Office for Product Safety & Standards

Smart Products: Labelling, Marketing, and Framing

Research Report

March 2023

Executive Summary

Objectives

The current work explores how individuals interact with smart products, and investigates the relationship between risk judgements of smart products, and how risk perception ultimately influences blame attribution and future product engagements.

Studies

We conducted 5 studies around a simulated smart-oven interactive platform. We manipulated 5 characteristics of the smart oven: (1) product smartness, (2) information transparency and disclosure, (3) product labelling and marketing, (4) illusion of control and agency, and (5) framing and anchoring. We measured how participants perceived risk, attributed blame, and what likely actions they would take in such situations. All of which were designed to inform the way in which consumers engage with smart products, and how their perceptions and behaviour are impacted when the smart product is marketed in different ways (e.g., focus on transparency, performance, or safety).

Findings

Individuals perceived the smart oven to be riskier than a conventional oven. However, this did not necessarily translate into safer behaviour. This risk perception was influenced by the performance of the product, with more failures translating into higher risk perception. Individual differences in risk perception ultimately influenced blame attributions and likely actions: when risk was perceived to be higher, individuals blame the product and the regulator more and blamed themselves less. We showed how subjective risk perception (and, by consequence, blame and actions) can be manipulated by changes to how the product is labelled or marketed.

Implications

The risk of a smart product is a key factor in determining how individuals perceive and interact with it. While the objective measurable performance of the smart product is important, it was the subjective perception of risk and performance that ultimately influenced participants' blame attribution and likely actions when engaging with such products. This subjective perception of risk can be manipulated and influenced by how a smart product is described, labelled, or marketed.

Contents

Introduction

The proliferation of smart products and devices in our daily lives is unambiguous, yet their behavioural, social, cultural, and psychological implications are largely unexplored. For example, there is very limited research investigating the psychology of why individuals reject smart products (Raff & Wentzel, 2019), the feelings of disempowerment when people use such devices (Schweitzer & den Hende, 2016) and the associated perceived risks (Sovacool & Del Rio, 2020). Instead, past research has mostly focused on the technological aspect of smart devices and products. In this research, we seek to understand the psychological elements of smart product use relating to risk perception, behaviour, and blame attribution. The exploration of such psychological processes is paramount to understanding user views, attitudes, and actions with smart products. For example, when people exaggerate the risks of using a smart device, then adoption has been found to be limited. Similarly, attitudes towards smart products are moderated by judgments of blame attribution: when things go wrong and smart devices do not function based on the described or expected standards, who is to blame between the user, the manufacturer, and the market regulator?

Understanding the psychology underpinning how users perceive and interact with smart products are important components for developing campaigns, raising awareness, and increasing product safety (Inouye, 2014). Recent models of risk perception (van der Linden, 2015) identify different dimensions of risk including cognitive (i.e., knowledge of the situation), experiential and individual (i.e., emotion and affect), and socio-cultural (i.e., social norms and values). In a similar fashion, identifying how people attribute blame is central to understanding how people use smart products and devices. In fact, these two dimensions, risk and blame, may be inherently connected and jointly affect user experience with smart products.

A pertinent question is how the addition of smart features and functionality to a conventional product or device affects perceptions of risk and blame attributions (e.g., the differences between a conventional oven and its smart counterpart). However, past research on risk attitudes has shown that it is not the objective underlying risk of a product that determines risk perception, but instead, their own individual subjective judgements of risk (Slovic, 1987). Because risk is a subjective construct, it is liable to biases and individual differences, and can be manipulated in many different ways (Bennett & Calman, 1999). We will explore how different ways to label and market a smart product's functionality can ultimately influence risk perceptions, and alter how an individual assigns blame and interacts with a smart product. In other words, people's attitudes on the concept of "smartness" should be judged in the context in which the specific product or device and its characteristics are presented to the user (e.g., functionality, labelling, transparency).

Overview of experiments

In total, we collected data from N=927 participants across 5 different experiments. Individuals were only allowed to participate in one experiment, and those who participated once were blocked from participating in a later experiment. All experiments were based on the smart oven task, with small variations to test different psychological evaluations. Data was collected using the online platform Prolific from participants in the UK. On average, participants completed the task in 18.8 minutes. Participants were paid a fixed amount of £2 for participation, plus a bonus calculated based on the final number of correctly baked loaves of bread and memory matches, which averaged £2.97 (SD=0.44).

The first experiment tests the experimental paradigm and how individuals engage with a smart oven. Subsequent experiments made small manipulations to Experiment 1's smart oven, exploring a series of different psychological themes, and how they relate to risk perception and blame attribution:

- Experiment 2: Information transparency and disclosure
- Experiment 3: Product labelling and performance
- Experiment 4: Illusion of control, agency, and anthropomorphisation
- Experiment 5: Framing and anchoring

Main experimental task: Smart oven

The current studies combine experimental tasks and questionnaires to assess three key variables in people's interaction with smart products: risk perception, blame attribution, and the concept of smartness.

The experimental task allows for exploring participants' experience with a smart device: they are presented with a computer software platform that simulates the functionality of a typical oven (see Figure 1). The benefit of this design is that behaviour is explored in a simulated environment where the variables of interest are carefully controlled, while attempting to trigger affective reactions similar to those with an actual smart oven. In addition, the platform allows us to modify key variables, observe their effect on participants' reactions, and test specific hypotheses. This cannot be achieved using questionnaires and surveys alone, which only assess established knowledge and attitudes.

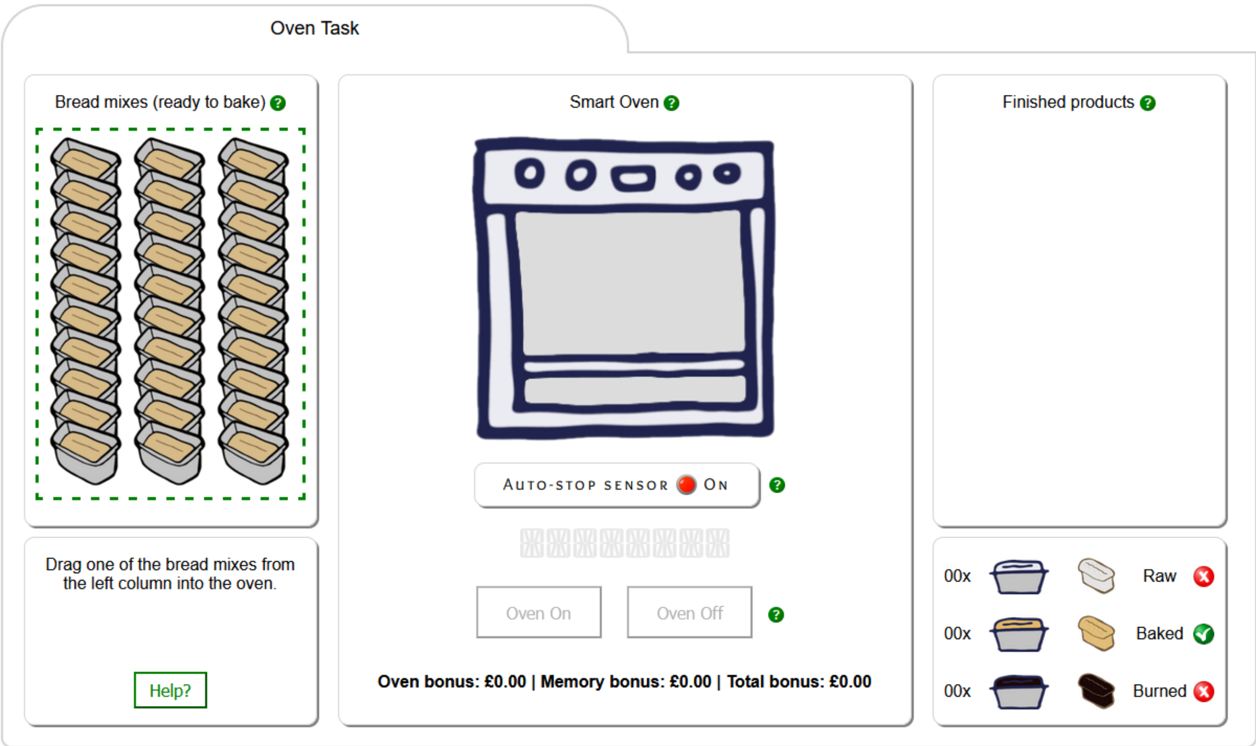

Figure 1. Experiment 1: Smart product platform ("smart oven" experimental condition). All experiments used here employ small alterations of this platform, for example with an additional message. The majority of the platform remains the same throughout.

As Figure 1 shows, participants control an oven by taking a "bread mix" from the pile on the left-hand side of the screen and placing it into the oven. As soon as the mix is dragged into the oven, they have to operate the oven by clicking the button "Oven On." The main objective of the task is to have as many baked loaves as possible in the "Finished" products column (right-hand side of the screen). If the oven is turned off prematurely (i.e., the bread mix is "Raw") or too late (the bread mix is "Burned"), participants receive no points. These points are translated into actual money which participants receive at the end of the task. Maximising performance on the task requires monitoring the bread mix in the oven and switching off the oven as soon as the mix is baked.

In the smart oven condition, participants are told that the oven is equipped with a smart sensor (Auto-Stop feature) which can detect burning and make the oven automatically switch off. Unbeknownst to participants, the sensor was programmed to function properly 66% of the time.

So far, the task may seem rather trivial: participants can monitor the state of the bread mix in the oven and as soon as it is baked, they can stop the oven and move the baked mix to the pile with the finished products. However, one important property of smart products is that they can operate and finish intended tasks unattended, without the constant input and monitoring from the user; this provides the agent the opportunity to undertake other parallel tasks at the same time. To incorporate this aspect of smart product functionality, the main experimental platform also included a memory task as in Figure 2.

While the oven was in operation, participants could engage with the task presented in Figure 2 and earn extra points (which translate into money) by matching the correct objects hidden underneath the grey tiles. Clicking on a tile would reveal the object: a match occurs when participants discover and reveal two tiles of the same object. However, playing the memory game would not allow monitoring the oven and the progress of baking, as the memory game hides the oven. To prevent the bread mix from burning and to maximise their points/money, participants would have to return to the main task screen and turn the oven off at the right time. Participants could switch between the main task and the memory game as often as they wanted.

However, in order to avoid participants simply returning to check on the task progress every few seconds, we implemented a penalty cost: every time they left the memory task and returned to the main task (presumably to check on their progress), the memory game would restart with new randomly positioned tiles. Even though the memory game points earned so far were always stored and never lost, the restart of the memory game made it more difficult to accumulate new points. This is similar to real life situations in which the side task being performed is not near the oven, and returning to check on the oven is costly.

Crucially, more points were earned by observing the oven and stopping the bread from burning (10 points) than it was possible to earn by focusing only on the memory game (1 point each match for a total of 8 points). Points were translated into financial rewards, with participants earning £0.01 for every point. In addition, the memory game is also designed to be entertaining, while observing the bread bake is arguably more boring, replicating what might happen in real life.

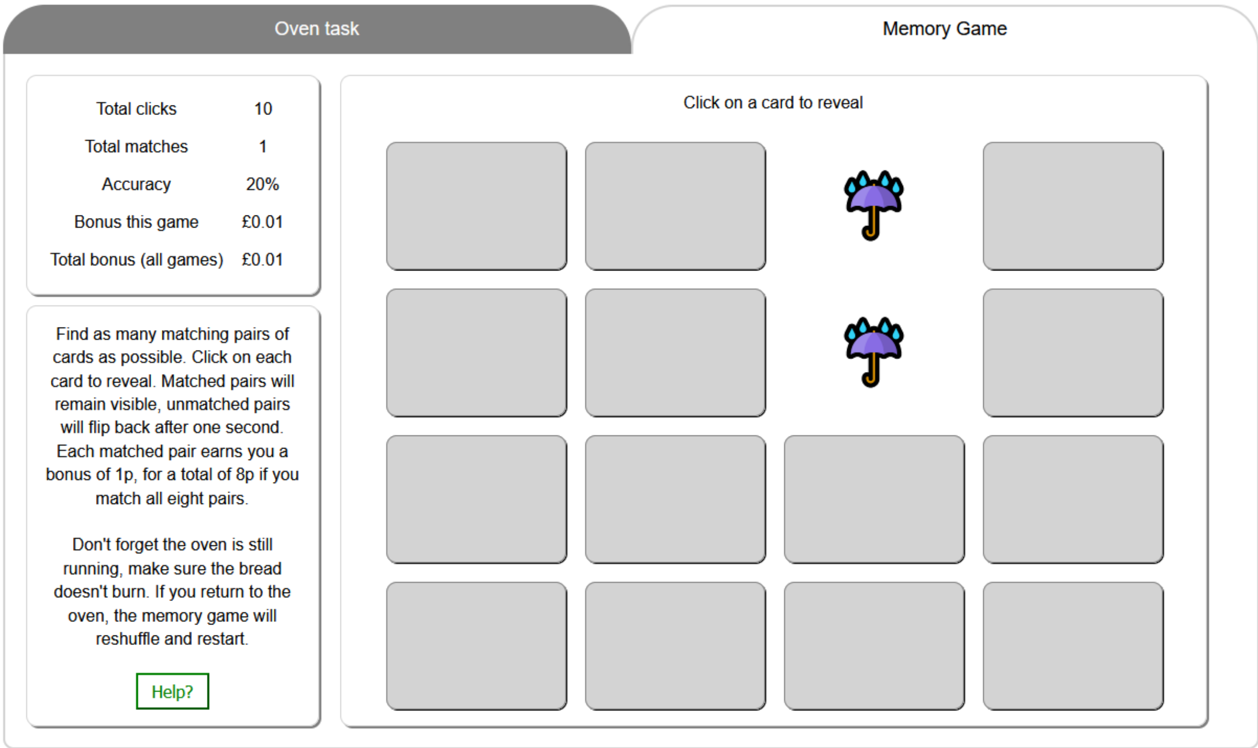

Figure 2. Experiment 1: Secondary memory task. Participants could engage with this memory task when the oven was on (or the star making device was active). While playing the memory task, participants could not check on the progress of the main task.

After the task, participants were asked a series of multiple-choice questions about risk (e.g., "how risky do you think this smart oven is", from "very safe" to "very risk"), blame attribution (e.g., blame yourself, the oven, the manufacturer, from "not at all" to "a lot to blame"), and likely actions they would take when interacting with a similar real smart oven (e.g., be more careful, never use, return as faulty, lodge a formal complaint, from "very unlikely" to "very likely"). The questions differed slightly from experiment to experiment, depending on the experimental manipulation, and are listed in full in the appendix.

Experiment 1

Experiment 1 was designed to test the validity of the experimental paradigm described above. In particular, we were interested in verifying that any observed behaviour or responses to questionnaires were not simply due to participants learning how the coded software works, due to model-free reinforcement learning (i.e., similar to a "black box" that provides rewards in response to certain behaviours), but instead that participants engaged with the oven platform as they would with a real oven, and it triggered similar affective responses, most likely based on their own previous understanding of how ovens work (model based learning). Model-free and model-based learning are of particular interest to behaviour in relation to smart products, as model-free assumes no previous knowledge of the device and its operation (and therefore is based purely on new learning which can be shaped by the provided feedback), while model-based assumes that the operator has a previous model of how the device works, and therefore brings in their own pre-existing knowledge, which in this case might be biased by conventional (non-smart) devices, or even other smart devices (Dayan & Daw, 2008).

We tested this by manipulating the "context" over which the same underlying software code (governing rules and rewards of human interaction) was super-imposed. In one condition (the "oven" condition), participants were presented with the meaningful scenario described above, about baking bread. In a control condition (the "star" condition), the same outcomes, probabilities, points earned, and responses to behaviours and actions, including the memory game and trade-offs, were employed, but instead of baking bread, participants were shown a meaningless context-free platform in which they had to produce "green stars" from "grey squares," while avoiding "grey pentagon," or "red circles" (baked bread, bread mix, raw bread, and burned loaf, respectively, in the oven scenario), as in Figure 3 (Murphy & Allopenna, 1994). This no-context star condition is similar to many generic psychological experimental paradigms used to test reinforcement learning in a model-free environment.

If participants provided similar responses to the questions in both the oven and star conditions, it could mean that they were learning how to engage with the task presented, regardless of the context. However, any differences in response can be attributed to the addition of the oven context over the context-free version of the task. As a result, responses to subsequent questions are likely due to how participants perceived their interaction with the smart oven scenario specifically.

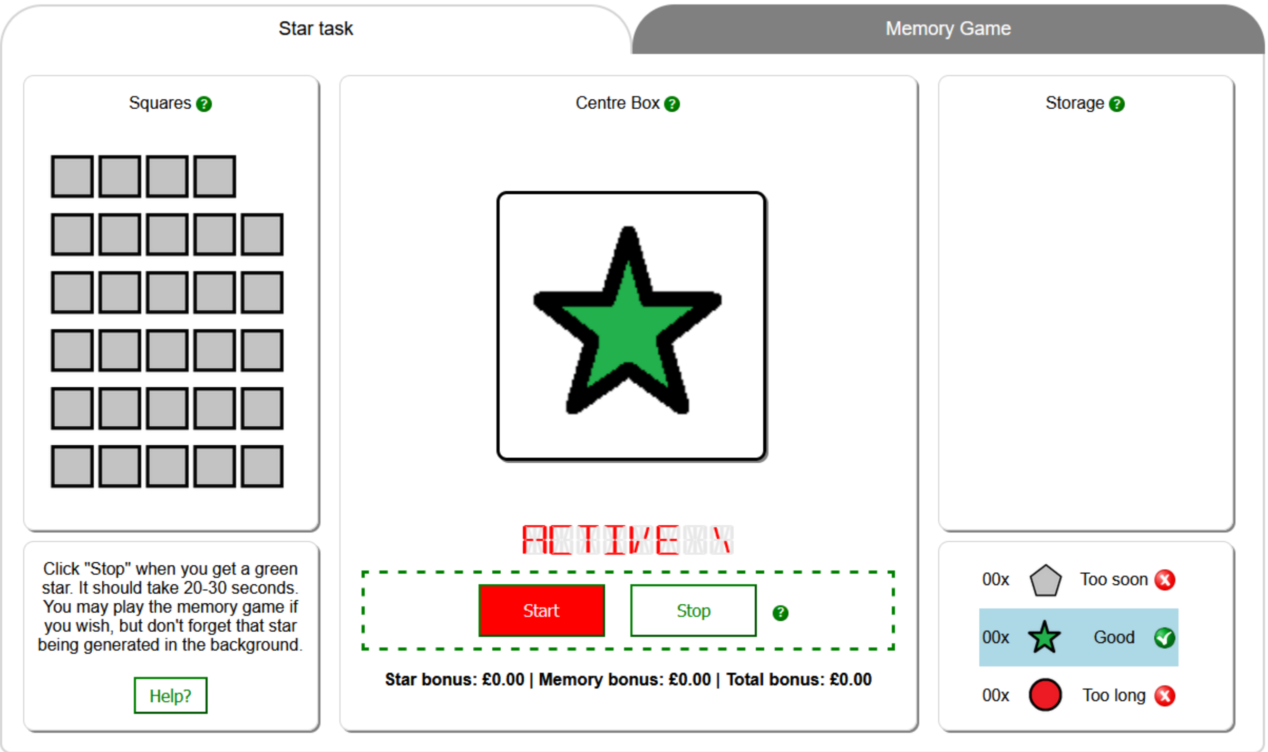

Figure 3. Context-free "star" condition in Experiment 1

In addition to testing the context manipulation, we also wanted to evaluate the smartness manipulation: in the "smart" condition, the auto-stop feature that stops loaves being burned (and red circles appearing) was active and protected the participants with a 66% probability; while in the "conventional" condition, no protection existed, and any unattended trials would end up as lost points.

In particular, participants were told about the "auto-stop" feature of the smart oven in the oven condition, however, they were not told about any protection in the context free star condition. In the smart oven condition, the oven was labelled as a "smart oven" and participants were told that "The smart oven features a safety sensor, which monitors the baking process for signs of burning. If the sensor detects that the bread inside might start to burn, it automatically turns off the oven before the bread can burn" and that "the auto-stop sensor is always on. It monitors the baking process and stops the oven before the sensor detects burning. However, it does not work 100% of the time." In the star condition, the "device" would still protect the participant with a 66% probability (and it would warn them that the device "auto-stopped"), however, the device was not labelled as "smart" and there was no associated text to explain what the auto-stop feature was. As a result, we can measure if the labelling of a device as "smart" influences behaviour and responses, or if they were influenced ex-post by the protection provided by the software code.

Participants

The experiment was a 2 x 2 between-subjects design, with two experimental manipulations, each with two levels: smartness (smart or conventional) and context (oven or star), for a total of four experimental conditions: smart-oven (N=71), conventional-oven (N=70), smart-star (N=71), and conventional-star (N=67). Across all experiments, Participants were recruited online using the Prolific platform, and only those resident in the UK who reported to be fluent in English were allowed to participate. All participants were compensated for their time, both with a fixed fee, and a bonus in relation to correctly baked loaves (or stars) and memory game matches. All experiments were approved by the Humanities and Social Sciences Research Ethics Committee, University of Warwick.

Results

Risk perception

We asked how participants perceived the riskiness of the oven (or device) in both context conditions, so this can be compared between oven and star, and between smart and conventional. We evaluated riskiness with an ANOVA with three predictors: context (oven or star), smartness (smart of conventional), and number of loaves burned. We included the last predictor to control for differences in number of loaves burned, as we expected participants who burned more loaves to believe the oven/device to be riskier, regardless of experimental manipulation. We can therefore evaluate the impact of the experimental manipulations on risk perception after controlling for number of burned loaves.

There was a significant main effect of context ($F(1, 273)=22.78$, $p<.001$), with participants perceiving the oven to be significantly riskier than the star. This suggests that the context manipulation was successful, as participants perceived the oven and the star conditions to be different.

There was a significant main effect of smartness ($F(1, 273)=6.40$, $p=.011$). A posthoc analysis shows that participants perceived the smart oven to be significantly riskier than the conventional oven ($t(273)=2.334$, $p=.02$), with no differences by smartness in the context-free star condition (see Figure 4). These effects have been controlled for differences in number of loaves burned, which also significantly influenced risk perception ($F(1, 273)=15.704$, $p<.001$), as participants perceived the oven or device to be riskier when more loaves were burned.

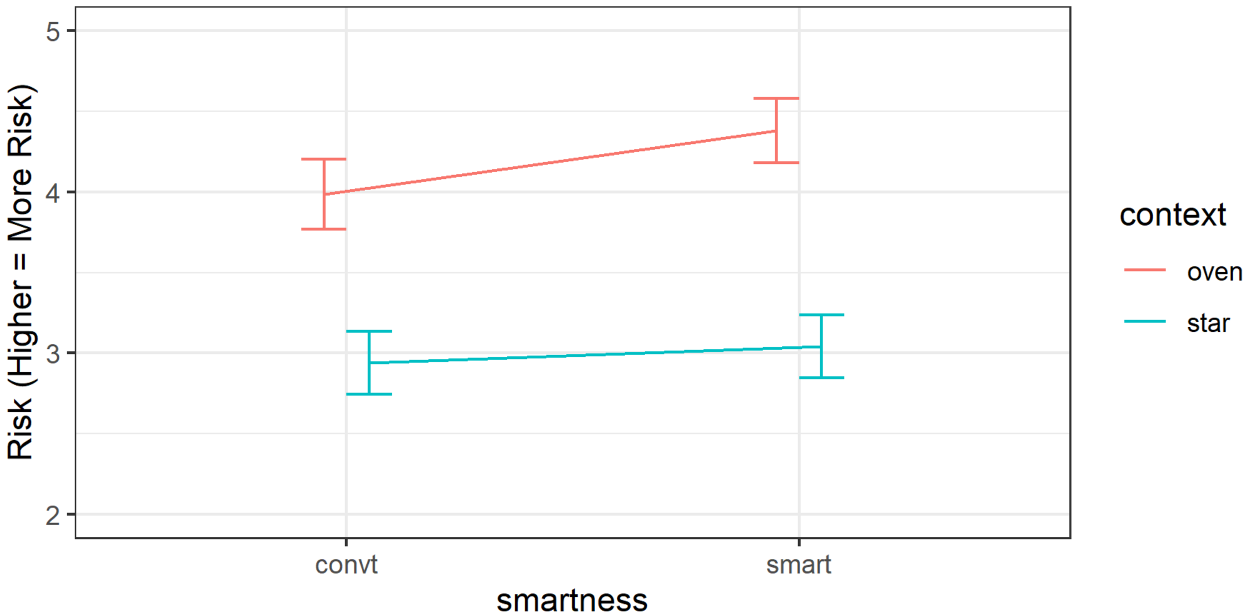

Figure 4. Risk perceptions in Experiment 1. Higher values equal more risk.

Blame attribution

We were interested if participants would attribute blame differently between the two context conditions (oven vs. star making) and smartness (smart vs. conventional). We asked participants two blame-attribution questions across all four experimental conditions: to what extent they blamed the user (i.e., "yourself"), or the oven (or the device, in the no-context star condition), for any burned loaves of bread (or red circles).

Figure 5 shows the blame attributions for the user (A. Blame Yourself) and the oven or device (B. Blame Oven/Device). We ran a MANOVA with smartness and context as independent variables (and their interaction), as well as their risk perceptions (as a control). We predicted that participants' perception of how risky the oven or device was would determine their attribution of blame, and we wanted to control for that effect.

Participants blamed themselves less when using a smart device, than when using a conventional device ($t(273)=2.784$, $p=.006$). In terms of blaming the oven or device, participants blamed the oven significantly more than they blamed the context-free starmaking device ($t(273)=4.534$, $p<.001$). In addition, there was a significant interaction between smartness and context when assigning blame to the oven/device ($F(1, 273)=28.35$, $p<.001$). Participants blamed the oven significantly more in the Smart condition than in the Conventional condition ($p<.001$), but there was no change in blame in the Star condition across smart or conventional ($p=.44$).

There was also a significant effect of risk perception on the blame assigned to the oven/device ($F(1, 273)=9.79$, $p=.004$), but not on the blame assigned to themselves ($p=.52$). Participants who perceived the task as riskier blamed the oven/device more, but riskiness did not influence the blame attributed to themselves.

We were also interested in the differences between the two attributions, "Yourself" vs "Oven/Device". From Figure 5, we can see that participants blamed themselves (A) more than they blamed the oven (B), across all conditions, except in the smart-oven condition in which participants blamed themselves at around the same level as they blamed the oven.

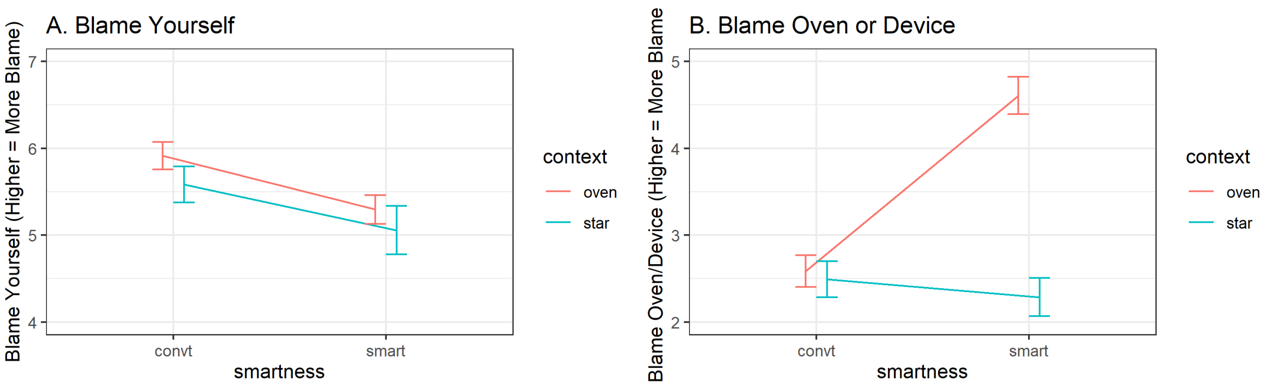

Figure 5. Blame attributions in Experiment 1. Higher values equal more blame.

For participants in the "oven" condition only (i.e., excluding participants in the "star" context-free condition), we asked two additional blame questions. We asked to what ex tent participants blamed the manufacturer, or the regulator, for burned loaves (Figure 6A). Across both metrics, participants attributed higher blame to both the manufacturer and the regulator in the smart oven condition in comparison to a conventional oven ($F(2, 137)=52.38$, $p<.001$). The largest increase was in the blaming of manufacturers, more than blaming the oven or the regulator. We also included in this analysis the participants' perception of risk. We observed the the higher the perceived risk, the higher the blame attributed to manufacturer and to regulator (F(2, 137)=6.14, p=.003).

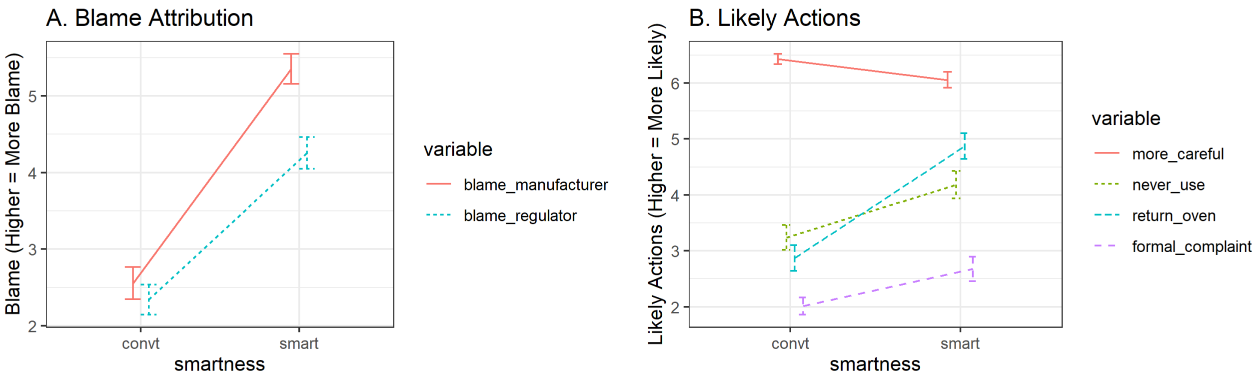

Figure 6. Blame attributions and likely actions in Experiment 1, oven condition only.

Likely actions

Responses to the likely actions questions were only captured for the oven condition (not for the no-context star condition). We asked participants if they were likely to: be more careful, never use such an oven, return the oven, lodge a formal complaint with the regulator. When looking at likely actions, all four questions were significantly different between conventional and smart ovens (MANOVA: F(4, 135)=10.85, p<.001). Participants said they were less likely to be more careful with a smart oven, and more likely to never use, return, and complain about a smart oven (Figure 6B). This model also included their perception of risk, as in the models before, and this was also significant (F(4,135)=6.50, p<.001). In particular, the riskier the participants' perceptions of the oven, the more they said they were likely to never use such an oven, or return it. There was no apparent correlation between risk perception and being more careful or complaining to the regulator.

Discussion

Overall, analyses of Experiment 1 confirm that participants responded differently to the task when it was presented as an oven, in comparison to a no-context task with the same underlying dynamics and rules. We can conclude that participants engaged with the oven task differently, and they did not simply learn from the feedback provided and treated the task as a "black box."

Participants perceived the smart oven as riskier than a conventional oven (Bechlivanidis, Zhu, & Osman, 2021). This is plausibly because the smart oven is expected to provide further protection and entices the user to allocate less attention to the baking process, but because it does not work every time, when it fails it is perceived as a higher risk. As expected, the number of burned loaves was also correlated with the perceived riskiness of the device.

The riskiness questions suggested that the context is important and points to the consequences of the severity of the oven failing, as participants perceived the oven to be riskier than the star task, indicating that they internalised the emotional reactions of actual burned loaves.

Regardless of the context or the smartness of the device, participants blamed themselves the most, more than the oven, the manufacturer, or the regulator. In addition, when using a smart oven, participants blamed the oven, the manufacturer, and the regulator, more, and blamed themselves less. It seems that participants shifted some of the responsibility from themselves onto the smart device. This is similar to Miller and Ross (1975)'s self-serving bias: that individuals will blame others when something goes wrong, if possible, but will not blame a tool - however it appears that by attributing "smartness" to a tool, shift in blame can occur. This difference was not observed in the no-context manipulation.

The reason that the smartness manipulation only influenced riskiness and device blame in the oven condition but not in the star condition is likely because the "smartness" was advertised to participants only in the oven condition ("smart oven" versus just "oven"). In the no-context star condition, even though the auto-stop feature was still present, the protection of the smart sensor was not explicitly advertised, and could only be learned through experience after each "saved" star. This finding indicates the importance between a feature being explicitly labelled, as opposed to simply being active behind the scenes, without the user's knowledge.

In terms of future actions, participants indicated that they are less likely to be careful with a smart oven than with a conventional oven in the future, likely because the smart oven provides additional protection; at the same time, they indicated that it will be more likely that they will never use, return, or submit a formal complaint, about a smart oven, arguably because the protection provided was not perfect and occasionally failed.

Both blame attribution and likely actions were also correlated with risk perception. This highlights the importance of understanding the drivers behind user risk perception in interactions with smart products. As shown in Figure 7, we hypothesise the mechanism behind the responses provided by participants. In subsequent experiments, we will explore further potential drivers of risk perception using different experimental manipulations.

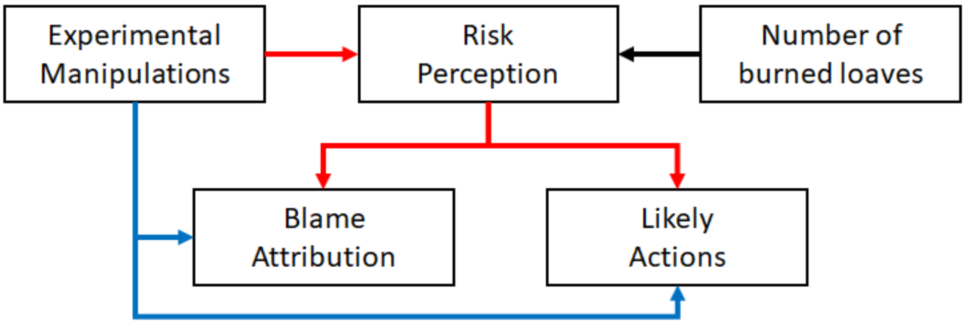

Figure 7. Proposed mechanism behind the responses provided by participants. We believe that there is a direct pathway (in blue) through which experimental manipulations (alterations to the smart product) influence blame attribution and likely actions. There is also an indirect pathway (in red) through the impact of manipulations to risk perception. Risk perception is also determined by number of burned loaves (black arrow).

Experiment 2: Information transparency

In Experiment 2, we were interested in evaluating the impact of information transparency on behaviour and sentiment when using a smart device. In this experiment, all participants were only shown a smart oven, with the auto-stop feature triggering with probability 66%. Previous research has shown how additional information can increase confidence and risk-taking, even if it does not help the decision-making process (Oskamp, 1965; Keller & Staelin, 1987). We manipulated the amount of information presented to participants. In the "opaque" condition, when the oven was on, the oven display simply showed "Anti-burn sensor is active." In the "transparent" condition, more information was shown to participants to indicate a higher level of awareness for the oven. When the oven was on, the display showed "Monitoring for burning. Current risk of burning:" followed by either "low", "medium", or "high", as the baking progressed. In addition, once the auto-stop triggered and stopped the oven (with the same 66% probability as in Experiment 1), the display in the "opaque" condition would simply state "Oven is off (Autostop)," while in the "transparent" condition it would provide more information saying "Anti-burn sensor triggered. Sensor has stopped the oven. High risk of burn detected."

Our hypothesis was that risk taking and blame attribution would increase with additional information, as participants perceived the smart feature of the oven to be more aware and in control of the baking process.

Participants

The experimental design had one between-subject factor with two levels, depending on the amount of information displayed by the sensor: participants were either shown a transparent (N=92) or an opaque (N=93) smart oven sensor.

Results

Risk perception

When evaluating how risky participants perceived the smart oven to be, there was a significant effect of information transparency on risk perception ($F(1, 182)=5.68$, $p=.018$). Participants perceived the transparent oven to be riskier than the opaque oven (Figure 8A): The addition of more information increases the perception of risk. As in Experiment 1, the model included the number of burned loaves as a predictor, to control for any differences in risk perception due to number of burned loaves. This effect was also significant ($F(1, 182)=6.53$, $p=.011$), with participants perceiving the oven to be riskier when it burned more loaves.

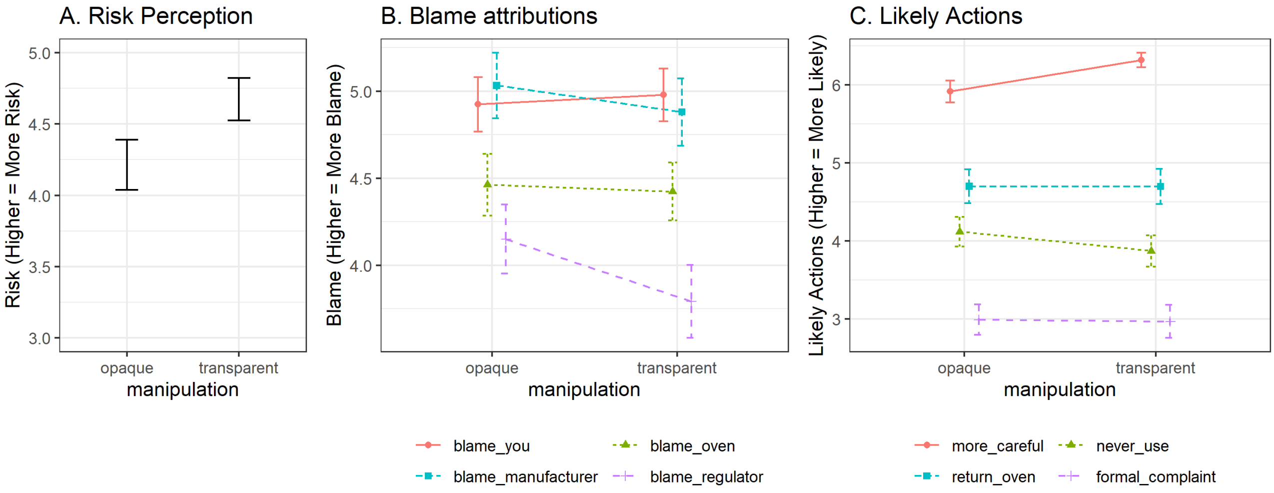

Figure 8. Risk perception, blame attribution, and likely actions in Experiment 2.

Blame attribution

We evaluated how participants attributed blame, depending on the level of information provided (opaque or transparent). There was no difference in blame attribution according to amount of information, in any of the four questions asked (F(4, 179)=0.66, p=0.62). The information manipulation did not significantly influence any of the blame attributions (Figure 8B). There was, however, a significant correlation of blame attribution and risk perception (F(4, 179)=4.62, p=.001), as before. Participants blamed themselves less, and blamed the oven, manufacturer, and regulator, more, when they perceived the oven to be riskier (Figure 9A).

Likely actions

In Experiment 2, there was no significant effect of the information manipulation on the answers to the likely actions overall (F(4, 179)=2.00, p=.096, Figure 8C). There was, as before, a significant positive relationship between likely actions and risk perception (F(4, 179)=11.57, p<.001). Participants who perceived the oven as riskier were more likely to never use, and more likely to return such a smart oven (Figure 9B).

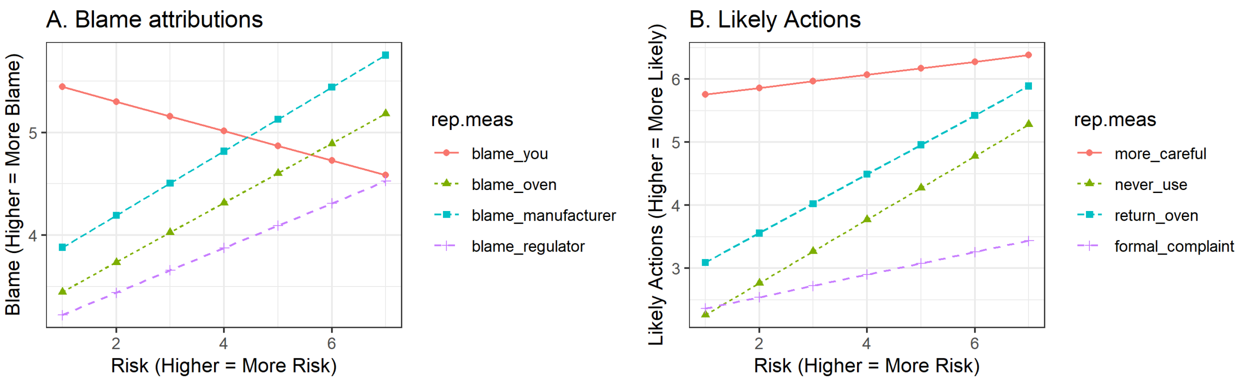

Figure 9. Blame attribution and likely actions in relationship to risk perception in Experiment 2.

Mediation analysis

While in the case of both blame attribution and likely actions, we did not observe a direct significant influence of the information manipulation, we did observe significant influences of risk perception (Figure 9). However, we wanted to investigate if the information manipulation indirectly influenced blame and actions. This is because in our previous analysis on risk perception, we showed how risk perception is influenced by information manipulation, which might indicate an indirect mediated relationship (Figure 10).

We ran two bootstrapped mediation analyses, one for blame attribution and one for likely actions, each with N=10,000 simulations. The results of the analyses shows that there is indeed an indirect path, through which information manipulation influences risk perception, which in turn influences blame and actions. This indirect path was significant, with participants blaming more the oven (b: 95% CI=[0.02, 0.34]), the manufacturer (b: 95% CI=[0.03, 0.36]), and the regulator (b: 95% CI=[0.003, 0.29]), and more likely to never use (b: 95% CI=[0.05, 0.56]) and return the oven (b: 95% CI=[0.04, 0.53]), with transparent information.

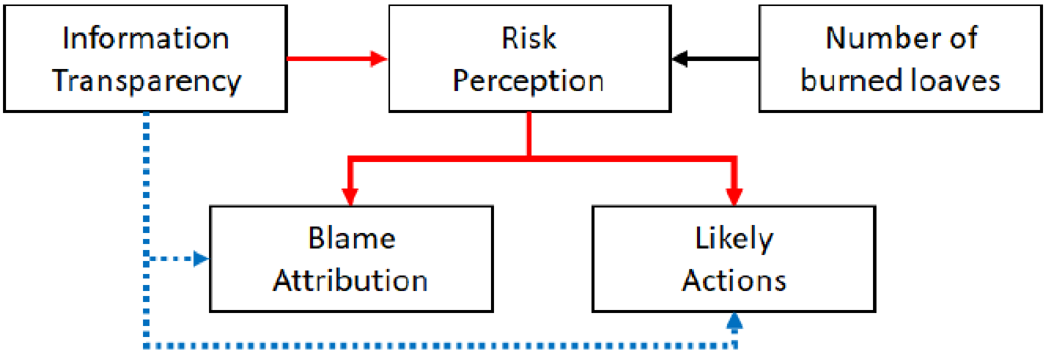

Figure 10. Diagram of the significant indirect effect of information transparency on blame attribution and likely actions (red pathway) via risk perception. In this case, there was no significant direct effect (the blue pathway was not significant).

Discussion

In Experiment 2, we showed how the disclosure of more information, which makes the "smartness" of a smart oven more transparent, can influence the perception of risk. Participants considered the oven that provided more information about how the sensor works, to be riskier, than an opaque oven that does not provide much information about its internal underpinnings. This is perhaps because with more information participants perceive that the oven should be more efficient and smarter - but because the number of failures was the same across conditions at 66%, the more transparent oven was therefore perceived as riskier. It is likely that the expectations of how much protection a smart oven inherently needs to provide played an important part in risk perceptions, and will be explored in more detail in Experiment 3.

Even though there was no direct impact of transparency on blame or likely actions, mediation analyses showed an indirect path: higher transparency increased risk perception, which in turn led to higher blame to the oven, manufacturer, and regulator, and increased likelihood of never using and returning a smart oven. As before, this manipulation shows the importance of risk perception and risk management as the key mediator to user reactions to smart products, both of which can be influenced by how information is marketed or labelled to the consumer.

Experiment 3: Promise labelling

So far, we observed how the perception of risk can influence the attitudes towards blame attribution and likely actions when using a smart device. In Experiment 3, we explored how the labelling of the smart oven, in the form of a manufacturer’s promise of performance and reliability, might influence behaviour via its associated impact on risk perception.

Consumer products often carry labels such as "kills up to 99.9% of bacteria" or "up to 100% effective." We introduced two similar promises with our simulated smart oven, depending on the experimental manipulation. Each participant was presented one of two promises: Low (75%) or High (99%). The low promise said prominently on screen at all times that "the smart oven can protect your loaves from burning up to 75% of the time."

The high promise replaced the figure with "up to 99% of the time." As in all experiments apart from Experiment 1, participants only engaged with a smart oven in Experiment 3. In both experimental conditions, the auto-stop feature was set to protect the loaves from burning 66% of the time, as before, which is less than both promises. However, the labels were not misleading because they promised protection "up to," which in both cases include the value of 66%; an often-employed technique in product labelling. In fact, because of the random nature of the protection, and the fact that participants sometimes stopped the oven before the autostop function had a chance to trigger (and therefore we cannot confirm in these cases if the autostop would have worked or not), data analysis of Experiment 3 shows that the autostop function protected more than half of the participants with greater than 75% probability, and for 11% of participants with greater than 99% probability. In previous experiments, participants’ risk perceptions were determined by number of burned loaves, probably in comparison to their own pre-existing expectations of how efficiently a smart oven should operate. Our hypothesis was that the higher promise would trigger different behaviour and different responses than the lower promise, by influencing such expectations.

Participants

The experimental manipulation employed one between-subjects factor with two levels, depending on the promise provided: participants were either shown the low promise of 75% protection (N=100) or the high promise of 99% protection (N=100).

Promise

This experiment had two additional questions that were not in previous experiments: how many loaves of bread were burned, and if the number of loaves burned was higher or lower than the manufacturer’s promise.

We first analyse the answer to the question regarding the number of burned loaves in relation to the manufacturer’s promise (Figure 11). Participants could have given three answers: "lower than promised," "about the same," or "higher than promised." This type of data requires an ordinal logistic regression. The analysis shows that the response depended on the promise itself ($z=7.55$, $p<.001$). Even though the actual number of loaves burned was, on average, always higher than the higher percentage provided by the promise, participants were significantly more likely to respond with "higher than promise" when they were shown the high promise 99% message, and more likely to respond with "lower than promised" when they saw the low promise of 75%. The model also included the actual number of loaves burned, and as expected, the more loaves burned, the more likely that participants would answer with "higher than promised" (z=5.602, p<.001).

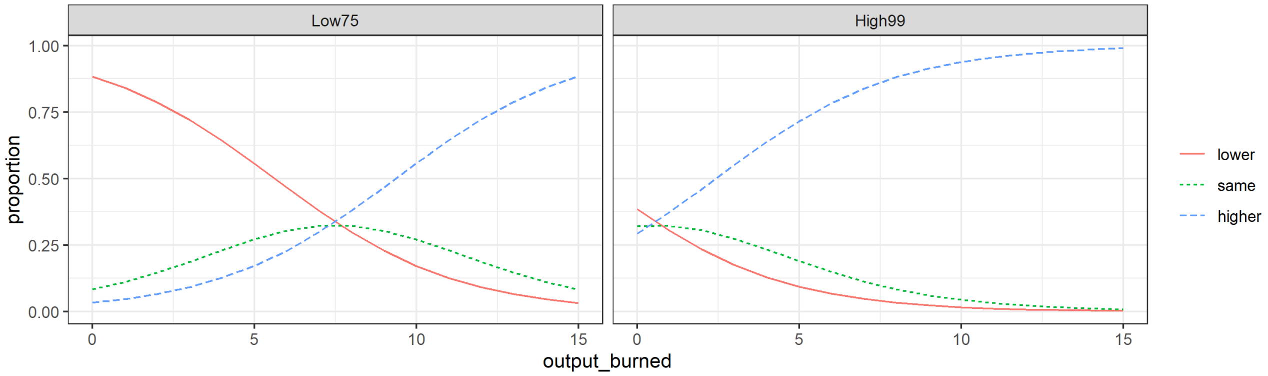

Figure 11. Participants evaluation of the promise, as provided as an answer to the question "Was the number of loaves of bread burned lower or higher than the manufacturer's promise?" in Experiment 3. The plots indicate the probability of providing each different answer according to each experimental condition.

Risk perception

We evaluated if the perception of risk is determined by the information transparency manipulation. We also include in this analysis the answer to the perception of the promise question (higher, lower, or the same; analysed in the previous sub-section), to control for differences in how participants perceived the relationship between burned loaves and the promise (similar to previous analysis where we used the number of loaves burned). When evaluating how risky participants perceived the smart oven to be, there was a significant effect of the promise on risk perception (F(1, 196)=4.05, p=.046). Participants perceived the high-promise condition to be significantly less risky, likely because they believed in the higher protection provided by the 99% promise, even though their experience of actual protection was the same on average, at 66%. There was also a significant impact on risk perception of the perception of the promise in relation to burned loaves (F(2, 196)=14.48, p<.001). Participants who reported that the number of loaves burned was higher than promised, perceived the oven to be riskier than participants who perceived the number of loaves burned to be lower than promised (Figure 12A).

Blame attribution

We evaluated how participants attributed blame, depending on the promise manipulation. The model also controlled for perception of risk, as before. There was a significant impact of the promise on blame attribution (F(1, 194)=3.99, p=.004). Participants were more likely to blame themselves and less likely to blame the manufacturer in the low promise 75% condition (Figure 12B). There was a significant effect of risk perception (F(1, 194)=15.475, p<.001), with participants less likely to blame themselves and more likely to blame the oven, manufacturer, and regulator, as their risk perception increased (Figure 13A).

Likely actions

As before, we evaluated the impact of the promise manipulation on all likely actions, while controlling for risk perception (Figure 12C). There was a significant effect of promise manipulation (F(1, 194)=4.812, p=.001). Participants were more likely to return the oven and more likely to lodge a formal complaint in the high promise 99% condition. There was also a significant effect of risk perception (F(1, 194)=36.281, p<.001). Participants who perceived the oven to be riskier were also more likely to be more careful, never use, return the oven, and lodge a formal complaint (Figure 13B).

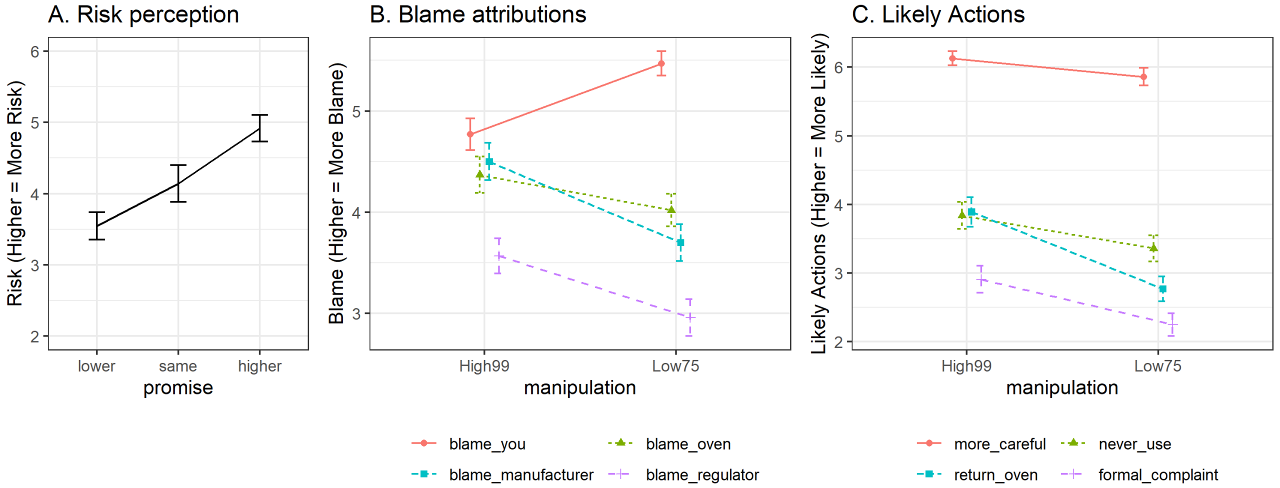

Figure 12. Risk perception, blame attribution, and likely actions in Experiment 3.

Discussion

In Experiment 3, we showed how labels promising different levels of protection, efficiency and reliability can influence the perception that users have of a smart device. The use of these labels is widespread as a marketing tool, used to attract clients and increase sales. However, they have detrimental effect on the way that the user reacts to the product based on how it performs in relation to the label.

A label promising higher levels of protection was associated with lower levels of risk perception. However, a higher promise also opens up the opportunity for users to experience lower actual performance and disappointment if the product does not live up to its expectations. Participants who considered the actual number of failures (burned loaves) to be higher than promised reported a higher risk perception of the oven.

The promise also influenced blame attribution and likely actions. Individuals blamed themselves more, and the manufacturer less, in the condition with a lower promise. This is likely because individuals demand more when the promise is of higher performance, and thought that they were less to blame if a high promise is undelivered - if something goes wrong but the device never promised high performance, then it cannot be blamed as much.

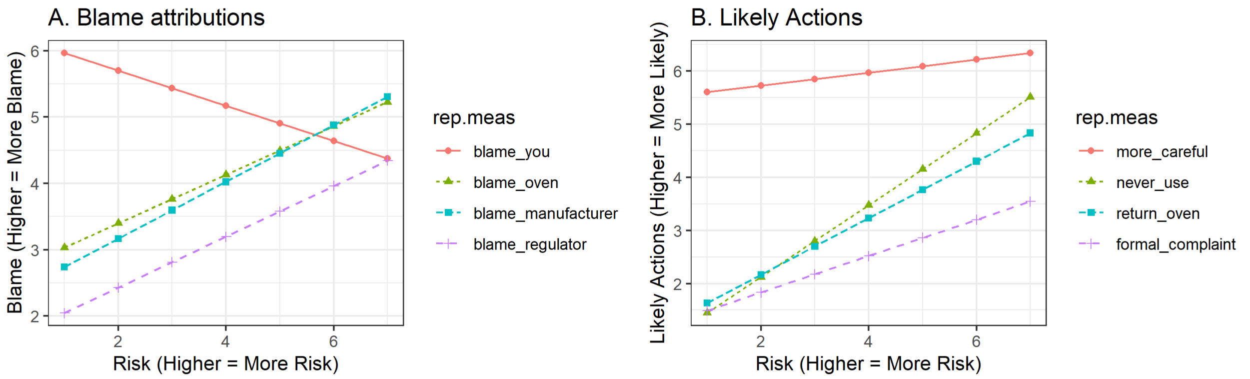

Figure 13. Blame attribution and likely actions in relationship to risk perception in Experiment 3.

Participants were also more likely to return a device or complain to the regulator if the device made a high promise, which was more difficult to achieve. Similar results were found in a previous OPSS report, suggesting that the way in which a product is marketed (i.e., increasing efficiency vs. increasing safety) impacts blame attributions.

Experiment 4: Agency

Figure 14. Icon used in Experiment 4 to represent IntelliChef.

In Experiment 4, we aim to explore the hypothesis that risk and blame attributions to devices might differ if the devices were endowed with antropomorphised agency. We manipulated that by introducing a character called the "IntelliChef," with an associated chef icon, see Figure 14. The task explained to participants that IntelliChef was in charge of the sensor and controlled the safety auto-stop feature of the smart oven.

In addition to adding agency to the oven itself, we also manipulated the level of user agency and control. There were two experimental manipulations: the Intellichef was either automatically always on, or had to be manually turned on by participants at every trial (manual control). We believe that by having to turn IntelliChef on at every trial, participants would perceive higher self-agency than in the automatic always-on mode.

All answers to the questions in Experiment 4 were analysed in comparison to the answers to the questions of the smart-oven condition in Experiment 1. By combining the two datasets, were were able to evaluate the overall impact of the addition of Intellichef in Experiment 4 against the same task without the mention of Intellichef in Experiment 1. The only difference between Experiment 4 and the smart-oven condition of Experiment 1 was the addition of IntelliChef.

Participants

In Experiment 4, all participants were shown a smart oven with IntelliChef. In addition, we manipulated user agency between-participants, with two levels: IntelliChef was either Always On (N=50), or User Controlled (N=50). The results were also compared to the smart-oven data collected for Experiment 1 (N=71).

Risk perception

There were no significant differences in risk perception across the manipulations. Participants reported the smart oven to have the same level of risk in both conditions of Experiment 4 as well as in the smart-oven condition of Experiment 1 ($F(2, 167)=0.40$, $p=.67$). There was no impact of adding IntelliChef to risk perception (Figure 15A).

Blame attribution

In terms of blame attribution, there was no difference between the two experimental conditions in Experiment 4 (user-control or always-on). Participants attributed the same level of blame across all questions regardless of that manipulation. There was, however, a significant difference between the two conditions in Experiment 4 and the smart-oven condition of Experiment 1. The addition of IntelliChef as an antropomorphised agent led to lower blame attribution to the oven, manufacturer, and regulator (Figure 15B). As before, there was also a significant effect of risk perception on blame attribution ($F(1, 167)=11.01$, $p=.001$), with higher risk perception translating as higher blame attributed to the oven, the manufacturer, and the regulator.

Likely actions

In terms of likely action, only the likelihood to return the oven was significantly different between conditions ($p=.005$), with participants more likely to return the oven in the smart-oven condition of Experiment 1, than in the two conditions of Experiment 4 (Figure 15). IntelliChef made it less likely that participants would return the oven. There was no difference to the other likely actions although, as before, they were significantly influenced by risk perceptions ($F(1, 167)=10.40$, $p=.001$).

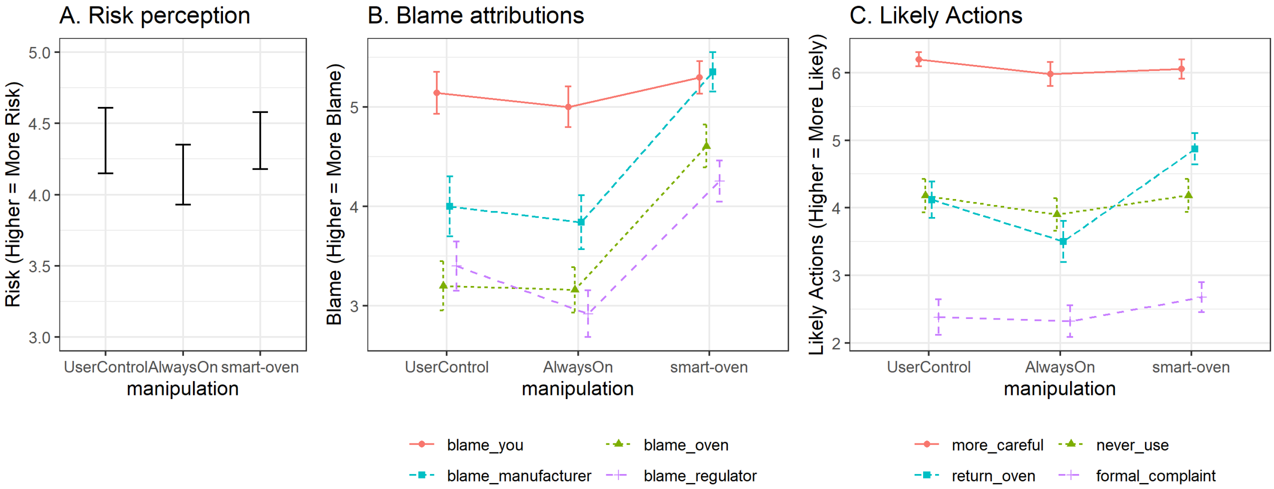

Figure 15. Risk perception, blame attribution, and likely actions in Experiment 2. The data for the Smart-Oven is from Experiment 1 (without IntelliChef), for comparison.

Discussion

In Experiment 4, we showed how the addition of an anthropomorphised agent to the smart oven, in the form of IntelliChef, influenced the reaction of participants in comparison to the standard smart oven from Experiment 1. Participants allocated lower blame to the oven, manufacturer, and regulator, when IntelliChef was present. Participants were also less likely to return an oven with IntelliChef on.

There was no effect on the metrics of the additional agency manipulation controlling for agency level of participants. If participants engaged with the oven at every trial to manually turn on IntelliChef, or if it was always automatically on, this did not influence any of their responses. Perhaps the presence of IntelliChef itself had a higher impact, and user agency should be investigated further in the future without IntelliChef.

It seems that by making the oven a bit more human, participants were less likely to assign blame - as they are perhaps more likely to be understanding of a human who makes mistakes.

Experiment 5: Framing

The questions added to Experiment 3 were framed as losses: Participants were asked how many loaves of bread "were burned" and if the number of loaves "burned" was higher or lower than the promise. Extensive previous research has showed how framing the same question as gains or losses can influence decisions (Tversky & Kahneman, 1981), risk taking (Roszkowski & Snelbecker, 1990) and emotional reactions (Levin & Gaeth, 1988). In Experiment 5, we evaluate if the framing of these questions as losses (loaves burned) against gains (loaves saved) influenced the reactions of participants, via different levels of risk perception.

We also evaluate the influence of the provision of a promise, by comparing the same questions with and without a promise, as the promise might be providing participants with a performance anchor. Previous research has shown how anchors can bias judgements (Tversky & Kahneman, 1974). Anchors can be particularly effective at influencing behaviour when individuals are not very confident about what to expect, which is likely to be the case with novel products such as smart devices (Jacowitz & Kahneman, 1995). We therefore compare the promise against participants’ more general expectations of how well a smart oven, that makes no promises, should perform. As we observed in previous experiments, it is likely that participants’ risk perception, in the absence of a promise that provides an anchor, are being calibrated against their own previous expectations of performance.

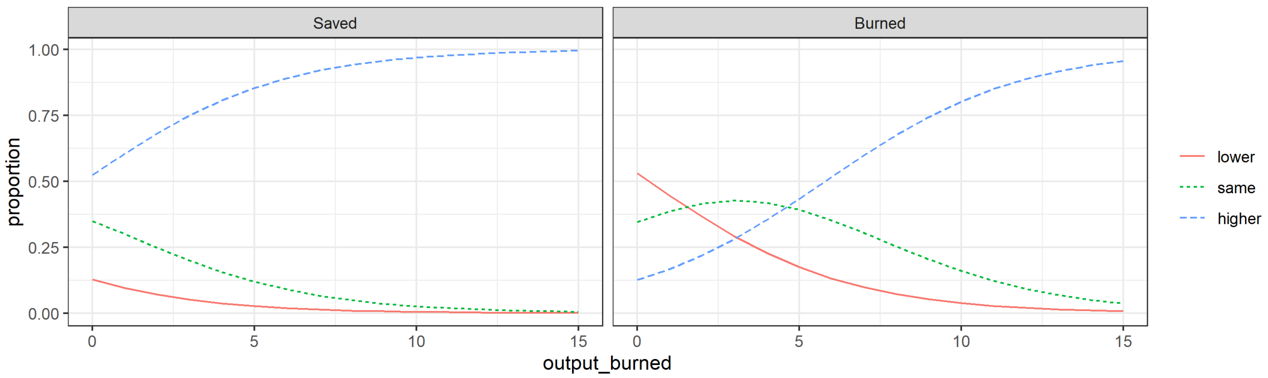

Figure 16. Participants evaluation of the promise, as provided as an answer to the question "Was the number of loaves of bread burned/saved lower or higher than expected for a smart oven?" in Experiment 5. The plots indicate the probability of providing each different answer according to each experimental condition. The y axis for "Saved" is inverted, so the two plots are comparable in terms of burned loaves.

There were three experimental conditions. The first two did not provide participants with a promise, but manipulated framing of the questions at the end. In the "Saved" condition, participants were not shown any promises of sensor performance, and at the end of the task they were asked "Was the number of loaves of bread saved by the sensor (autostop) lower or higher than expected for a smart oven?" In the "Burned" condition, participants were asked instead "Was the number of loaves of bread burned lower or higher than expected for a smart oven?" These were the first questions at the end of the task: by changing the way they are framed, we expected to influence participants’ responses to the remaining questions on risk perception, blame attribution, and likely actions. The third and final experimental condition was the "High99" condition, in which participants were shown the same promise as in the equivalent high promise condition in Experiment 3, but not asked any questions about the promise at the end of the task.

By comparing the first two conditions, we can evaluate the effect of framing; and by comparing the first two together against the last one, we can evaluate the anchoring effect of the promise.

Participants

There were three between-subjects experimental conditions in Experiment 5, and participants were only shown one of them: they were either shown a high-promise of 99% protection (N=54), or no promise at all, but with either a positive "saved" framing (N=54) or negative "burned" framing (N=55) of questions at the end.

Promise

As in Experiment 3, participants were asked if the number of loaves of bread burned was higher or lower than expected. However, the difference was that in Experiment 5, this question was only asked for participants in the "saved" or "burned" conditions, without a promise, not in the "high99" condition. Therefore, participants were asked if the number of loaves burned was higher or lower than expected, not than promised (because there was no promise provided). There was also an experimental manipulation as the question differed between "saved" or "burned" loaves according to the positive or negative framing of each manipulation.

As in Experiment 3, an ordinal logistic regression was employed for this type of data. This analysis was only conducted on the two framing manipulations ("saved" or "burned"), as this question was not asked in the "high99" condition. Between the two experimental conditions, the ordering of the answers was reversed: reporting a "higher than expected" answer in the saved condition was the same as reporting a "lower than expected" answer in the burned condition: they both indicated that fewer loaves were burned than expected. In order to conduct this analysis, we reverse-coded the answers to the question in the "saved" condition, converting all the answers to a "burned" frame (which was the same as in Experiment 3, so they can be compared).

There was a significant difference on the responses provided according to the framing ($z=4.609$, $p<.001$). A positive framing increased the probability that participants would report that the number of loaves burned was higher than expected. When the question was asked negatively, there was a higher probability of reporting that the number of loaves burned was lower than expected.

In Experiment 5, the answers to these promise questions were based around participants' expectations, as no promise was provided. These answers can be compared to those in Experiment 3, when a promise was provided. In particular, we can compare the answers in the "burned" framing, as this was the same frame employed in Experiment 3. We can see that the responses in the "burned" condition of Experiment 5 are most similar to the responses in the "High99" condition of Experiment 3. Participants seem to have very high expectations of the smart oven, if an anchor is not provided.

Risk perception

When participants were asked how many loaves of bread were saved, instead of burned, they perceived the oven to be significantly riskier ($t(159)=3.701$, $p<.001$). A positive framing increased the perception of risk (Figure 17A). In comparison, a promise of high performance led to relatively lower risks (similar to the results in Experiment 3), in comparison to no promise at all (t(159)=2.597, p<.01). As in previous experiments, more burned loaves translated into higher risk perception (F(1, 159)=12.18, p<.001).

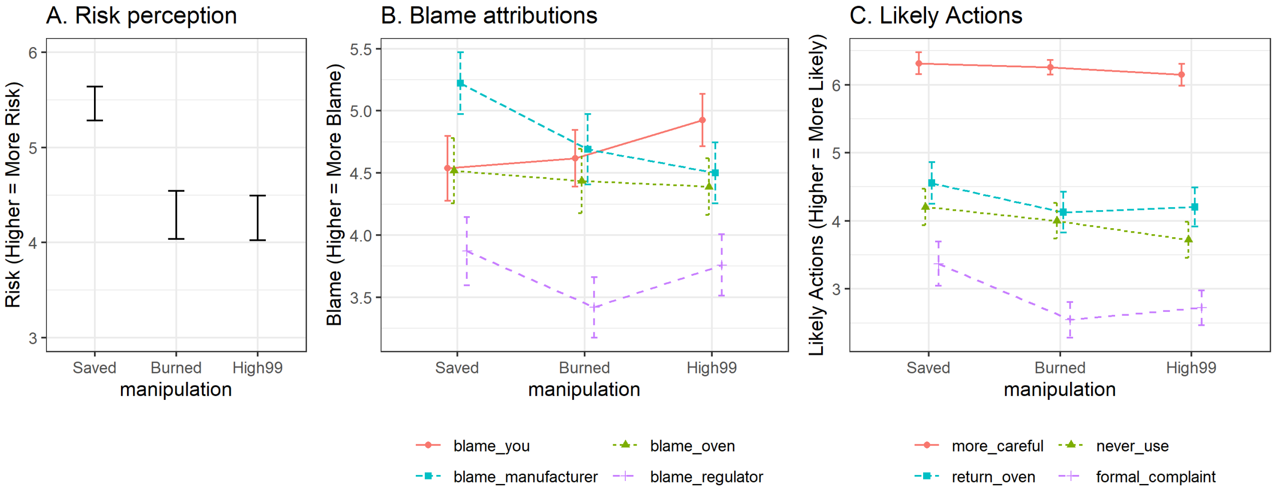

Figure 17. Risk perception, blame attribution, and likely actions in Experiment 5.

Blame attribution

There was no significant impact of the experimental manipulations in Experiment 5 on blame attribution, after controlling for risk perception (F(8, 314)=0.82, p=.59, Figure 17B). As before, there was a significant relationship between risk and blame attributions, with participants attributing more risk to oven, manufacturer, and regulator, when they perceived the riskiness of the oven to be higher (F(4, 156)=9.95, p<.001).

Likely actions

Similarly to the previous analysis, there was no significant impact of experimental manipulations on likely actions (F(8, 314)=1.13, p=.34, Figure 17C), after controlling for risk perception (if risk perception is not controlled for, then participants are more likely to lodge a formal complaint in the positive "save" framing). There was a significant relationship with riskiness, with participants more likely to perform all four actions if they perceive the oven to be riskier (F(4, 156)=21.97, p<.001).

Discussion

In Experiment 5, we showed how risk perception changes when participants are asked questions about the performance of the smart oven either in a positive or negative framing. Positively framed questions (loaves "saved") were associated with higher risk perception. We also observed how the framing can affect the perception of the performance of the smart oven, and how, in comparison to Experiment 3, it appears that participants have high expectations of the smart oven when no promise was provided.

This experiment confirms the importance of labelling and promising established in Experiment 3, and how framing and anchoring can be used to change risk perceptions.

Conclusion

The aim of this research was to investigate how individuals react to smart ovens, in different situations, and how alterations to the product can influence those reactions.

Throughout the five experiments included in this report, we observed a series of common themes, which we summarise below.

- Participants perceived the smart oven to be riskier than the conventional oven. But there was no such difference in the no-context condition. This shows that it is the subjective perception of a "smart" oven, and the expectations or protection and potential losses associated with it, that are likely to be driving the increase in risk perception.
- Product performance influences risk perception: across all experiments, the performance of the smart oven, as measured by the number of loaves burned, influenced risk perception. Participants perceived the oven to be riskier when more loaves were burned. The actual performance of the oven was determined randomly for all participants, with the oven protecting participants with a 66% probability. However, because of the way that participants engaged with the task, some taking more risk than others, the actual number of burned loaves could differ between participants - and this influenced their perception of riskiness of the smart oven.
- Participants blamed themselves more than the oven, the manufacturer, or the regulator: across all experiments, participants blamed themselves more than they blamed the oven. The blame attribution changed according to many experimental manipulations. Participants blamed themselves less, and the oven more, when the oven was smart in comparison to conventional oven.
- Promises and expectations of performance influenced risk perception: in Experiments 3 and 5, we explored different promises of the performance of the smart oven, as well as how individuals perceived the performance with and without a promise. The results show that high promises of performance are associated with higher demands - participants expected more of ovens with high performance, but also seemed to be more disappointed when they inevitably failed to deliver. We also observed how, when there was no promise of performance, participants seem to have expected the smart oven to perform to high standards (similar to a high promise of performance).
- Subjective risk perception influenced blame attribution and likely actions: it was not the absolute risk itself, but the subjective risk perception, that ultimately influenced the relationship between user and smart oven. Once participants have established their own subjective perceptions of how risky the smart oven was, this in turn influenced how they attributed blame, and which actions they would take if interacting with such a smart oven in real life, across all experiments. This means that risk perception can be an indirect pathway to how product characteristics, labelling, and expectations, translate into blame and actions. Going forward, it is important to establish which factors determine user risk perception, and controlling these factors can be crucial to understand the relationship between user and smart products.

Implications

Overall, it seems that individuals treat smart products as generally riskier than their non-smart counterpart. Previous work conducted for OPSS also found that individuals perceived smart ovens to be riskier than conventional ones (Bechlivanidis et al., 2021).

However, it is also the case that even though the smart product is perceived as riskier, it doesn't necessarily mean that people interact with the (riskier) smart product with more care, in fact they may engage in more risky behaviour because of the smart autonomous component of its functionality. In other words, just because something is perceived as riskier doesn't necessarily also mean that people take this into account in attenuating risky behaviours when interacting with a smart product.

It is important to acknowledge that there is considerable variability in the way different individuals perceive smart products, and throughout our experiments we observed that risk perception was a key mediator of blame and likely actions. How each individual perceives a smart product's riskiness has implications on blame attributions and likely actions. Previous research on risk judgement has shown that psychological assessments of risk can be very subjective, individual, and disconnected from actual objective risk (Slovic, 1987). In particular, higher subjective risk is often attributed to unknown situations or devices, such as a smart product.

Crucially, several key experimental manipulations were tested and indicate that, depending on how a smart product is marketed or its smartness labelled, this can influence risk perception, and ultimately, blame attributions and likely actions. From a regulator's perspective, it is worth taking into account not only whether a product has smart functionality, but also how that smart functionality is marketed to the consumer - which has some impact on their expectations of it and their behaviour with it.

References

Bechlivanidis, C., Zhu, Y., & Osman, M. (2021). Public Perceptions of Smart Products: Attributions of Risk and Blame in Smart Product Failure. In *Research summary*

report: 2021/036. OPSS Office for Product Safety and Standards. Bennett, P., & Calman, K. (1999). *Risk communication and public health*. Oxford University Press.

Dayan, P., & Daw, N. D. (2008). Decision theory, reinforcement learning, and the brain. *Cognitive, Affective, & Behavioral Neuroscience*, *8* , 429–453. doi:10.3758/CABN.8.4.429

Inouye, J. (2014). *Risk perception: Theories, strategies, and next steps*. Itasca, IL: Campbell Institute National Safety Council.

Jacowitz, K. E., & Kahneman, D. (1995). Measures of Anchoring in Estimation Tasks. *Personality and Social Psychology Bulletin*, *21* (11), 1161–1166.

Keller, K. L., & Staelin, R. (1987). Effects of quality and quantity of information on decision effectiveness. *Journal of Consumer Research*, *14* (2), 200–213. doi: 10.1086/209106

Levin, I. P., & Gaeth, G. J. (1988). How consumers are affected by the framing of attribute information before and after consuming the product. *Journal of Consumer Research*, *15* (3), 374. doi: 10.1086/209174

Miller, D. T., & Ross, M. (1975). Self-serving biases in the attribution of causality: Fact or fiction? *Psychological Bulletin*, *82* (2), 213–225. doi: 10.1037/h0076486

Murphy, G. L., & Allopenna, P. D. (1994). The locus of knowledge effects in concept learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20* (4), 904–919. doi: 10.1037/0278-7393.20.4.904

Oskamp, S. (1965). Overconfidence in case-study judgments. *Journal of Consulting Psychology*, *29* (3), 261–265. doi: 10.1037/h0022125

Raff, S., & Wentzel, D. (2019). A cognitive perspective on consumers' resistances to smart products. Springer International Publishing.

Roszkowski, M., & Snelbecker, G. (1990). Effects of "framing" on measures of risk tolerance. *The Journal of Behavioral Economics*, 19 (3), 237–246.

Schweitzer, F., & den Hende, E. A. (2016). To Be or Not to Be in Thrall to the March of Smart Products. *Psychology & Marketing*, *33* (10), 830–842. doi: 10.1002/mar.20920

Slovic, P. (1987). Perception of risk. *Science*, *236* (4799), 280–285. doi: 10.1126/science. 3563507

Sovacool, B. K., & Del Rio, D. D. F. (2020). Smart home technologies in Europe: A critical review of concepts, benefits, risks and policies. *Renewable and Sustainable Energy Reviews*, *120* , 109663. doi: 10.1016/j.rser.2019.109663

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185* (4157), 1124–1131. doi: 10.1126/science.185.4157.1124

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, *211* (4481), 453–458. doi: 10.1126/science.7455683 van der Linden, S. (2015). The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology*, *41* , 112–124. doi: 10.1016/j.jenvp.2014.11.012

Appendix

Questionnaires

At the end of each task, participants were asked a series of questions, which changed slightly between experiment and across experimental conditions. We start by listing the questions that were common to all experiments. These questions were asked on a 7-point Likert scale.

A.1 Common questions

1. How risky do you think this smart oven is?

Very Safe | | Very Risky

2. In comparison to a conventional oven, how would you rate this smart oven?

Safer | | Riskier

3. Consider you had a similar experience with an actual smart oven. Please indicate the extent to which each of the following parties is to blame for any burned loaves of bread:

3a. Yourself

Not at all to blame | | A lot to blame

3b. The oven

Not at all to blame | | A lot to blame

3c. The oven manufacturer

Not at all to blame | | A lot to blame

3d. The government regulator

Not at all to blame | | A lot to blame

4. Consider you had a similar experience with an actual smart oven. Please indicate how likely it would be for your to take one of the following actions:

4a. Be more careful next time

Very unlikely | | Very likely

4b. Never use a similar smart oven

Very unlikely | | Very likely

4c. Return the smart oven as faulty

Very unlikely | | Very likely

4d. Lodge a formal complaint with the government department responsible for regulating such products

Very unlikely | | Very likely

A.2 Experiment 1 specific questions

For experiment 1, the questions above were slightly different depending on experimental condition. The questions above were shown for the smart-oven condition only. In the case of the conventional-oven condition, the word "smart" was removed from all questions, and question 2 was not shown.

For the star conditions, the following four questions were shown instead of the questions above, as the other questions only applied to ovens.

1’. How risky do you think this task was, in terms of getting green stars or red circles?

Very Safe | | Very Risky

3’. Please indicate the extent to which each of the following parties is to blame for any red circles you got:

3a’. Yourself

Not at all to blame | | A lot to blame

3b’. The experiment/task

Not at all to blame | | A lot to blame

A.3 Experiments 3, 4, and 5

In addition to the questions above, the following extra question was asked at the end of Experiments 3, 4 and 5 - but before the questions above.

i. How many loaves of bread were burned? Please enter a number.

The following extra question was also asked at the end of Experiment 3.

ii. Was the number of loaves of bread burned lower or higher than the manufacturer’s promise?

Lower About the same Higher

In addition, for Experiment 5 only, the two questions above were also framed as positive gains, depending on the experimental condition. Therefore some participants saw the versions below, instead.

i’. How many loaves of bread were saved by the sensor (autostop)? Please enter a number.

ii’. Was the number of loaves of bread burned lower or higher than expected for a smart oven?

Lower About the same Higher

or

ii”. Was the number of loaves of bread saved by the sensor (autostop) lower or higher than expected for a smart oven?

Lower About the same Higher