hand, are less likely to be aware of the total number of injuries associated with prior product recalls. Their recall participation is more likely affected by the characteristics of the *current* recall. We use (2) the percentage of firms reporting recall effectiveness in a year because it is more likely that firms have the willingness and ability to restore the records for more recent recalls. The correlation of this exclusion restriction with the sample indicator is 0.478 (p = 0.000). However, this ability and motivation to restore and share more recent data should not directly correlate with recall effectiveness. The correlation of the exclusion restriction with recall effectiveness is only 0.052 (p = 0.451). Finally, we use (3) the firm's batch number (dummies for eight clusters based on alphabetical order) because the CPSC does not approach all firms at once but rather on a rolling basis over a longer period (two years). This increases the likelihood that the response rates differ due to reasons unrelated to the recall (e.g., CPSC approaches one batch of firms around a holiday period, which lowers response rates). It seems unlikely that customers' decision to (not) participate in the recall is affected by the firm's name order in the alphabet.

Correction for remedy choice self-selection bias

Firms choose their remedy strategically (e.g., Liu et al., 2016), so we need to adjust the observational data for this self-selection bias. We identified two potential exclusion restrictions that have a bearing on firms' remedy choice but are unlikely to have a direct impact on recall effectiveness. We use (1) the natural logarithm of the cumulative number of prior injuries. Many customer injuries in the past suggest that the firm has severe issues with product quality and harm-prevention

measures. Such firms might also follow a defensive and low-cost product recall management approach and therefore are more likely to opt for partial remedy. The cumulative number of past injuries should not have much bearing on a customer's decision to (not) participate in the current recall. Many customers are most likely not aware of this information because product recalls are relatively rare events (on average, about 55% of firms have one, and 25% of firms have no more than two recalls per year). Further, the number of past injuries is only weakly associated ($R^2 = 0.035$) with media coverage of the current recall (which serves as a control variable in the model anyway) while it is not mentioned in CPSC recall announcements. We use (2) the percentage of firms with full (vs. partial) remedy in a year. Managers observe and might feel pressured to adopt the behavior of their peers. For example, if many firms have chosen full remedy, then the focal firm is more likely to opt for the same remedy. Customers' responses to the focal firm's product recall are unlikely to be affected by remedies of *other* firms' recalls.

Model estimation

We estimate two first stage models. First, for each recall i, the probability for $T_i = 1$ (recall effectiveness reported = 1 vs. not = 0) is modeled as a function of the sample self-selection exclusion restrictions z_i:

$$P(T_i = 1) = \boldsymbol{\alpha}^T \boldsymbol{z_i} + \boldsymbol{\beta}^T \boldsymbol{x_i} + \epsilon_i \quad (1)$$

In line with Certo et al. (2016), we enter the focal X-variables (*Remedy*, *Incident likelihood*, and *Reputation*) into the first stage model. If they are significant, a sample-selection bias is likely, which requires the inclusion of the sample-selection correction term into the second stage model. The results suggest that the three focal variables are significantly associated with the sample indicator in the first stage model ($\Delta\chi^2(3) = 7.28$, $p = 0.063$, ΔPseudo-$R^2 = 0.017$), indicating that a self-selection bias in the second-stage estimates is possible. The three exclusion restrictions have a relatively strong predictive power of the sample indicator as the incremental Pseudo-R^2 increase is 0.222.[9] Table C1 in Web Appendix C shows the first-stage model results.

Second, for each recall i, the probability for $R_i = 1$ (remedy is full = 1 vs. partial = 0) is modeled as a function of the exclusion restrictions $\boldsymbol{y}_i$ associated with remedy choice:

$$P(R_i = 1) = \boldsymbol{\alpha}^T \boldsymbol{y_i} + \epsilon_i \quad (2)$$

The two exclusion restrictions have a relatively strong predictive power of remedy choice (Pseudo-R^2 is 0.316.). Table C2 in Web Appendix C shows the first-stage model results.

In the second stage, we enter the two control functions into the outcome equation:

$$\begin{aligned} &Recall\ Effectiveness_i = \\ &\boldsymbol{\beta}^T \begin{pmatrix} Remedy_i \\ Incident\ Likelihood_i \\ Reputation_i \\ Remedy_i * Reputation_i \\ Incident\ Likelihood_i * Reputation_i \end{pmatrix} \\ &+\boldsymbol{\gamma}^T \boldsymbol{Controls_i} + \lambda_1 IMR(sample\ selection)_i + \\ &\lambda_2 IMR(remedy\ choice)_i + \varepsilon_i \end{aligned} \quad (3)$$

For each recall i, recall effectiveness is a function of the focal covariates *Remedy* (full vs. partial), *Incident Likelihood*, *Reputation,* and the focal interaction terms. The vector $\boldsymbol{\beta}$ includes the regression coefficients. The vector ***Controls*** (including industry fixed effects, year fixed effects, and intercept) contains the control variables. The coefficients λ_1 and λ_2 control for the sample self-selection and remedy choice biases. It is common practice to add several control functions simultaneously (e.g., Lawrence et al., 2021). Finally, ε is the error term. Since the outcome is a percentage ranging between 0 and 1, we estimate a fractional probit regression (Papke & Wooldridge, 1996) and adjust for heteroscedasticity by industry cluster-robust standard errors and z-standardization of all metric covariates.[10] The z-standardization includes the focal metric variables *Incident Likelihood* and *Reputation,* which are included in interaction terms, thereby allowing for interpretation of the focal variables' main effects (Spiller et al., 2013). To compare effect sizes, we also show the Average Marginal Effects (AME).

Results

Table D1 in Web Appendix D shows the descriptive statistics and correlations of second-stage model variables.[11] Table 1 below shows the results for the fractional probit regression Table D2 in Web Appendix D shows the main effects only model).

[9] Certo et al. (2016) discuss different instrument strengths (see their Table 2). To further validate the strength of the exclusion restrictions, we regress the focal X-variables on the Inverse Mills Ratio (*IMR)*. The relatively small R^2 of this model (.188) suggests the instruments' combined strength is relatively good (see also Table 2 in Certo et al. (2016)).

[10] All covariates ' VIFs < 5 except for Reputation (14.3) and Remedy*Reputation (14.1), but a high correlation between a product term and its independent variables does not imply a multicollinearity problem (Disatnik & Sivan 2016).

[11] Although the partial remedy group is small (12.0% of observations) compared to the full remedy group (88.0% of observations), we do not find statistically significant differences between groups concerning their means ($F(1, 215) = .190$, $p = .662$), their variances ($F(1,215) = 1.691$, $p = .195$), and their distributions (Kolmogorov–Smirnov D = .211, $p = .223$) of the reputation variable.

Table 1 Fractional probit regression results for Study 1

		Hypothesis (exp. sign)	Dependent Variable: Recall Effectiveness			
			Coeff	SE	*p*-value	AME[c]
Focal effects	*Remedy (full vs. partial)*	*H1* (+)	.333*	.156	.032	.114
	Incident Likelihood[a]	*H2* (+)	-.020	.050	.685	-.007
	Reputation[a]	(±)	-.390***	.098	.000	-.133
	*Remedy*Reputation*[a]	*H3* (+)	.371**	.129	.004	.127
	Incident Likelihood[a]**Reputation*[a]	*H4* (+)	.111**	.042	.008	.038
Controls	*Product price*[a]	(+)	.361**	.112	.001	.123
	Product sell time[a]	(-)	-.327***	.067	.000	-.111
	Recall volume[a]	(-)	-.116**	.044	.008	-.040
	Hazard: Medium (vs. low)	(±)	-.011	.177	.951	-.004
	Hazard: High (vs. low)	(±)	-.173$^{\$}$	.104	.095	-.059
	Product relevance[a]	(+)	.092$^{\$}$	.049	.061	.031
	Percentage product registration[a]	(+)	-.058	.078	.455	-.020
	Media attention[a]	(±)	-.092*	.037	.014	-.031
	Investor response[a]	(±)	-.056	.064	.381	-.019
	Period since last recall[a]	(±)	.081*	.038	.032	.027
	Industry fixed effects		YES			
	Year fixed effects		YES			
Endogeneity correction	*Control Function Sample Selection (IMR*[b]*)*		.127	.254	.616	
	Control Function Remedy Choice (IMR[b]*)*		.314	.371	.397	
Model Fit	Wald Chi^2		81.000***			
	Pseudo-R^2		.135			
	Sq. correlation btw. observed and predicted		.454			
	N		217			

*** $p<.001$ ** $p<.01$ * $p<.05$ $^{\$}$ $p<.10$ (industry cluster robust standard errors reported)

[a] z-standardized

[b] IMR = Inverse Mills Ratio

[c] Average Marginal Effect (AME*100 = percentage point effect on Y of one unit change in X)

The model is significant ($\chi^2(5)=81.00$, $p<0.001$) and has a good fit (Pseudo-$R^2=0.135$, squared correlation of observed and predicted *Recall Effectiveness* is 0.454). The focal covariates (including interaction) produce a Pseudo-R^2 of 0.024 and the squared correlation of observed and predicted *Recall Effectiveness* is 0.085.

We find the following regarding H1 to H4 (we apply an error rate of $\alpha=5\%$ to all tests):

H1 (Remedy) Full (vs. partial) remedy is significantly associated with higher recall effectiveness ($b_{Remedy}=0.333$, $p=0.032$), supporting H1. The effect size is one of the strongest.

H2 (Incident Likelihood) The level of incident likelihood is not significantly associated with recall effectiveness ($b_{Incident\ Likelihood}$= -0.020, $p=0.685$), not supporting H2. The regression coefficient of the moderator *Reputation* is significantly negative ($b_{Reputation}$ = -0.390, $p<0.001$), which implies that recall effectiveness is lower, all else equal, for high (vs. low) reputation firms.

H3 (Remedy*Reputation) The interaction of *Remedy* and (z-standardized) *Reputation* is relatively strong and positive ($b_{Remedy*Reputation}=0.371$, $p=0.004$). Figure 2 (Panel A) visualizes the marginal effects of *Remedy* on recall effectiveness with a floodlight analysis (Spiller et al., 2013): full (vs. partial) *Remedy* increases recall effectiveness more for firms with high *Reputation* than for firms with low *Reputation*. We identify two Johnson-Neyman (JN) points. At extremely low *Reputation* (< -2.5), the relationship between *Remedy* and *Reputation* becomes significantly negative. At medium and high *Reputation* (> -0.1), the relationship is significantly positive. Overall, we find support for H3.

H4 (Incident likelihood*reputation) The interaction of *Incident likelihood* and (z-standardized) *Reputation* is

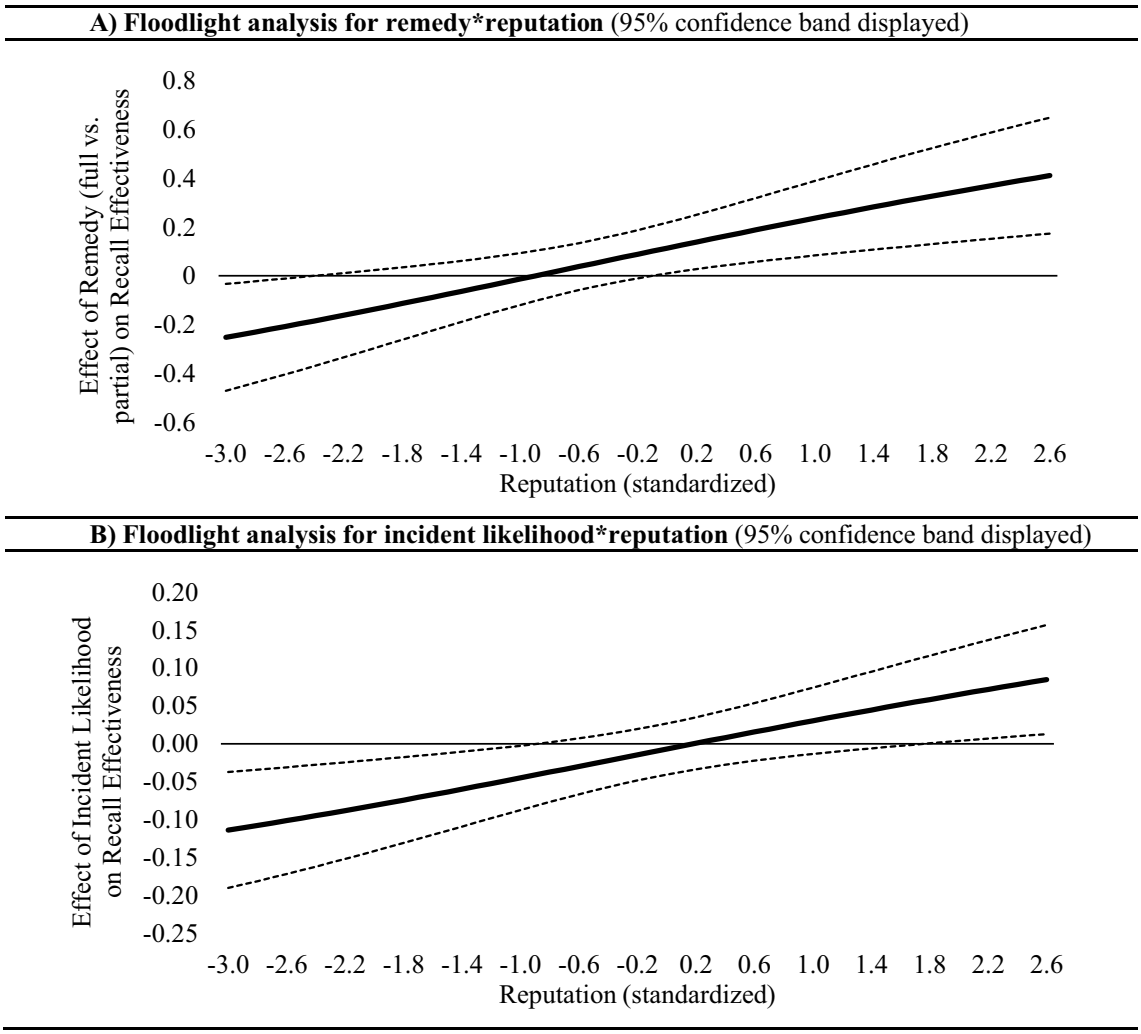

Fig. 2 Floodlight analysis for remedy*reputation and incident likelihood*reputation on recall effectiveness (in %) (Study 1)

moderately strong and positive ($b_{Incident\ Likelihood*Reputation}$= 0.111, $p = 0.008$). Figure 2 (Panel B) visualizes the marginal effects of *Incident likelihood* on recall effectiveness with a floodlight analysis (Spiller et al., 2013): The relationship between *Incident likelihood* and recall effectiveness is more positive for firms with high *Reputation* than for firms with low *Reputation*. We identify two JN points. At medium to low reputation levels (< -0.09), the relationship becomes significantly negative. At very high *Reputation* levels (> 1.8), the relationship becomes significantly positive. Overall, we find support for H4.

Controls Seven control variables are significantly associated with recall effectiveness. First, the higher the price of the product, the higher the recall effectiveness ($b_{Price} = 0.361$, $p = 0.001$). Second, the longer a product has been sold, the lower the recall effectiveness ($b_{Sell\ Time} = -0.327$, $p < 0.001$). Third, the more units have been recalled, the lower the recall effectiveness ($b_{Volume} = -0.116$, $p = 0.008$). Fourth, counterintuitively, for high hazard recalls, the recall effectiveness is slightly lower ($b_{Hazard\ High} = -0.173$, $p = 0.095$). Fifth, the higher the relevance of the product is, the higher the recall effectiveness ($b_{Relevance} = 0.092$, $p = 0.061$). Sixth, counterintuitively, the more media attention a recall receives, the lower the recall effectiveness ($b_{Media\ Attention} = -0.092$, $p = 0.014$). Seventh, the longer ago the last recall was, the higher the recall effectiveness ($b_{Period\ since\ last\ recall} = 0.081$, $p = 0.032$).

Control Functions Although the control functions (Inverse Mills Ratio), which correct for the potential sample self-selection and endogenous remedy choice, do not have significant coefficients in the fully specified model ($p > 0.10$), their pairwise correlation with the focal outcome is significant ($ps < 0.10$, Web Appendix D). This finding implies that self-selection and endogeneity biases are likely and warrant the inclusion of the control functions into the model.

Robustness checks The analysis includes several degrees of freedom regarding the model setup. Therefore, we have tested a variety of alternative specifications and find that the hypotheses test results are almost identical. Please refer to Web Appendix E for details.

Discussion

In Study 1, we leverage unique field data to analyze drivers of recall effectiveness. We find support for three out of four hypotheses. First, the results highlight the importance of full (vs. partial) remedy. Generally, firms are advised to offer full remedy to achieve high recall effectiveness (support for H1). There are, however, situations where firms can offer partial remedy and achieve equally high recall effectiveness (H3). Vice versa, in other situations, a firm's full (vs. partial) remedy offer creates disproportionally higher recall effectiveness. First, when firm reputation is low (not extremely low), there is no significant difference between partial and full remedy. For high reputation firms, however, offering full remedy is much more important as it leads to significantly higher recall effectiveness than partial remedy. Although incident likelihood alone, all else being equal, is not significantly related to recall effectiveness (H2), this effect differs significantly for low vs. high reputation firms (H4). The results suggest that for low reputation firms the relationship between incident likelihood and recall effectiveness is negative. Customers do not trust low reputation firms to correct the defective product when there is a high incident likelihood. In contrast, for high reputation firms, high incident likelihood goes along with higher recall effectiveness. These findings suggest that recall participation is shaped by the firm's reputational profile. Accordingly, high, medium, and low reputation firms should manage recalls differently to achieve similarly high recall effectiveness.

The goal of the next two experiments is twofold. First, we would like to test the results of the field study in an experimental setting, thereby eliminating any endogeneity and self-selection concerns. Second, we would like to hone in on the psychological process by testing the extent to which our focal mediators perceived benefits and self-efficacy are affected by remedy (Study 2), incident likelihood (Study 3), and firm reputation (Studies 2 and 3), thereby testing H5a—H7b.

Study 2: Remedy × reputation (moderated mediation)

Participants, method, and design

We recruited 370 U.S.-based, "CloudResearch approved participants" (approval rate > 80%, < 5,000 studies completed) through the TurkPrime application for nominal payment (M_{age} = 32.48, 55% female).

First, participants selected their current laptop brand so we could tailor all subsequent questions to their brand. Second, participants rated their brand's reputation, which served as the moderator. We used a measure from Raithel and Schwaiger (2015), which consists of six 7-point Likert scales and captures both perceptions of a firm's abilities ("competence") and feelings about the firm ("likeability"). Sample items include *"[X] is a top competitor in its market*" (competence) and "*I regard [X] as a likable company" (likeability)*. The extracted factor shows a good fit (AVE = 0.694, α = 0.906). Third, participants read the recall of a laptop manufacturer which we tailored to their brand to increase involvement. Specifically, they were informed that the battery can overheat, leading to skin redness in some cases. In line with Mafael et al. (2022), we manipulated remedy (partial vs. full) randomly between subjects by telling participants in the partial (full) condition that the firm offered a free do-it-yourself repair kit (free inspection and full repair), see Web Appendix F. Fourth, we assessed the dependent variable ("*How likely are you to participate in the recall and request the free do-it-yourself repair kit?*" (partial), "*How likely are you to participate in the recall and schedule a free inspection and full repair?"* (full)), which served as a proxy for recall effectiveness. Fifth, we asked them about our two focal mediators, namely perceived benefits ("*How much would you benefit from participating in the product recall?*") and perceived self-efficacy ("*How comfortable would you feel in your ability to follow the advised action of the product recall?*"). We also included three other potential mediators derived from the HBM, namely perceived susceptibility ("*How likely is it that you would suffer from skin redness?*"), perceived barriers ("*How difficult would it be for you to participate in the product recall?*"), and (5) perceived severity ("*How severe would you rate this product recall?*"), all from 1 = not at all to 7 = very. Sixth, we asked them "*What remedy did [X] offer according to the official recall announcement?*" (free do-it-yourself repair kit vs. free inspection and full repair), which served as the manipulation check. Sixty-seven respondents answered the question incorrectly. To maximize sample size, we included those participants in all our analyses, but our pattern of results does not change when excluding them. Last, participants indicated how old their laptop was, how much it cost, and provided demographics. We thanked and debriefed participants to prevent carry-over effects to actual brand perceptions.

Results

Remedy Full remedy increases recall effectiveness (M_{full} = 5.24, SD = 4.90 vs. $M_{partial}$ = 4.90, SD = 1.96; $F(1, 368) = 3.12$, p = 0.078, d = 0.18), providing marginal support for H1.

Moderated mediation We employed the SPSS bootstrapping macro developed by Hayes (2017, model 7) with 5,000 bootstrap samples and entered all five potential

mediators as parallel mediators. This allowed us to test (1) if our two focal mediators perceived benefits and perceived self-efficacy mediate the effect of remedy on consumers' likelihood of participating in the recall and (2) if reputation moderates these two mediators. Results revealed that perceived self-efficacy ($\beta = 0.156$, $SE = 0.064$; 95% CI: 0.042, 0.290) mediated the impact of remedy on recall effectiveness, supporting H5b, whereas perceived benefits ($\beta = 0.160$, $SE = 0.089$; 95% CI: -0.011, 0.338) did not, failing to support H5a.

The interactions of remedy and reputation were significant for our two focal mediators perceived benefits ($\beta = 0.333$, $SE = 0.153$, $p = 0.030$; 95% CI: 0.032, 0.633) and self-efficacy ($\beta = 0.443$, $SE = 0.153$, $p = 0.004$; 95% CI: 0.143, 0.743). Figure 3 visualizes these effects with floodlight analyses. Specifically, as reputation increases and the firm offers full (vs. partial) remedy, consumers (i) feel that they would benefit more from participating in the product recall (Panel A, JN point 0.051) and (ii) feel more comfortable in their ability to follow the advised action of the product recall (Panel B, JN points -3.279, -0.258).

Most importantly, the index of moderated mediation was only significant for perceived benefits (95% CI: 0.011, 0.330) and self-efficacy (95% CI: 0.032, 0.266), indicating that the effect of remedy on participation likelihood is not only mediated by perceived benefits and self-efficacy but also moderated by reputation, supporting H7a and H7b. Specifically, for *benefits*, the indirect effects for firms with low ($\beta = -0.029$, $SE = 0.117$; 95% CI: -0.258, 0.204) and medium reputation ($\beta = 0.162$, $SE = 0.088$; 95% CI: -0.007, 0.341) were not significant, whereas the indirect effect for firms with high reputation ($\beta = 0.352$, $SE = 0.136$; 95% CI: -0.088, 0.630) was significant. For *self-efficacy*, the indirect effect for firms with low reputation ($\beta = -0.007$,

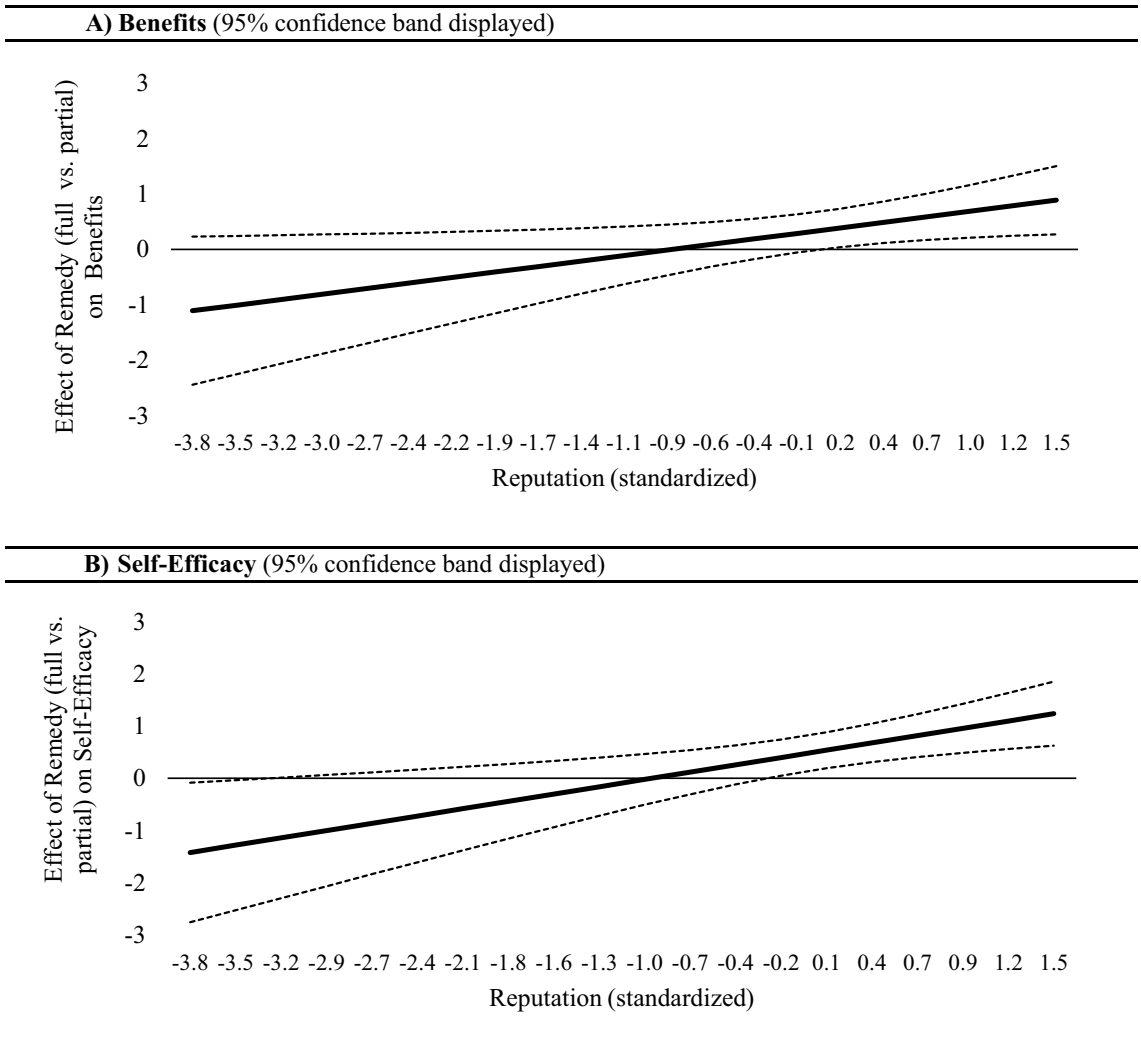

Fig. 3 Floodlight analysis for remedy*reputation on the mediators (Study 2)

$SE = 0.082$; 95% CI: -0.164, 0.159) was not significant, whereas the indirect effects for firms with medium ($\beta = 0.158$, $SE = 0.064$; 95% CI: 0.042, 0.293) and high reputation ($\beta = 0.324$, $SE = 0.103$; 95% CI: 0.137, 0.538) were significant.

Finally, the direct effect of remedy became non-significant when the mediators and the moderator were added ($\beta = 0.033$, $SE = 0.142$, $p = 0.815$; 95% CI: -0.246, 0.313). Overall, we find support for H5b, H7a, and H7b, marginal support for H1, and no support for H5a.[12] Web Appendix G provides the summary statistics.

Discussion

Study 2 provides a better understanding of the impact of remedy on recall effectiveness and the underlying processes. We show that the impact of remedy on participation likelihood is not only mediated by perceived benefits and self-efficacy but also moderated by reputation. When high reputation firms offer full remedy, they not only make consumers feel like they would benefit more from participating in the product recall, but they also make them feel more comfortable in their ability to follow the advised action, which in turn increases consumers' likelihood of participating in the recall. In the next study, we examine the interaction of incident likelihood and reputation on recall effectiveness and the underlying processes.

Study 3: Incident likelihood × reputation (moderated mediation)

Participants, method, and design

We recruited 371 U.S.-based, "CloudResearch approved participants" (approval rate > 80% or higher, < 5,000 studies completed) through the TurkPrime application for nominal payment ($M_{age} = 38.22$, 56% female).

First, participants selected their smartphone brand so we could tailor all subsequent questions to their specific brand. Second, participants rated their brand's reputation, which served as moderator (extension of HBM). We again used the measure from Raithel and Schwaiger (2015; AVE = 0.654, α = 0.886). Third, participants read the recall of a smartphone producer which we tailored to their specific brand to increase involvement. Specifically, they were informed that the battery can overheat, leading to skin burns. We manipulated incident likelihood (low vs. high) randomly between subjects by telling participants in the low (high) condition that the firm has not received any reports of skin burns yet (372 reports of skin burns already), see Web Appendix H. Fourth, we assessed the dependent variable ("*How likely are you to participate in the recall?*", which served as a proxy for recall effectiveness. Fifth, we again asked them about our two focal mediators and three other potential mediators, using the same set of measures as in Study 2. Sixth, we asked them if there had been any incidents reported already, which served as a manipulation check. Nineteen participants answered the question incorrectly. To maximize sample size, we included those participants in all our analyses, but our pattern of results does not change when excluding them. Last, participants indicated how old their phone was, how much it cost, and provided demographics. We thanked and debriefed participants to prevent carry-over effects from the experiment to actual brand perceptions.

Results

Incident likelihood Recalls with high incident likelihood directionally achieved higher recall effectiveness ($M_{high} = 5.05$, $SD = 1.84$ vs. $M_{low} = 4.74$, $SD = 1.88$; $F(1,369) = 2.97$, $p = 0.101$, $d = 0.17$). In line with the secondary data (Study 1), H2 is not supported.

Moderated mediation We again employed Hayes' (2017) SPSS bootstrapping to test (1) if our two focal mediators perceived benefits and perceived self-efficacy mediate the effect of incident likelihood on the likelihood of participating in the recall and (2) if reputation moderates these two mediators. Perceived benefits ($\beta = 0.310$, $SE = 0.108$; 95% CI: 0.107, 0.535) mediated the impact of incident likelihood on recall effectiveness, supporting H6a, whereas perceived self-efficacy ($\beta = -0.041$, $SE = 0.030$; 95% CI: -0.109, 0.008) did not, failing to support H6b.

The interactions of incident likelihood and reputation were significant for our two focal mediators benefits ($\beta = 0.372$, $SE = 0.164$, $p = 0.024$; 95% CI: 0.050, 0.694) and self-efficacy ($\beta = 0.272$, $SE = 0.141$, $p = 0.054$; 95% CI: -0.005, 0.549). Figure 4 visualizes these effects with floodlight analyses. Specifically, as reputation and incident likelihood increase, consumers feel (i) that they would benefit more from participating in the product recall (Panel A, JN point -0.405) and (ii) more comfortable in their ability to participate in the product recall (Panel B, JN point -0.187).

Most importantly, the index of moderated mediation was significant for benefit (95% CI: 0.002, 0.408) and

[12] Susceptibility ($\beta = -.001$, $SE = .013$; 95% CI: -.032, .027), barrier ($\beta = -.004$, $SE = .014$; 95% CI: -.038, .020), and severity ($\beta = -.012$, $SE = .018$; 95% CI: -.055, .015) did not mediate the impact of remedy on recall effectiveness. The interactions of remedy and reputation effects were marginally/non-significant for susceptibility ($\beta = .268$, $SE = .148$, $p = .070$; 95% CI: -.022, .559), barrier ($\beta = -.174$, $SE = .162$, $p = .284$; 95% CI: -.492, .144), and severity ($\beta = -.257$, $SE = .148$, $p = .082$; 95% CI: -.548, .033). The index of moderated mediation was also non-significant for susceptibility (95% CI: -.016, .059), barrier (95% CI: -.034, .057), and severity (95% CI: -.064, .007).

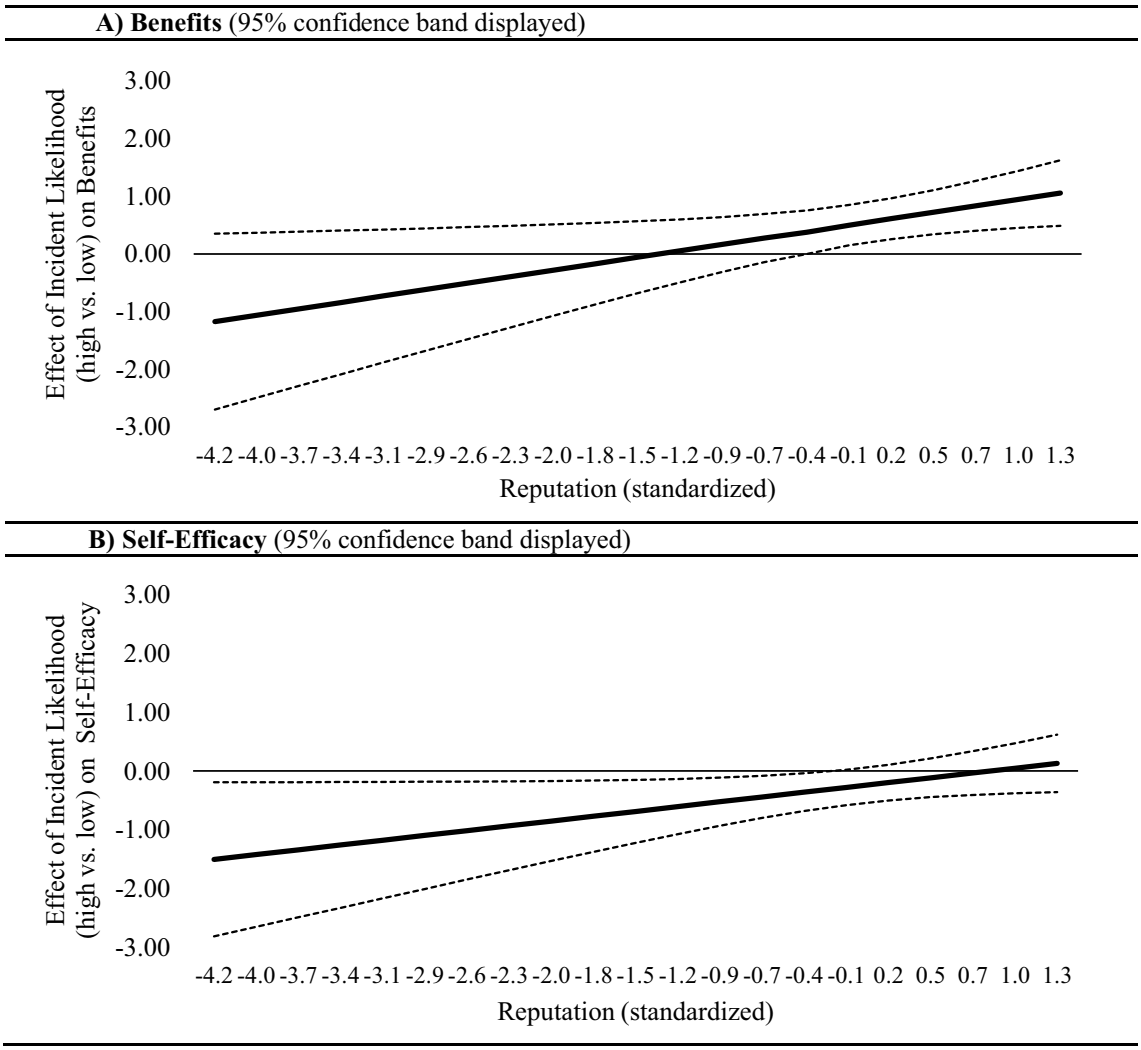

Fig. 4 Floodlight analysis for incident likelihood*reputation on the mediators (Study 3)

self-efficacy (90% CI: 0.000, 0.097), indicating that the effect of incident likelihood on participation likelihood is not only mediated by perceived benefits and self-efficacy but also moderated by reputation, supporting H7a and H7b. Specifically, for *benefits*, the indirect effect for firms with low reputation ($\beta = 0.078$, $SE = 0.152$; 95% CI: -0.198, 0.408) was not significant, whereas the indirect effect for firms with medium ($\beta = 0.310$, $SE = 0.105$; 95% CI: 0.118, 0.526) and high reputation ($\beta = 0.542$, $SE = 0.151$; 95% CI: -0.250, 0.852) was significant. For *self-efficacy*, the indirect effect for firms with low reputation ($\beta = -0.090$, $SE = 0.049$; 95% CI: -0.196, -0.007) was significant, whereas the indirect effects for firms with medium ($\beta = -0.041$, $SE = 0.029$, 95% CI: -0.106, 0.007) and high reputation ($\beta = 0.007$, $SE = 0.039$; 95% CI: -0.007, 0.084) were not significant.

Furthermore, the direct effect of incident likelihood became non-significant when the mediators and moderator were added ($\beta = -0.033$, $SE = 0.149$, $p = 0.544$; 95% CI: -0.383, 0.202). Overall, we find support for H6a, H7a, H7b, but not for H2 and H6B. Web Appendix I provides the summary statistics.[13]

Discussion

Study 3 provides a better understanding of the impact of incident likelihood on recall effectiveness and the underlying

[13] Susceptibility (β = .097, SE = .043; 95% CI: .027, .192) mediated the impact of incident likelihood on recall effectiveness, whereas barrier (β = -.011, SE = .020; 95% CI: -.057, .024) and severity (β = .051, SE = .061; 95% CI: -.069, .173) did not. The interactions of incident likelihood and reputation were non-significant for susceptibility ($\beta = .055$, $SE = .150$, $p = .714$; 95% CI: -.239, .349), barrier ($\beta = -.242$, $SE = .159$, $p = .128$; 95% CI: -.554, .070), and severity ($\beta = .146$, $SE = .156$, $p = 349$; 95% CI: -.160, .453). The index of moderated mediation was also non-significant for susceptibility (95% CI: -.046, .075; 90% CI: -.035, .062), barrier (95% CI: -.013, .038), and severity (95% CI: -.012, .036).

processes. We show that the impact of incident likelihood on participation likelihood is not only mediated by perceived benefits and self-efficacy but also moderated by reputation. When firm reputation and incident likelihood are high, firms not only make consumers feel like they would benefit more from participating in the product recall, but they also make them feel more comfortable in their ability to participate in the product recall, which in turn increases consumers' likelihood of participating in the recall.

General discussion

How do remedy and incident likelihood impact recall effectiveness for consumer products? How does the firm's reputation influence these effects? And what are the underlying psychological processes? Previous literature does not address any of these important questions. In the present research, we use a combination of unique field data and two experiments to answer these questions. Thereby, we not only contribute to the literature on product recall management but also provide managers and policymakers with guidelines to increase recall effectiveness.

Research implications and contributions

First and foremost, high recall effectiveness rates are extremely important for consumers to maintain their well-being. Previous research on recall effectiveness has solely focused on the automobile and food industry. The lack of knowledge in the consumer product sphere is alarming (Cleeren et al., 2017), but not surprising because recall effectiveness data on consumer products is not publicly available and involves a time-consuming FOIA process. The reluctance of firms to collect and share information about recall effectiveness is also surprising because high recall effectiveness is important for firms to minimize fees, penalties, and lawsuits (The New York Times, 2020). We apply the HBM to analyze consumers' willingness to comply with the product recall procedures to prevent health risks associated with product malfunctions. We modify and extend the HBM to accommodate the specific context of product recalls. In doing so, our integrative framework demonstrates the influence of remedy, incident likelihood, and their interaction with firm reputation on recall effectiveness, and highlights the underlying psychological processes. This provides a relevant contribution to the HBM, as we highlight the importance of investigating different components of cues to action (here: recall announcement) on consumers' likelihood to engage in corrective actions. Moreover, it provides evidence that the HBM offers both explanatory power and theoretical flexibility to aid our understanding of individuals' participation in corrective actions, even outside the realm of preventative health measures (Jones et al., 2015).

Second, our research provides insights into firms' post-recall management efforts that go beyond industry-wide efforts, such as regulator-initiated communication campaigns (Pagiavlas et al., 2022). Most studies examining managerial decision-making after a product recall focus on marketing-mix elements, such as price (Cleeren et al., 2008) or advertising (Borah & Tellis, 2016). However, they focus on how firms can mitigate the negative consequences of the recall but do not investigate firms' ability to influence consumer participation in the recall. Given that the recovery of relationships with current customers plays a crucial role in managing customer satisfaction (Grégoire et al., 2009; Mafael et al., 2022), understanding how firms can leverage consumer perceptions of product usage risks (e.g., incident likelihood) or their efforts (e.g., remedy) depending on their reputation is important. Our theorizing and results underscore that interactions among these variables shape recall effectiveness and need to be considered in managerial decisions (Ball et al., 2018).

Third, we use a wide variety of consumer products in our secondary data (Study 1) and test the findings in two experiments that focus not only on the interactive effects of remedy and firm reputation (Study 2) and incident likelihood and firm reputation (Study 3), but also highlight the underlying psychological processes. To the best of our knowledge, this is the first study to offer such a holistic picture of drivers of recall effectiveness for consumer products. Our findings highlight that targeting consumers' beliefs about (i) the benefits of participating in corrective actions and (ii) enhancing their self-efficacy increases recall effectiveness. On the contrary, targeting beliefs about barriers, severity, and susceptibility are less relevant – at least in the context of product recalls.[14]

Managerial and public policy implications

Defective consumer products are involved in the deaths of an estimated 23,000 Americans and cause injuries to 31 million others each year. These injuries, deaths, and associated property damages cost the American public more than $1 trillion annually. In addition, firms face lawsuits and financial as well as reputational damages if not enough defective

[14] This finding is partially in line with prior meta-analyses in the context of health-related interventions (e.g., Carpenter 2010; Jones et al., 2015). These meta-analyses show also that perceived benefits are a medium to strong predictor and severity is a weak predictor of health-related behavior. However, unlike in the product recall context, barrier and susceptibility are stronger predictors concerning other health-related interventions. For self-efficacy, broader empirical evidence is missing, which does not permit any comparison of effect sizes.

products are corrected properly. Therefore, it is of utmost importance for firms, regulators, consumers, and society to increase recall effectiveness. Figure 5 provides guidelines for firms and regulators to increase recall effectiveness.

Our results suggest that firms should consider the joint impact of remedy, incident likelihood, and reputation to maximize recall effectiveness. Generally, firms should offer full remedy to achieve high recall effectiveness. While this seems like an obvious suggestion, our data shows that firms do not always follow that suggestion, even when the product and defect are the same. This is particularly puzzling as research also indicates that offering full remedy is the dominant strategy to preserve customer satisfaction after a product recall (Mafael et al., 2022) and protects firm reputation after the recall (Germann et al., 2014). However, using reputation as a moderator, we identify situations where offering partial remedy leads to equally high recall effectiveness compared to full remedy.

Since consumers have lower expectations towards *low reputation firms*, they perceive any remedy offer as acceptable. In other words, there is no difference between partial and full remedy in terms of recall effectiveness. Nevertheless, if the situation and the firm's resources allow for it, firms should still offer full remedy to minimize risk for consumers. At the same time, there are situations where full remedy leads to disproportionally higher recall effectiveness. Since *high reputation* provides a halo effect, those firms need to offer full remedy to signal that the failure is much worse than expected (Chen et al., 2009). For high recall effectiveness, these high reputation firms need to highlight the benefits for consumers to participate in the advised action and increase consumers' confidence in their ability to follow the advised action. Given managers' propensity to choose partial remedy over full remedy for financial reasons (Liu et al., 2016) it is crucial to highlight the trade-off between (short-term) financial incentives on the one hand and protecting consumer satisfaction and welfare on the other hand. Our field data (Study 1) shows that recall effectiveness improves, on average, by 11.4 percentage points (all else equal) if firms offer full instead of partial remedy (see column AME in Table 1). This improvement more than doubles to 24.1% (all else equal) for high reputation firms (measured by one standard deviation above the reputation mean).

Although incident likelihood alone, all else being equal, is not significantly related to recall effectiveness, a result in line with Hall and Johnson-Hall (2021), we find that this effect differs significantly for low vs. high reputation firms. For *low reputation firms*, higher incident likelihood leads to lower recall effectiveness. It seems like customers do not trust low reputation firms to correct the defective product when there is a high incident likelihood. Those low reputation firms need to improve their customers' trust in the firm's ability to fix the product defect, for example by providing them with information about the success rate of product repairs. In contrast, for *high reputation firms*, high incident likelihood goes along with higher recall effectiveness. Therefore, these high reputation firms should highlight the incident likelihood and educate consumers about the risks of continued usage (e.g., by describing different usage cases that have led to injuries). Otherwise, consumers do not take

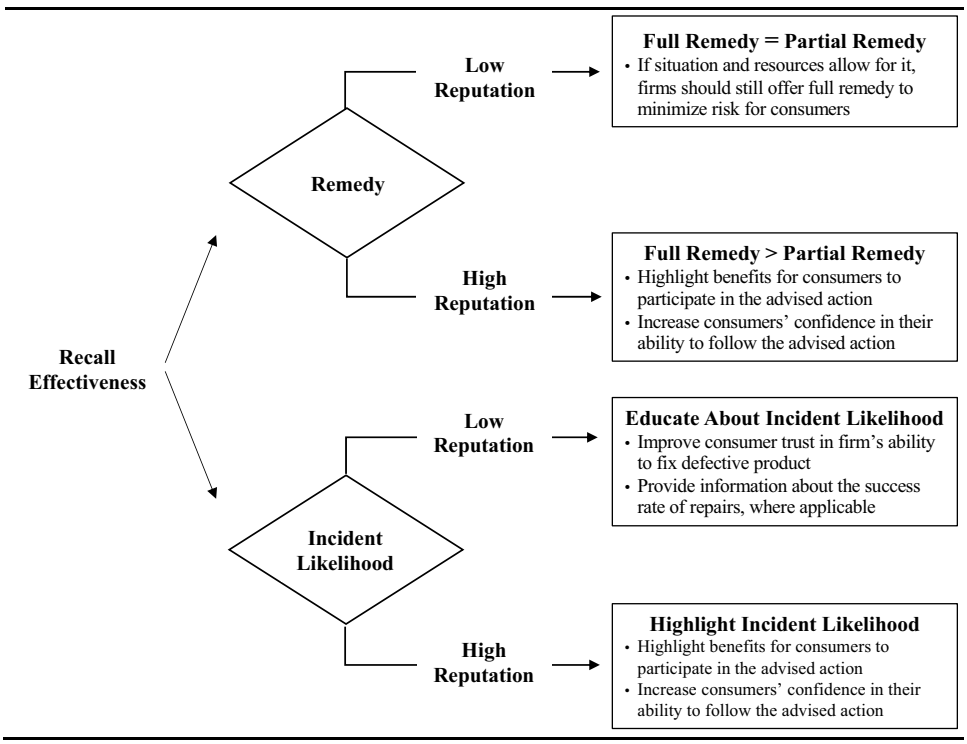

Fig. 5 Guidelines to increase recall effectiveness

the product malfunction seriously due to the "halo effect" of high reputation firm. Similar to remedy, firms need to highlight the benefits for consumers to participate in the advised action and increase consumers' confidence in their ability to follow the advised action.

Overall, these findings suggest that customers' recall participation is shaped by the recalling firm's reputational profile. Accordingly, high and low reputation firms should manage recalls differently to achieve similar recall effectiveness. Our results suggest that regulators could build on these findings and highlight to firms that their reputation influences consumers' compliance with corrective actions and provide recommendations and guidelines how high and low reputation firms should manage their recalls.

Limitations and future research opportunities

While we focus on remedy, incident likelihood, and their interaction with reputation, there may be at least three other factors that could influence recall effectiveness. First, recall effectiveness could be increased if firms offered different remedy choices to consumers. For instance, in the VW emission scandal, there were, broadly speaking, two groups of consumers. One group did not want a refund. Instead, they wanted VW to fix their car, so it worked as promised. The other group, however, wanted a full refund because they felt betrayed by the manufacturer. Research suggests that offering consumers the ability to choose between a limited set of options is beneficial (Sethi-Iyengar et al., 2004). When the firm offers only one type of remedy, consumers might not perceive this as a good fit for their needs and refrain from participating in the recall.

In line with previous research (e.g.,Liu et al., 2016; Raithel et al., 2021), our study operationalizes remedy as partial versus full remedy. However, within partial remedy, some firms may require consumers to pay for fixing the problem and some firms want consumers to repair the product themselves.[15] In addition, firms could also provide additional incentives to consumers for participating in the recall (e.g., coupons, gift cards, store credit, free accessories, and/or upgrades). Future research could examine the different options within partial and full remedy as well as additional incentives to identify the most successful remedy.

Second, in addition to the standardized CPSC recall announcement, firms often issue press releases on their own, which offer much more flexibility. Future research could utilize language processing techniques to identify the most successful communication practices and derive guidelines for firms–and regulators, since recent research suggests that regulator-initiated communication campaigns can increase overall recall effectiveness (Pagiavlas et al., 2022).

Third, our study covers a broader set of products than prior research, which has focused on either automotive or food recalls. While this allows us to provide insights into the generalizability of the effects, it is possible that there are differences between industries. Further research could examine differences between industries empirically and provide more fine-grained guidelines.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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