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Survey instructions bias perceptions of environmental health risks

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Abstract

A basic function of government is to manage environmental risks. This requires measurement of how the public perceive different risks, but it is hard to measure risk perceptions in a neutral, unbiased way. In a pre-registered experiment with a nationally representative sample ($N = 800$), we tested the effects of survey instructions on perceived risk from common environmental health hazards. Participants were randomised to read instructions that made salient a relatively unfamiliar hazard (electromagnetic fields; EMFs), a familiar hazard (carbon monoxide) or no hazard (i.e., that the study was about environmental health risks in general) before rating perceived risk of a series of hazards. Results showed an asymmetric salience effect. Instructions that highlighted EMFs elicited higher levels of perceived risk from EMFs, but perceptions of other hazards were unaffected. Instructions that made carbon monoxide salient did not affect perceptions of carbon monoxide, but diminished perceived risk from other hazards. Effects were observed on widely used rating scales and on a novel policy budget allocation task. In exploratory analyses, we further sought to test the relationship between perceived risk as elicited by rating scales and revealed risk perceptions. Results showed that how often respondents report thinking about a hazard day-to-day best predicted choices in a hypothetical budget task and self-reported mitigative behaviour, even when other dimensions of perceived risk, such as perceived severity of the consequences of exposure, were controlled for. The results have implications for designing surveys to measure perceived risk of environmental health hazards.

Keywords: risk perception; experiment; measurement; mitigation; EMFs

1. Introduction

Keeping people safe is a fundamental role of government and environmental health risks are a routine threat to public safety. Effective management of such risks requires not only that government quantifies environmental risks, but also that it measures how they are perceived by the public (Weber, 1997). Where members of the public underestimate a risk, they may unwittingly expose themselves to harmful levels of it. Overestimation, on the other hand, could lead to unnecessary fear and political pressure to prioritise relatively benign risks over ones with more severe health outcomes, resulting in inefficient allocation of limited resources. In each case, communications and other policy tools are needed to address misperceptions. However, it is not straightforward to measure public perceptions of risk accurately (Sjöberg & Drottz-Sjöberg, 2001). A large body of psychological research shows that reported attitudes and beliefs are influenced by survey features that one might expect to be trivial, such as the order in which questions are asked (Bruin de Bruin, 2011; McFarland, 1981). In the present study, our aim was to investigate whether the explicit purpose of a survey is one such feature.

This paper was motivated by a request from policymakers. We were commissioned by Ireland's Environmental Protection Agency to measure public perceptions of risks from radiofrequency electromagnetic fields (EMFs) emitted by telecommunication equipment (e.g., base stations and mobile phones). There is no scientific evidence for human health effects of RF EMF exposure, but regulations typically follow the precautionary principle whereby exposure thresholds are set to levels for which there is evidence for safety (e.g., Zamanian & Hardiman, 2005). EMF levels in public places are far below these recommended exposure limits, but survey data suggests that one-in-three European citizens report being highly concerned about the health effects of EMFs (European Commission, 2007). However, these data were gathered by surveys that explicitly sought to measure risk perceptions from EMFs. We hypothesised that drawing attention to a specific hazard through survey instructions would exaggerate reported risk perceptions. Although a number of innocuous elements of survey design have been investigated previously, as reviewed in the next section, we could locate no prior work that tested whether the stated purpose of a survey is sufficient to bias measures of risk perception.

1.1 Relevant Literature

1.1.1 Survey Design Effects

How questions are framed influences perceptions of risk. This includes the wording of questions, the wording of choices and the order in which questions are asked (Bruin de Bruin, 2011). For example, faced with the same risky choice, people make systematically different decisions if options are framed in a way that highlights positives (e.g., lives saved) rather than negatives (e.g., lives lost) (Druckman, 2001; Tversky & Kahneman, 1981). Framing effects are also observed on evaluations of policies that seek to mitigate risk; people often prefer policies that class certain actions as "not allowed" over identical policies that class them as "forbidden" (Holleman, 2006).

Reframing a single attribute of a product or policy can alter preferences (Levin & Gaeth, 1988). Framing environmental surcharges as offsets instead of taxes can make them more appealing to groups who otherwise reject such policy instruments (Hardisty, Johnson & Weber, 2010; see also Freudenstein et al., 2020; Parag, Capstick & Poortinga, 2011; Ritov, Baron & Hershey, 1993). In choices between two options, introducing a third "decoy" option can influence how the other two are evaluated (Huber, Payne & Puto, 1982; Simonson & Tversky, 1992). For example, if the decoy is worse on all attributes than one of the original two, choice of the original "dominating" option increases compared to when the decoy is absent, with effects observed on consumer choice and for policy preferences (Herne, 1997).

Surrounding information can also shape responses (Strack & Martin, 1987). Schuman, Presser and Ludwig (1981) demonstrated that estimates of support for abortion varied by 15% depending on whether a general question about support was preceded by a question about support under specific circumstances. "Context effects" driven by preceding survey items are thought to alter attitudinal responses by priming certain beliefs, making them more accessible for later judgements, or by inviting a standard of comparison that would not have otherwise been activated (Tourangeau & Rasinski, 1988). Such effects have been observed for environmental risks. Among Republicans in the US, support for limiting greenhouse gas emissions was higher if the preceding question related to the scientific consensus for climate change compared to when it probed their personal beliefs in climate change (Schuldt, Roh & Schwarz, 2015).

Our interest was in a different sort of context effect, but one that likely operates via similar cognitive processes. We hypothesised that making salient to respondents that a survey is concerned with one specific hazard, rather than environmental health hazards in general, would amplify reported perceived risk for the one specified. This hypothesis has important implications. If true, previous measures of public perceptions of hazards such as EMFs are likely to be overestimated. By identifying conditions under which risk perception may be artificially biased, we seek to contribute to best-practice guidelines for measuring perceptions of environmental risks.

1.1.2 Hazard Salience

Salience is a psychological phenomenon whereby attention is differentially directed to certain pieces of information over others, resulting in that information receiving disproportionate weighting in judgements (Taylor & Thompson, 1982). The effects of salience on survey responses have perhaps been most widely documented in social psychological studies on attitudes towards outgroups. The basic idea is that making salient certain group identities (e.g., a superordinate identity that links two groups together) can mitigate ingroup biases (e.g., Brown, Vivian & Hewstone, 1999; Transue, 2007). Salience has been further demonstrated in economic models of choice (Bordalo, Gennaiolo & Shleifer, 2012). Other studies show that experimentally manipulating the salience of political issues, for example by varying the prominence of news article headlines, alters behaviour (e.g., increased petition signing) (Fox & Ward Schofield, 1989).

The salience of environmental issues also alters survey responses. Recent experience with a climate phenomenon leads survey respondents to report greater concern about the environment and support for mitigative policy. This environmental salience effect has been observed for air pollution (Whitmarsh, 2008), earthquakes (Greer, Wu & Murphy, 2018), sea level rise (Altinay, Rittmeyer, Morris & Reams, 2020), wildfires

(McCoy & Walsh, 2018) and climate change in general (e.g., following warm days) (Marlon et al., 2019; Zaval, Keenan, Johnson & Weber, 2014). With respect to EMFs, Wiedemann and Schütz (2005) show using an experimental design that cueing survey participants with details on precautionary measures to limit exposure increases perceived risk.

Taken together, the relevant literature shows that making environmental issues more salient can lead to increased reports of concern and that subtle features of survey design can alter salience. It follows that survey design features, such as the instructions, may make environmental hazards more salient and thereby artificially increase reported risk perception. To motivate our test for this hypothesis, the next section briefly reviews recent literature on how to measure perceived risk.

1.1.3 Measuring Risk Perception

Risk perception is typically measured using rating scales, with the assumption that respondents who, for example, give a risk judgement of 5 out of 7 perceive greater risk than those who give a risk judgement of 4. We used the same approach and took risk perception to be multi-dimensional (Ferrer et al., 2016; Walpole & Wilson, 2021). In other words, rather than merely asking respondents if they perceive a hazard as "risky", we followed recommendations from Wilson, Zwickle and Walpole (2019) and treated risk perception as comprised of distinct psychological dimensions: a general affective response (i.e. worry), a perceived likelihood of being affected by the risk and an expected severity of outcomes if affected. Measuring perceived risk using these dimensions has been shown to better predict risk mitigation intentions compared to other models of risk. Our data allow us to extend previous research to test the association between dimensions of risk and self-reported engagement in exposure mitigation (i.e., not just intentions).

In addition, we complemented Wilson et al.'s tripartite model with a fourth factor: daily relevance (as recommended by Wiedemann et al., 2017). As noted above, our initial aim was to measure perceived risk of EMFs. Previous research shows that, although technological sources of potential health hazards tend to elicit moderate or high ratings of risk when asked in standard surveys, they are seldom spontaneously generated when respondents are asked in interviews about risks they perceive in daily life (Freudenstein, Wiedemann & Varsier, 2015; Zwick, 2005). As such, standard scales likely produce overestimates of how risky the public perceive EMFs and other forms of technology. External stimuli like survey questions may boost the cognitive availability of such hazards, which otherwise have little impact on an individual's life (Wiedemann et al., 2017). Thus, we also measured often respondents report thinking about environmental risks in daily life and tested whether hazard salience biases this measure, too. The addition of this question allowed us to further extend work by Wilson et al. (2019), by testing whether measuring the daily relevance of a perceived risk helps to predict behaviour.

We also included a novel measurement of perceived risk. Despite the utility of measuring perceived risk using rating scales, one limitation is that they do not make explicit the trade-offs inherent in mitigating risks for policy. Governmental budget to address environmental health hazards is necessarily constrained, meaning that decisions need to be made over which ones to prioritise. Most people would reason that hazards that produce objectively more harm should be prioritised, and measures of harm are available for most environmental hazards. However, if public perception of risk diverges from objective measures or they fail to appreciate the trade-offs inherent with policy decisions, there may be political pressure to address less problematic hazards at the expense of more harmful ones (Weber, 1997). We adapted the slider task used by Belton et al. (2020) to measure perceived risk in a way that makes this trade-off explicit. In the task, participants are presented with a hypothetical budget and must apportion the budget across selected risks (see Figure 2.1 below). This task invites participants to rank the risks while retaining a continuous indicator to show the magnitude of the difference in priority (including no difference). The logic here is that participants should allocate a greater share of the budget to issues they perceive greatest risk from. (Allocation may also depend on belief in the efficacy of the proposed solution, and we sought to control for this factor by presenting participants with example policies for each risk.) This task allowed us to test (1) if effects of risk salience observed on standard rating scales are similarly observed on novel experimental tasks, and (2) whether responses on rating scales predict perceived risk as elicited by other means.

1.2 Research Questions and Hypotheses

Our overriding research question was whether making an environmental health hazard salient in survey instructions increases reports of perceived risk from it. We could locate no studies that have directly tested this hypothesis, despite the importance of its implications for policymaking and survey design. We were interested specifically in perceptions of EMFs, having been originally commissioned to investigate public perceptions of it. However, as previous work suggests low levels of familiarity with EMFs in Ireland, and familiarity is often used a heuristic for perceived risk (Song & Schwarz, 2009), we added a second condition whereby the focus was carbon monoxide ("CO"), a risk the public in Ireland are more familiar with as demonstrated by market research conducted by the EPA. To diminish the salience of these target hazards for the control group, all participants were also asked about other risks under the remit of the EPA: E. coli, lead in drinking water, microplastics, nitrous oxide (NO_x) and particulate matter (PM).

From the above, we had three research questions. First, our primary research question was:

> RQ1. Does specifying a hazard in survey instructions alter reported perceptions of risk? We pre-registered our hypothesis (H1) that perceived risk, as measured by rating scales and the budget allocation task, will be higher when instructions specify that hazard, compared to when instructions specify an alternative hazard or do not specify one.

The following were exploratory research questions:

> RQ2: Does specifying a singular hazard in instructions alter perceptions of non-specified hazards? Measuring the additional environmental risks allowed us to conduct exploratory tests of the spillover effects of specifying a singular risk in instructions. We did not pre-register a hypothesis for this research question.

RQ3: How do rating scales of perceived risk relate to perceived risk as elicited by the novel budget allocation task and mitigation behaviour? We were interested in the association between rating scale judgements of risk (i.e., perceived probability of being affected, expected severity, affective response and daily relevance) and both allocation in the budget task and self-reported mitigation of EMF exposure, but again had no specific hypothesis for this relationship.

2. Method

The study was run online using Gorilla Experiment Builder and was laptop, tablet and mobile compatible (Anwyl-Irvine et al., 2020). The design and analysis plan were pre-registered on the Open Science Framework (https://osf.io/h4xkz/?view_only=4b88ad8b48954c879a94391865089702). The study was undertaken in accordance with institutional ethics policy. For this paper, we focus on stages of the study that measured perceptions of risk. Other stages of the study are reported separately (Timmons, Papadopoulos & Lunn, 2024).

2.1 Participants

Eight hundred participants aged 18 and over were recruited using quota sampling (by age, gender, region and social grade) from online panels held by a leading market research and polling agency.[1] An additional 77 started the study but did not complete it: most dropped out during the study (*n* = 48) but a minority failed a forced-response attention check (*n* = 29) and were excluded.[2] For descriptive statistics, we weight the sample by age, gender, educational attainment and living area. The (weighted and unweighted) sample characteristics are reported in Table 2.1. We set the sample size to allow for 250 participants in each of the three experimental groups (Guadagnoli & Velicer, 1988).

Table 2.1
Sample Characteristics

		Sample – Unweighted	Sample – Weighted	CSO Estimate
Gender	Men	48.6	49.0	49.0
	Women	51.3	50.9	51.0
	Non-binary/Other	0.1	0.1	-
Age	18-39 years	37.1	36.8	36.8
	40-59 years	36.0	36.5	36.5
	60+ years	26.9	26.7	26.7
Educational Attainment	Leaving Certificate or below	31.6	43.9	43.9
	Tertiary Education below degree	30.9	28.6	28.6
	Degree or above	37.5	27.5	27.5
Living Area	Urban	61.6	68.6	68.6
	Rural	38.4	31.4	31.4

[1] https://www.redcresearch.ie/product/red-c-live/

[2] During the rating scales, participants were requested to select '3' on the scale. Those that failed twice were excluded.

Note: The Census does not record non-binary as a gender. The discrepancy between the CSO estimate and our unweighted sample is due to the use of social grade instead of education in the quota sampling applied by the market research agency.

This study was run after an unrelated survey on day-to-day behaviour. Participants were paid €4 for completing both studies, which took approximately 20 minutes. Data collection ran between 5th and 19th September 2023.

2.2 Materials and Design

Full materials are available in the Appendix and on the project's Open Science Framework page (https://osf.io/h4xkz/?view_only=4b88ad8b48954c879a94391865089702).

Participants were first informed that the study was about how factors in the environment can affect health. The main outcome measures derived from the budget allocation task and a series of rating scales to measure perceived risk. Before beginning the budget allocation task, participants were randomised by the experimental software into one of three groups: control instructions (n = 267), EMF-salient instructions (n = 268) and carbon monoxide (CO)-salient instructions (n = 265).[3] Each group completed the same tasks but the instructions to those tasks varied. For the budget allocation task, the control group read the following:

> "For this next task, we would like you to please **imagine you are in charge of the government budget for addressing possible environmental risks**. You will be given a budget and your task will be to divide this budget across different issues.
>
> You can allocate as little or as much of the budget to as many environmental risks from the list below as you want, but please make sure to use the full budget."

The only change for the EMF-salience group was that they were asked to "**imagine**

[3] Chi-square tests show the groups are balanced by gender (χ^2 = 4.13, p = .390), age (χ^2 = 6.87, p = .143), educational attainment (χ^2 = 2.52, p = .283) and living area (χ^2 = 0.12, p = .941).

you are in charge of the government budget for addressing the risks from electromagnetic fields (EMFs) and other possible environmental risks." The CO-salience group read: "…**you are in charge of the government budget for addressing the risks from carbon monoxide and other possible environmental risks**…" As such, the differences between experimental groups were mere wording changes to instructions.

Participants were then shown four environmental health hazards from a pool of seven (CO, E. coli, EMFs, lead in drinking water, microplastics, NO_x, PM) with an example policy for each (Figure 2.1). Risks were selected as those under the remit of the EPA, following discussion with a group of its officers. We set a total budget of €100 million and limited the task to four hazards in order to reduce complexity for participants. The EPA were particularly interested in perceptions of EMFs and hence all participants saw this hazard, with three other hazards selected at random from the remaining six. Participants' task was to allocate the €100 million budget across the four risks, as an adapted version of the slider trade-off task developed by Belton et al. (2020) (Figure 2.1). Participants were informed that they could allocate as much or as little of the budget to each risk but that the total must equal €100 million. Participants could not proceed with the study until the full €100 million (and no more) was allocated across the risks. Hence the task differed from standard preference elicitation methods (e.g., discrete choice) by emphasising trade-offs between the policies, thereby revealing preferences where different risks must be prioritised.

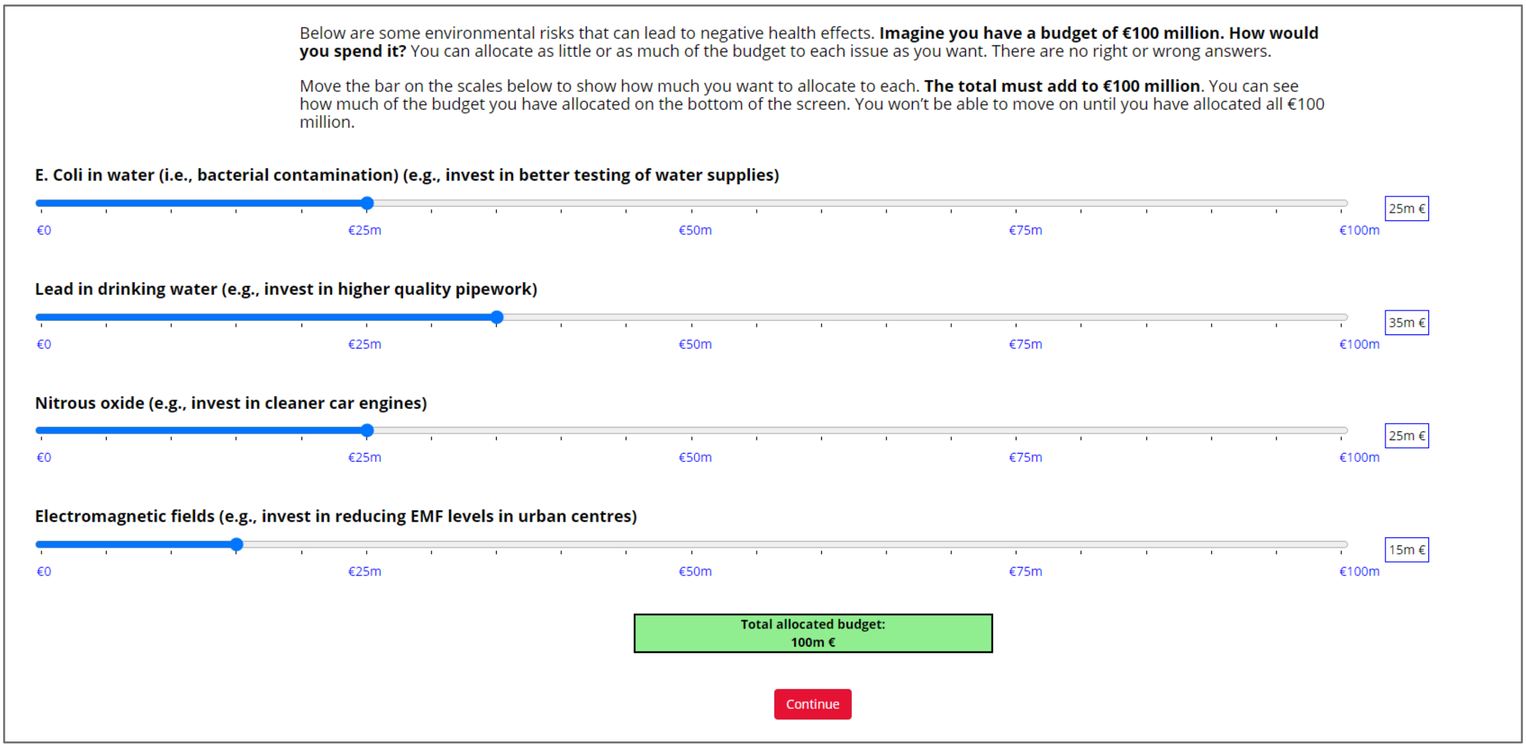


Figure 2.1. Example budget allocation task.

Participants were subsequently presented with a series of rating scales about different environmental risks. The instructions again differed between the groups, with the control group told they would see "questions about different environmental risks," whereas the EMF-salience and CO-salience groups were told they would see questions about "electromagnetic fields (EMFs) and other environmental risks" or "carbon monoxide and other environmental risks," respectively. Again, differences between the experimental groups were confined to four or five words in the instructions. Participants rated the same seven environmental health risks. Risk perceptions were elicited using 7-point rating scales for the four dimensions of perceived risk:

Probability: *How likely do you think it is that you will be exposed to harmful levels of…?*

Severity: *If you were exposed to any of the following, how severe do you think the effects of each would be?*

Affect: *How would you say the following make you feel?*

Relevance: *How often in your daily life do you think or talk about the potential health effects of…?*

Dimensions were presented in randomised order, with the order of risks on each page also randomised.

Lastly, participants were asked whether they take any actions to mitigate their exposure to EMFs and completed standard socio-demographic questions.

3. Results

We first report the effects of instructions on the risk perception rating scales before then presenting the budget allocation task. Throughout, we distinguish between our confirmatory and exploratory tests. We pre-registered directional hypotheses that perceived risk would be higher for risks specified in the instructions. However, we opt not to adjust our alpha criterion for these directional hypotheses to mitigate the increased risk of Type I error from running multiple tests (Maier & Lakens, 2022). We also report exploratory tests that show the effect of the instructions on rating scales for the other environmental health hazards in addition to the association between the rating scales and budget allocation task and reported EMF mitigative behaviour. For these, we opt to report only coefficients with 95% confidence intervals (Cumming, 2014; Nosek & Lakens, 2014; Rubin, 2021).

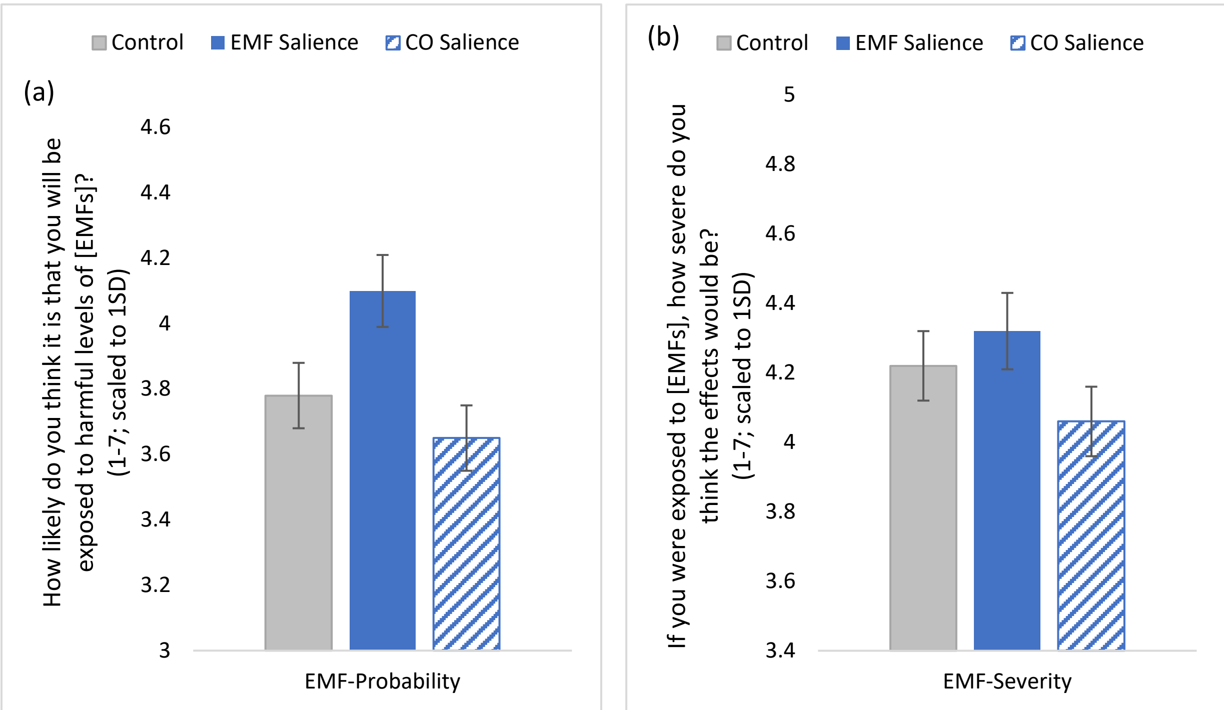
3.1 Rating Scales

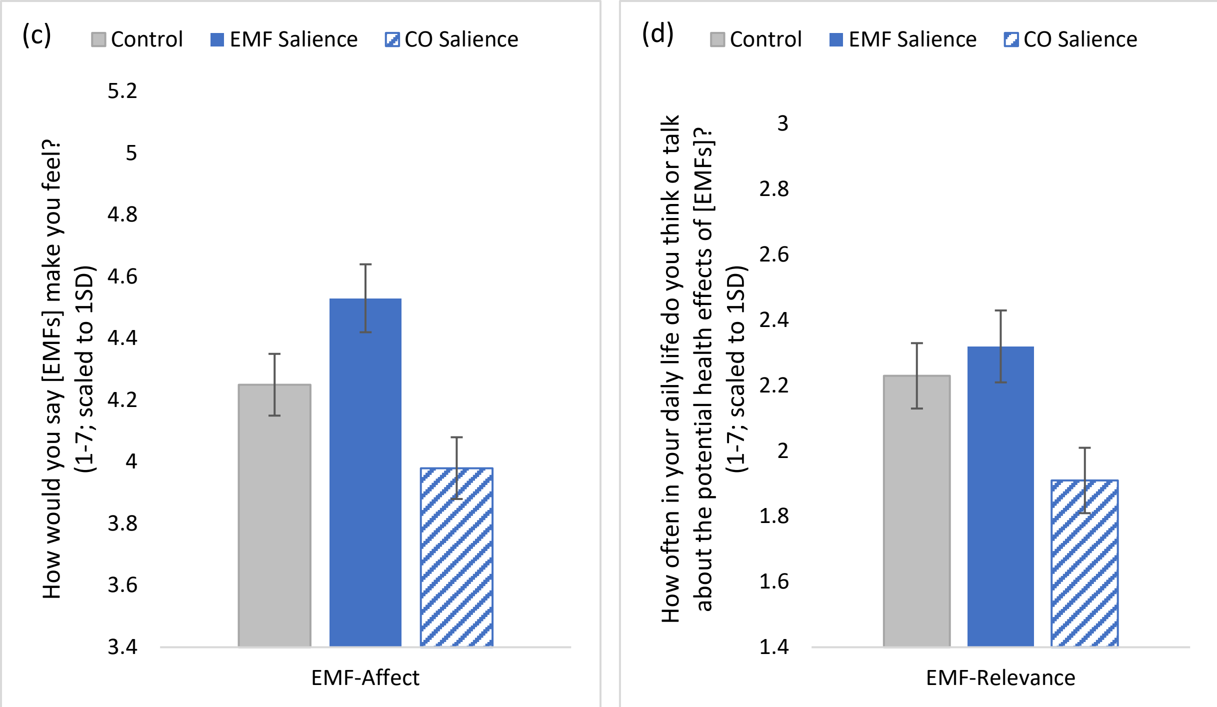
3.1.1 Confirmatory Tests

Cronbach's alphas for the dimensions of perceived risk were below the standard threshold of .8 (α_{EMF} = .77; α_{CO} = .59) and so, as pre-registered, we model the effects of instructions on perceived risk from EMF and CO on each dimension independently. We report in the Supplementary Online Material models combining the risk dimensions, which support the effects reported here.

To contextualise differences in perceptions between EMFs (which we expected participants to be broadly unfamiliar with) and CO (with which we expected greater familiarity), paired t-tests pooled across the conditions show that participants reported that they perceived greater likelihood of exposure to high levels of CO than EMFs (M = 4.23, SD = 1.65 vs. M = 3.84, SD = 1.72, respectively; t (799) = 5.90, p < .001, d = 0.21), that the effects of exposure would be more severe (M = 5.99, SD = 1.36 vs. M = 4.20, SD = 1.58; t (799) = 28.01, p < .001, d = 0.99), that in general they feel worse about CO (M = 5.57, SD = 1.52 vs. M = 4.26, SD = 1.78; t (799) = 20.06, p < .001, d = 0.71) and that they think about CO more often in their everyday life (M = 3.17, SD = 1.79 vs. M = 2.12, SD = 1.66; t (799) = 16.71, p < .001, d = 0.59).

Table 3.1 presents ordinal logistic regression models that test for the effect of instructions on perceived EMF risk, controlling for sociodemographic characteristics (age, gender, educational attainment and living area) as pre-registered. The Probability model shows that the EMF-salient instructions strengthened participants' belief that they could be exposed to high levels of EMF, compared to the control instructions and the CO-salient instructions (Figure 3.1a). A similar pattern is observed on the Affect model (Figure 3.1c). On the Severity and Relevance models, the difference between the EMF-salient instructions and control instructions is non-significant, but the CO-salient instructions elicited significantly lower perceptions of risk than the EMF-salient instructions on both (Figures 3.1c and 3.1d). To illustrate the effect of risk salience on perceived risk, we compared the proportion of participants in the EMF-salient and CO-salient group who responded above the midpoint for each EMF scale. Among those in the EMF-salient group, there was a 43% (12%-point) increase for Probability (40.0% vs. 27.9%), a 24% (9%-point) increase for Severity (44.0% vs. 35.5%), a 21% (8%-point) increase for Affect (45.2% vs. 37.4%) and a 48% (5%-point) increase for Relevance (15.7% vs. 10.6%).

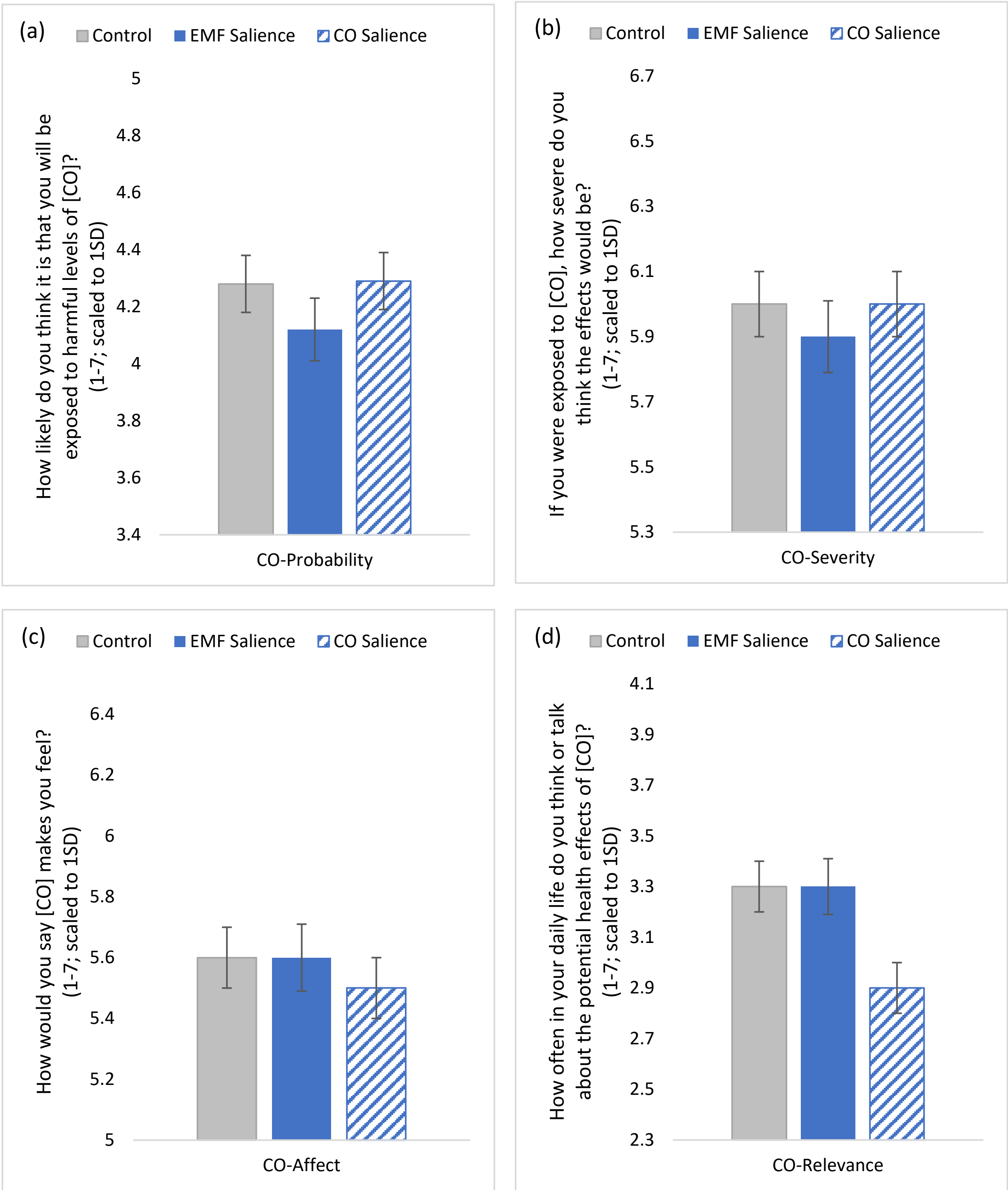




Figures 3.1a-d. Average risk perception ratings to EMF by treatment. Error bars are the standard error of the mean and the y-axis is scaled to one standard deviation to show the effect size.

The same models testing perceived risk from CO are presented in Table 3.2 and show an asymmetry in effects compared to the above. There is no evidence for a difference in perceived CO Probability, Severity or Affect based on instructions (Figures 3.2a-c). In fact, the CO-salient instructions led participants to report thinking *less* often about CO compared to the control instructions and compared to the EMF-salient instructions (Figure 3.1d).

The results thus show reported perceptions of risk from of an unfamiliar environmental issue (EMFs) were amplified when instructions made that risk salient and diminished when instructions made an alternative risk salient. However, when asked about a familiar risk (CO), instructions had very little effect.



Figures 3.2a-d. Average risk perception ratings to CO by treatment. Error bars are the standard error of the mean and the y-axis is scaled to two and a half standard deviations to show the effect size.

3.1.1 Exploratory Tests

To explore the effects of the instructions on perceptions of the other environmental hazards, we plot coefficients from ordinal logistic regression models in Figures 3.3a-d, with error bars representing the 95% confidence intervals. The general pattern across these charts suggests that the EMF-salient instructions had little influence on other hazards, relative to the control instructions. Many coefficients are close to zero and those above zero are roughly balanced by those below. However, the CO-salient instructions appear to have diminished perceptions of risk associated with the other environmental factors. All coefficients are negative, with larger effects on Severity, Affect and Relevance. In other words, when instructions highlighted carbon monoxide – a hazard participants are relatively familiar with – participants reported perceiving the effects of all other environmental risks to be less severe, that other risks made them feel less negative and that they think about other risks less often, compared to when the study was purportedly about environmental risks in general.

Table 3.1

Ordinal Logistic Regression Models Predicting EMF Risk Perceptions

	Probability		Severity		Affect		Relevance	
	B [95% CI]	*p*	*B* [95% CI]	*p*	*B* [95% CI]	*p*	*B* [95% CI]	*p*
Instructions *Ref: EMF-Salient*								
Control	-0.35* [-0.65, -0.05]	.022	-0.14 [-0.44, 0.16]	.354	-0.28 [-0.58, 0.02]	.071	-0.03 [-0.35, 0.29]	.852
CO-Salient	-0.51** [-0.81, -0.21]	.001	-0.38* [-0.69, -0.08]	.013	-0.57*** [-0.88, -0.27]	< .001	-0.49** [-0.83, -0.15]	.004
Socio-demographic Controls	Yes		Yes		Yes		Yes	
N	800		800		800		800	

p* < .05; ** *p* < .01; * *p* < .001. *Note.* Socio-demographic controls are age, gender, educational attainment and living area.

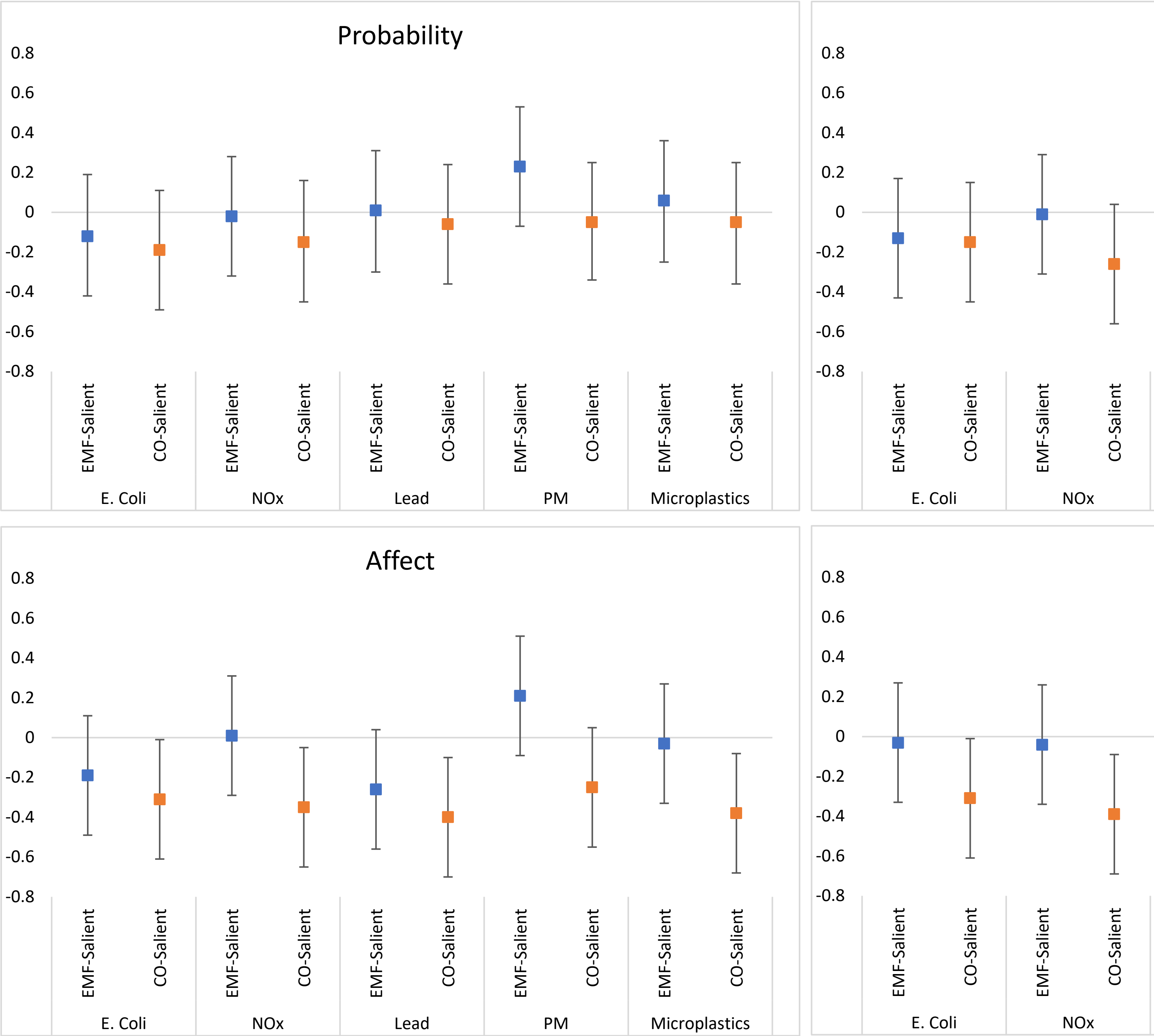
Table 3.2

Ordinal Logistic Regression Models Predicting Carbon Monoxide Risk Perceptions

	Probability		Severity		Affect		Relevance	
	B [95% CI]	*p*	*B* [95% CI]	*p*	*B* [95% CI]	*p*	*B* [95% CI]	*p*

Instructions								
Ref: CO-Salient								
Control	0.01 [-0.28, 0.31]	.923	0.09 [-0.23, 0.41]	.600	0.15 [-0.15, 0.46]	.329	0.38* [0.08, 0.68]	.014
EMF-Salient	-0.16 [-0.46, 0.15]	.312	-0.09 [-0.42, 0.23]	.566	0.10 [-0.21, 0.41]	.523	0.33* [0.03, 0.64]	.030
Socio-demographic Controls	Yes		Yes		Yes		Yes	
N	800		800		800		800	

p* < .05; ** *p* < .01; * *p* < .001. *Note.* Socio-demographic controls are age, gender, educational attainment and living area.



Figures 3.3a-d. Model coefficients for the effects of risk salience on (a) probability, (b) severity, (c) affect and (d) relevance perceptions of non-specified risks. Error bars are the 95% confidence intervals.

3.2 Budget Allocation

Figure 3.4 shows the average budget allocation to each environmental health risk. EMF and CO were the least prioritised hazards and a paired t-test finds no statistically significant difference between them, t (404) = 1.38, p = .168, d = .07. Regression models presented in Table 3.3 test for effects of instructions on allocations to both risks. Results again show an asymmetry. The EMF-salient instructions led to significantly greater budget allocation to EMF policies compared to the control instructions and the CO-salient instructions (Figure 3.5). However, there is no evidence for an effect of the CO-salient instructions on allocations to CO policies, relative to the control instructions or the EMF-salient instructions (Table 3.3). Hence, EMF policies were given greater priority when participants believed the focus of the study was on EMF, but the same was not true for CO (Figure 3.5).

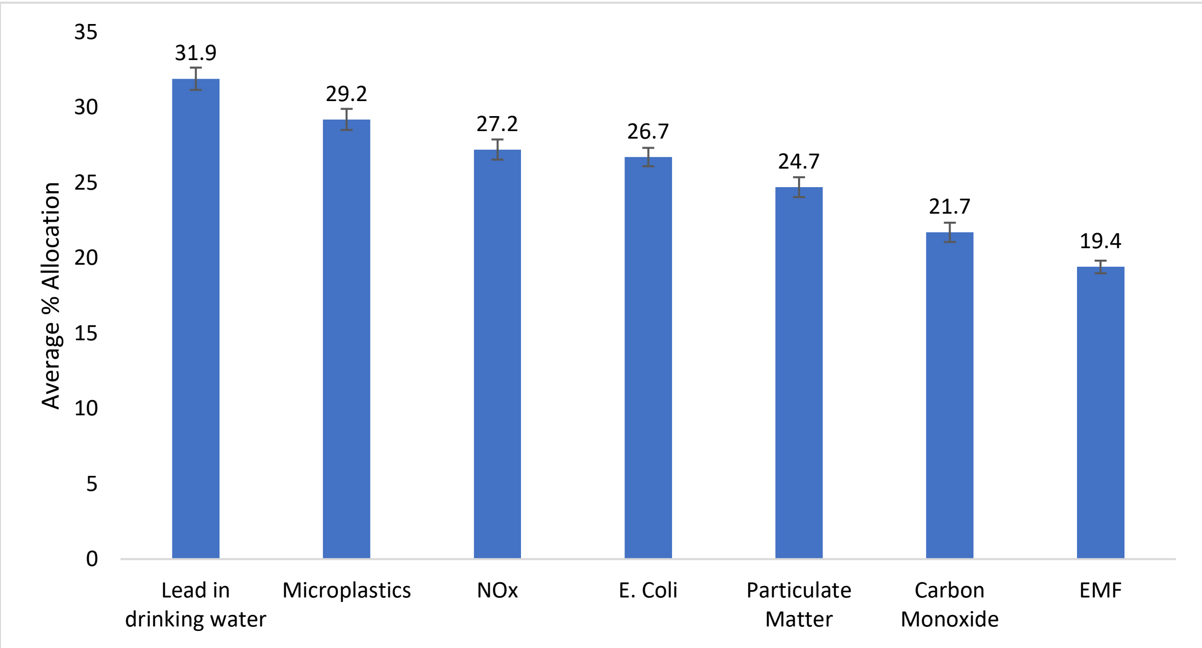


Figure 3.4. Mean budget allocation share to each environmental risk. Error bars are the standard error of the mean.

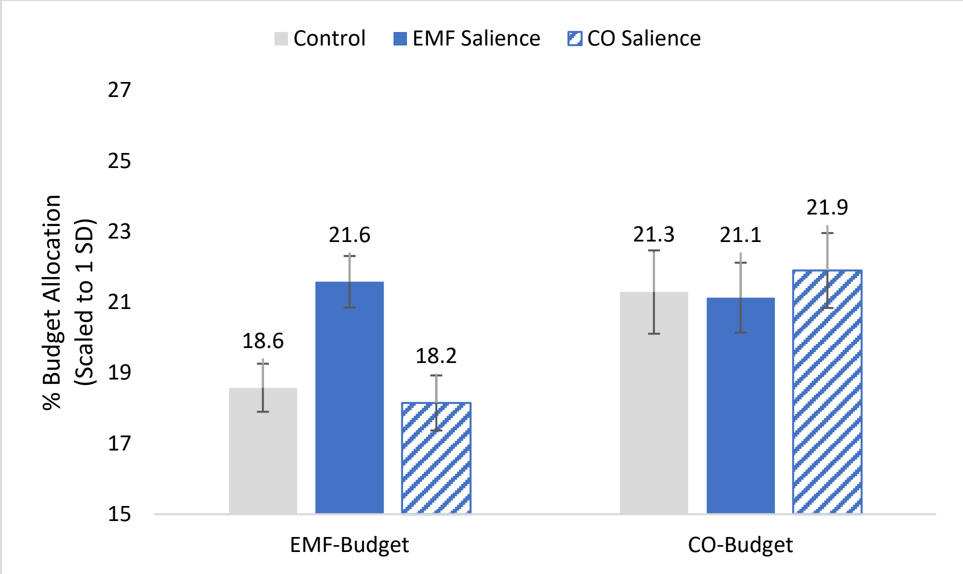


Figure 3.5. Average budget allocation to EMF and CO policies by treatment. Error bars are the standard error of the mean. The Y-axis is scaled to 1 standard deviation to illustrate the effect size.

Table 3.3

Regression Model Predicting EMF and CO Budget Allocations

	EMF			CO	
	B [95% CI]	*p*		*B* [95% CI]	*p*
Instructions			Instructions		
Ref: EMF-Salient			*Ref: CO-Salient*		
Control	-2.86** [-4.90, -0.82]	.006	Control	-0.65 [-3.72, 2.43]	.679
CO-Salient	-3.44** [-5.48, -1.41]	.001	EMF-Salient	-0.95 [-3.94, 2.05]	.535
Socio-demographic Controls	Yes		Socio-demographic Controls	Yes	
Experimental Controls	Yes		Experimental Controls	Yes	
N	793			405	

*$p < .05$; ** $p < .01$; *** $p < .001$. *Note.* Data from seven participants were lost on this task due an error with the experimental software. Socio-demographic controls include gender, age, educational attainment and living area.

3.3 Risk Dimension Validity

Lastly, we test the predictive validity of the four dimensions of perceived risk. As above, we treat this analysis as exploratory and hence report coefficients with 95% confidence intervals in place of p-values. We first test the association between EMF risk ratings and responses to the budget allocation task. To do so, we use OLS regression to predict allocation to EMF from standardised ratings on the Probability, Severity, Affect and Relevance measures for EMF. We first model each measure independently before then including all measures in one model, given expected correlation between them. All models control for socio-demographic variables (age, gender, educational attainment and living area) and include further controls for experimental group and the three other risks shown to participants on this task. Figure 3.6 suggests that each dimension positively predicted budget allocation when included independently in the model, with strongest effects for Severity and Affect followed by Probability and Relevance. However, in the model that includes all measures, the effects of Probably and Relevance weaken.

A final question in the survey asked respondents whether they take any action to mitigate their exposure to EMFs. A minority (9.8%) responded affirmatively and we model response using a logistic regression, controlling again for socio-demographics and experimental variables. Figure 3.6 shows that, when dealing with reported real behaviour, the pattern is somewhat different from that produced by the hypothetical budget allocation. In the combined model, Relevance has the strongest coefficient, followed by Affect with very little (if any) effect of Probability and Severity. The 95% confidence intervals for Probability and Severity contain 0, implying no association. Notably, whereas all dimensions predict choices and behaviours in the singular models, only Relevance is a significant predictor when all dimensions are included in the model.

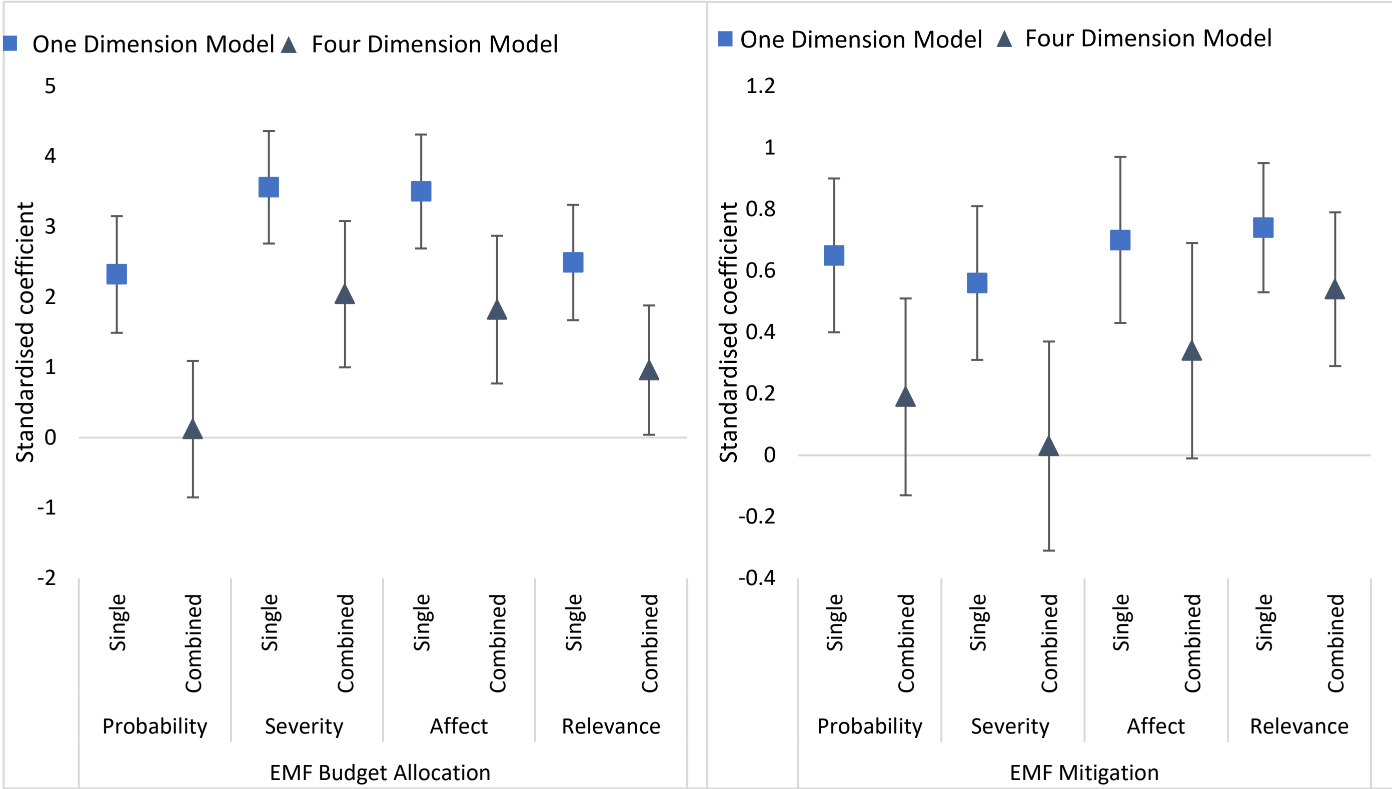


Figure 3.6. Standardised coefficients predicting EMF budget allocation (left) and reported EMF mitigation behaviour (right). Light squares indicate coefficients from models that include measures independently whereas dark triangles indicate coefficients for the models that include all measures. Error bars are the 95% confidence interval.

4. Discussion

RQs 1 and 2 concerned how hazard salience affects perceptions of (i) that hazard and (ii) others, respectively. When instructions drew attention to EMFs, participants reported greater perceived risk from EMFs than participants who completed the same survey but read slightly different instructions. Perceptions of other environmental hazards were unaffected. By contrast, when instructions drew attention to CO – a more familiar risk – perceived risk from CO was unaffected. Instead, participants reported diminished perceptions of risk from other hazards. Despite this asymmetry in effects of hazard salience, in both cases drawing attention to a particular hazard led to greater *relative* perceived risk from that hazard compared to others. This effect was observed both with standard rating scales, as used widely in surveys and the academic literature, and with a novel experimental task. Thus, the findings provide reasonably strong support for H1.

However, future research is needed to identify the mechanism driving this asymmetric salience effect. One possibility is that the direction of the effect may depend on familiarity with the hazard in question (Song & Schwarz, 2009). Another is that the target hazard may act as a reference point against which other hazards are compared. We show that, for a hazard that generates high levels of perceived risk (CO), perceptions of risk from others are depressed. But for a hazard that elicits more moderate levels of perceived risk (EMF), perceptions of other risks are amplified. In our study (and in general), the association between familiarity and perceived risk means it is not possible to disentangle these possible mechanisms (e.g., Richardson, Sorenson & Soderstrom, 1987). Nonetheless, the findings further adds to the broad literature on survey design effects altering reported perceptions of risks (e.g., Bruin de Bruin, 2011).

RQ3 concerned the relationship between dimensions of stated risk perceptions and revealed perceptions, as elicited through the budget allocation task and reports of real behaviour. Wilson et al. (2019) show that treating risk perception as multidimensional and measuring components independently (probability of exposure, severity of exposure and general affect) provides greater explanatory power than single-item measures. We extend this work by adding Wiedemann et al. (2017)'s suggestion of measuring daily relevance of risk, i.e., how often respondents report thinking about a risk day-to-day. Our findings show that daily relevance significantly predicts choices in a hypothetical budget task and day-to-day mitigative behaviour even when other dimensions of risk are included in the model. Thus, daily relevance appears to be a worthwhile addition to Wilson et al. (2019)'s model for research in which predicting real world behaviour is of importance.

4.1 Implications

The findings have implications for measuring public perceptions of environmental risks. Where surveys set out to measure perceptions of risk associated with an unfamiliar hazard, which presumably would include a new hazard, simply stating in the survey instructions that this is the intention appears sufficient to bias risk perceptions upwards. Indeed, despite the need to inform participants on the nature of studies they are requested to partake in (Jefford & Moore, 2008; Nijhawan et al., 2013), the results suggest more generally that simply informing participants of a focus on individual hazards could bias results. The effects we measured were not small: across all dimensions of risk, 20-50% more people responded with a rating above the midpoint of the scale, depending on the instructions provided. For relatively benign hazards, such as EMFs, such surveys may overestimate concern and thereby risk inefficient allocation of resources to mitigate a hazard most people in fact (and appropriately) hold little concern about. Including other risks as benchmarks for comparison, which is often advised as good practice, may exacerbate biases brought about by context effects. The findings hence imply that instructions should be general where possible and avoid making any individual hazard salient.

The findings also imply that measures of day-to-day thinking about specific environmental hazards might usefully be included in surveys. Although previous research shows that perceptions of probability, severity and affect predict behavioural intentions (Wilson et al., 2019), reported daily relevance produced the largest point-estimate for EMF mitigation behaviour taken in real life. Of further note is how respondents use scales for each dimension. Ratings for probability, severity and affect perceptions were at or above the midpoint for each risk, whereas daily relevance measures were typically below the midpoint. The measure thus helps to provide context for responses on other dimensions; simply because absolute ratings suggest that the public believe there is moderate likelihood of being exposed to high levels of an individual hazard, this likelihood may not be cognitively available without external prompting. Hence campaigns to correct overestimation of risk may only be necessary where relatively benign hazards are high on probability, severity or affect *in addition to* daily relevance. Indeed, our finding suggest that it is even possible that campaigns to correct overestimated risk may backfire by drawing attention to hazards not otherwise thought about.

4.2 Limitations

Some limitations of the experiment provide opportunities for future research. First, we tested effects of making salient two specific risks (EMF and CO) that represent hazards relatively unfamiliar and familiar to a nationally representative sample in Ireland. We have no reason to suspect effects would differ on other unfamiliar and familiar hazards or in other populations, but the generalisability of the findings would benefit from further testing, particularly with respect to the predictive validity of daily relevance for real behaviour.

Second, our exploratory analyses warrant confirmatory replication. We pre-registered exploratory analyses of the effect of salience on non-specified hazards and the relationship between stated risk preferences and revealed ones. These analyses were exploratory because there was little previous research to allow for specific hypotheses to be tested, and our inferences are derived from observed patterns rather than p-values. The results thus provide inputs necessary to make future confirmatory testing more informative (Scheel, Tiokhin, Isager & Lakens, 2020).

4.3 Conclusion

Accurate measurement of public perceptions of environmental health hazards is important for preventing unwitting exposure and misdirected political pressure. However, multiple features of how survey questions are asked can bias reported perceptions. Drawing attention to a specific hazard through subtle changes to instructions can amplify perceived risk relative to non-specified hazards, resulting in inaccurate estimates of risk perceptions. Future investigations of public perceptions of individual hazards are likely to be more accurate if they are embedded within larger studies on a broad range of hazards, with no individual hazard highlighted to respondents. Such surveys could also include measures of daily relevance for respondents, to provide important context for reported risk perceptions.

References

Altinay, Z., Rittmeyer, E., Morris, L. L., & Reams, M. A. (2021). Public risk salience of sea level rise in Louisiana, United States. *Journal of Environmental Studies and Sciences*, *11*, 523-536. https://doi.org/10.1007/s13412-020-00642-5

Anwyl-Irvine, A. L., Massonnié, J., Flitton, A., Kirkham, N., & Evershed, J. K. (2020). Gorilla in our midst: An online behavioral experiment builder. *Behavior Research Methods*, *52*, 388-407. https://doi.org/10.3758/s13428-019-01237-x

Belton, C. A., Lavin, C. & Lunn, P. (2020 Eliciting trade-offs between water charges and service benefits in Scotland. *ESRI Working Paper No. 655.* https://www.esri.ie/system/files/publications/WP655_1.pdf

Bordalo, P., Gennaioli, N., & Shleifer, A. (2012). Salience theory of choice under risk. *The Quarterly Journal of Economics*, *127*(3), 1243-1285. https://doi.org/10.1093/qje/qjs018

Brown, R., Vivian, J., & Hewstone, M. (1999). Changing attitudes through intergroup contact: The effects of group membership salience. *European Journal of Social Psychology*, *29*(5-6), 741-764. https://doi.org/10.1002/(SICI)1099-0992(199908/09)29:5/6%3C741::AID-EJSP972%3E3.0.CO;2-8

Bruin de Bruin, W. (2011). Framing effects in surveys: How respondents make sense of the questions we ask. In Keren, G. (Ed.) *Perspectives on Framing, edited* by *Gideon Keren*, (pp. 303-325). London, UK: Taylor & Francis

Cumming, G. (2014). The new statistics: Why and how. *Psychological Science*, *25*(1), 7-29. https://doi.org/10.1177/0956797613504966

Druckman, J. N. (2001). The implications of framing effects for citizen competence. *Political Behavior*, *23*, 225-256. https://doi.org/10.1023/A:1015006907312

European Commission (2007). *Special Eurobarometer 27a/Wave 66.2 – TNS Opinion & Social: Electromagnetic Fields.* https://ec.europa.eu/health/ph_determinants/environment/EMF/ebs272a_en.pdf

Ferrer, R. A., Klein, W. M., Persoskie, A., Avishai-Yitshak, A., & Sheeran, P. (2016). The tripartite model of risk perception (TRIRISK): Distinguishing deliberative, affective, and experiential components of perceived risk. *Annals of Behavioral Medicine*, *50*(5), 653-663. https://doi.org/10.1007/s12160-016-9790-z

Fox, D. L., & Ward Schofield, J. (1989). Issue salience, perceived efficacy and perceived risk: A study of the origins of anti-nuclear war activity. *Journal of Applied Social Psychology*, *19*(10), 805-827. https://doi.org/10.1111/j.1559-1816.1989.tb01223.x

Freudenstein, F., Croft, R. J., Wiedemann, P. M., Verrender, A., Böhmert, C., & Loughran, S. P. (2020). Framing effects in risk communication messages–Hazard identification vs. risk assessment. *Environmental Research*, *190*, 109934. https://doi.org/10.1016/j.envres.2020.109934

Freudenstein, F., Wiedemann, P. M., & Varsier, N. (2015). Exposure knowledge and risk perception of RF EMF. *Frontiers in Public Health*, *2*, 289. https://doi.org/10.3389/fpubh.2014.00289

Guadagnoli, E., & Velicer, W. F. (1988). Relation of sample size to the stability of component patterns. *Psychological Bulletin*, *103*(2), 265. https://psycnet.apa.org/doi/10.1037/0033-2909.103.2.265

Greer, A., Wu, H. C., & Murphy, H. (2018). A serendipitous, quasi-natural experiment: Earthquake risk perceptions and hazard adjustments among college students. *Natural Hazards*, *93*, 987-1011. https://doi.org/10.1007/s11069-018-3337-5

Hardisty, D. J., Johnson, E. J., & Weber, E. U. (2010). A dirty word or a dirty world? Attribute framing, political affiliation, and query theory. *Psychological Science*, *21*(1), 86-92. https://doi.org/10.1177/0956797609355572

Herne, K. (1997). Decoy alternatives in policy choices: Asymmetric domination and compromise effects. *European Journal of Political Economy*, *13*(3), 575-589. https://doi.org/10.1016/S0176-2680(97)00020-7

Holleman, B. C. (2006). The meanings of 'yes' and 'no'. An explanation for the forbid/allow asymmetry. *Quality and Quantity*, *40*, 1-38. https://doi.org/10.1007/s11135-005-4479-6

Huber, J., Payne, J. W., & Puto, C. (1982). Adding asymmetrically dominated alternatives: Violations of regularity and the similarity hypothesis. *Journal of Consumer Research*, *9*(1), 90-98. https://doi.org/10.1086/208899

Jefford, M., & Moore, R. (2008). Improvement of informed consent and the quality of consent documents. *The Lancet Oncology*, *9*(5), 485-493. https://doi.org/10.1016/S1470-2045(08)70128-1

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), 374-378. https://doi.org/10.1086/209174

Maier, M., & Lakens, D. (2022). Justify your alpha: A primer on two practical approaches. *Advances in Methods and Practices in Psychological Science*, *5*(2), 25152459221080396. https://doi.org/10.1177/25152459221080396

Marlon, J. R., van der Linden, S., Howe, P. D., Leiserowitz, A., Woo, S. L., & Broad, K. (2019). Detecting local environmental change: the role of experience in shaping risk judgments about global warming. *Journal of Risk Research*, *22*(7), 936-950. https://doi.org/10.1080/13669877.2018.1430051

McCoy, S. J., & Walsh, R. P. (2018). Wildfire risk, salience & housing demand. *Journal of Environmental Economics and Management*, *91*, 203-228. https://doi.org/10.1016/j.jeem.2018.07.005

McFarland, S. G. (1981). Effects of question order on survey responses. *Public Opinion Quarterly*, *45*(2), 208-215. https://doi.org/10.1086/268651

Nijhawan, L. P., Janodia, M. D., Muddukrishna, B. S., Bhat, K. M., Bairy, K. L., Udupa, N., & Musmade, P. B. (2013). Informed consent: Issues and challenges. *Journal of Advanced Pharmaceutical Technology & Research*, *4*(3), 134. https://doi.org/10.4103%2F2231-4040.116779

Nosek, B. A., & Lakens, D. (2014). Registered reports. *Social Psychology*. https://doi.org/10.1027/1864-9335/a000192

Parag, Y., Capstick, S., & Poortinga, W. (2011). Policy attribute framing: A comparison between three policy instruments for personal emissions reduction. *Journal of Policy Analysis and Management*, *30*(4), 889-905. https://doi.org/10.1002/pam.20610

Richardson, B., Sorensen, J., & Soderstrom, E. J. (1987). Explaining the social and psychological impacts of a nuclear power plant accident 1. *Journal of Applied Social Psychology*, *17*(1), 16-36. https://doi.org/10.1111/j.1559-1816.1987.tb00290.x

Ritov, I., Baron, J., & Hershey, J. C. (1993). Framing effects in the evaluation of multiple risk reduction. *Journal of Risk and Uncertainty*, *6*, 145-159. https://doi.org/10.1007/BF01065355

Rubin, M. (2021). When to adjust alpha during multiple testing: A consideration of disjunction, conjunction, and individual testing. *Synthese*, *199*(3-4), 10969-11000. https://doi.org/10.1007/s11229-021-03276-4

Scheel, A. M., Tiokhin, L., Isager, P. M., & Lakens, D. (2021). Why hypothesis testers should spend less time testing hypotheses. *Perspectives on Psychological Science*, *16*(4), 744-755. https://doi.org/10.1177/1745691620966795

Schuldt, J. P., Roh, S., & Schwarz, N. (2015). Questionnaire design effects in climate change surveys: Implications for the partisan divide. *The ANNALS of the American Academy of Political and Social Science*, *658*(1), 67-85. https://doi.org/10.1177/0002716214555066

Schuman, H., Presser, S., & Ludwig, J. (1981). Context effects on survey responses to questions about abortion. *Public Opinion Quarterly*, *45*(2), 216-223. https://doi.org/10.1086/268652

Simonson, I., & Tversky, A. (1992). Choice in context: Tradeoff contrast and extremeness aversion. *Journal of Marketing Research*, *29*(3), 281-295. https://doi.org/10.1177/002224379202900301

Sjöberg, L., & Drottz-Sjöberg, B. M. (2001). Fairness, risk and risk tolerance in the siting of a nuclear waste repository. *Journal of Risk Research*, *4*(1), 75-101. https://doi.org/10.1080/136698701456040

Song, H., & Schwarz, N. (2009). If it's difficult to pronounce, it must be risky: Fluency, familiarity, and risk perception. *Psychological Science*, *20*(2), 135-138. https://doi.org/10.1111/j.1467-9280.2009.02267.x

Strack, F., & Martin, L. L. (1987). Thinking, judging, and communicating: A process account of context effects in attitude surveys. In Hippler, H. J., Schwarz, N. & Sudman, S. (Eds.). *Social information processing and survey methodology* (pp. 123-148). New York, NY: Springer New York.

Taylor, S. E., & Thompson, S. C. (1982). Stalking the elusive "vividness" effect. *Psychological Review, 89*(2), 155. https://psycnet.apa.org/doi/10.1037/0033-295X.89.2.155

Timmons, S., Papadopoulos, A. & Lunn, P. D. (forthcoming). Public Perceptions of Environmental Health Risks. *ESRI Survey and Statistical Series Report.*

Tourangeau, R., & Rasinski, K. A. (1988). Cognitive processes underlying context effects in attitude measurement. *Psychological Bulletin*, *103*(3), 299. https://psycnet.apa.org/doi/10.1037/0033-2909.103.3.299

Transue, J. E. (2007). Identity salience, identity acceptance, and racial policy attitudes: American national identity as a uniting force. *American Journal of Political Science*, *51*(1), 78-91. https://doi.org/10.1111/j.1540-5907.2007.00238.x

Tversky, A. & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211*(4481)*,* 438-458. https://doi.org/10.1126/science.7455683

Walpole, H. D., & Wilson, R. S. (2021). A yardstick for danger: Developing a flexible and sensitive measure of risk perception. *Risk Analysis*, *41*(11), 2031-2045. https://doi.org/10.1111/risa.13704

Weber, E. U. (1997). The utility of measuring and modeling perceived risk. In Marley, A. A. J. (Ed.) *Choice, Decision, and Measurement* (pp. 45-56). Routledge.

Whitmarsh, L. (2008). Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *Journal of Risk Research*, *11*(3), 351-374. https://doi.org/10.1080/13669870701552235

Wiedemann, P. M., & Schütz, H. (2005). The precautionary principle and risk perception: Experimental studies in the EMF area. *Environmental Health Perspectives*, *113*(4), 402-405. https://doi.org/10.1289/ehp.7538

Wiedemann, P. M., Freudenstein, F., Böhmert, C., Wiart, J., & Croft, R. J. (2017). RF EMF risk perception revisited: Is the focus on concern sufficient for risk perception studies? *International Journal of Environmental Research and Public Health*, *14*(6), 620. https://doi.org/10.3390/ijerph14060620

Wilson, R. S., Zwickle, A., & Walpole, H. (2019). Developing a broadly applicable measure of risk perception. *Risk Analysis*, *39*(4), 777-791. https://doi.org/10.1111/risa.13207

Zamanian, A., & Hardiman, C. J. H. F. E. (2005). Electromagnetic radiation and human health: A review of sources and effects. *High Frequency Electronics*, *4*(3), 16-26.

Zaval, L., Keenan, E. A., Johnson, E. J., & Weber, E. U. (2014). How warm days increase belief in global warming. *Nature Climate Change*, *4*(2), 143-147. https://doi.org/10.1038/nclimate2093

Zwick, M. M. (2005). Risk as perceived by the German public: Pervasive risks and "switching" risks. *Journal of Risk Research*, *8*(6), 481-498. https://doi.org/10.1080/13669870500064150

Supplementary Material

Table A1 Cronbach's alphas for risk ratings

	Carbon Monoxide	E. Coli	Lead	NOx	PM	EMF	Microplastics
α	.59	.64	.65	.69	.73	.77	.75

Combined Risk Dimensions

Table A3 shows the effect of instructions on a risk index that averages risk perception ratings for EMF and CO.

Table A2

Regression Models Predicting Combined Risk Perceptions

	EMF		CO	
	B [95% CI]	*p*	*B* [95% CI]	*p*

Instructions			Instructions		
Ref: EMF-Salient			*Ref: CO-Salient*		
Control	-0.21	.064	Control	0.15	.098
	[-0.01, 0.43]			[-0.03, 0.34]	
CO-Salient	-0.44***	< .001	EMF-Salient	0.07	.440
	[-0.66, -0.22]			[-0.11, 0.25]	
Socio-demographic Controls	Yes		Socio-demographic Controls	Yes	
N	800		N	800	

p* < .05; ** *p* < .01; * *p* < .001. *Note.* Socio-demographic controls are age, gender, educational attainment and living area.

Budget Allocation Task and Perceptions of Risk

Table A3 presents a regression model predicting EMF budget allocation from standardised ratings on each dimension of perceived risk, controlling for experimental group and sociodemographic characteristics. The model shows that Severity, Affect and Relevance significantly predicted allocation, but there is no evidence that Probability did. Tests of coefficients show that Severity and Affect were significantly stronger predictors than Probability (χ^2 = 5.30, p = .022; χ^2 = 4.52, p = .034, respectively) but neither were significantly stronger predictors than Relevance (χ^2 = 1.86, p = .017; χ^2 = 1.31, p = .253, respectively) nor were they different from each other (χ^2 = 0.03, p = .873). There was no difference between Probability and Relevance (χ^2 = 1.11, p = .293). The models suggest that greater belief in the severity of negative consequences of exposure and experiencing more negative affect are independently and equally predictive of prioritising EMF risk over others, more so than believing that one is likely to be exposed to harmful levels.

Table A3

Regression Model Predicting Budget Allocation from Perceived Risk

	B [95% CI]	*p*
Probability	0.17 [-0.80, 1.14]	.733
Severity	2.00 [0.96, 3.04]	< .001
Affect	1.85 [0.80, 2.90]	.001
Relevance	0.98 [0.07, 1.90]	.035
Instructions (Ref: Control)		
EMF-Salient	2.41 [0.49, 4.34]	.014
CO-Salient	0.16 [-1.78, 2.09]	.875
Sociodemographic Controls	Yes	
N	793	

p* < .05; ** *p* < .01; * *p* < .001. *Note.* Socio-demographic controls are age, gender, educational attainment and living area.

Appendix

Relevant Instrumentation

Thank you for agreeing to participate in this study.
This part of the study is about how factors in the environment can affect our health. Some environmental factors can have an immediate impact, while other factors can contribute other long term health conditions.

-- next page –

[Participants are randomised to either see one or none of the below]
We are interested specifically in your thoughts about **electromagnetic fields (EMFs).** Before continuing with the study, we would like to know what do you understand by the term "electromagnetic fields"?

OR

We are interested specifically in your thoughts about **carbon monoxide.** Before continuing with the study, we would like to know what do you understand by the term "carbon monoxide"?

-- next page –

<u>[Budget allocation task]</u>
For this next task, we would like you to please **imagine you are in charge of the government budget for addressing [the risks from electromagnetic fields/carbon monoxide and other] possible environmental risks.** You will be given a hypothetical budget and your task will be to divide this budget across different issues.
You can allocate as little or as much of the budget to as many environmental risks from the list as you want, but please make sure to use the full budget.

-- next page --

Below are some environmental risks that can lead to negative health effects. **Imagine you have a budget of €100 million. How would you spend it?** You can allocate as little or as much of the budget to each issue as you want. There are no right or wrong answers.
Move the bar on the scales below to show how much you want to allocate to each. **The total must add to €100 million**. You can see how much of the budget you have allocated on the bottom of the screen. You won't be able to move on until you have allocated all €100 million.
[Participants will be shown EMF + 3 other randomised risks]

- Carbon monoxide (e.g., invest in better carbon monoxide alarms) [SLIDER 0-100m EUR]
- E. Coli in water (i.e., bacterial contamination) (e.g., invest in better testing of water supplies) [SLIDER 0-100m EUR]
- Lead in drinking water (e.g., invest in higher quality pipework) [SLIDER 0-100m EUR]
- Nitrous oxide (e.g., invest in cleaner car engines) [SLIDER 0-100m EUR]
- Particulate matter (e.g., invest in cleaner manufacturing processes) [SLIDER 0-100m EUR]
- Electromagnetic fields (e.g., invest in reducing EMF levels in urban centres) [SLIDER 0-100m EUR]

- Microplastics (e.g., invest in better water filtering processes) [SLIDER 0-100m EUR]

-- next page --

Thank you for your responses so far. The next stage is a series of questions about different environmental risks [*or* EMF/carbon monoxide and other environmental risks]. Please try to answer these questions as honestly as possible. There are no right or wrong answers.

<u>Response Scales</u>

Thematic relevance

How often in your daily life do you think about the potential health effects of: [environmental risk]?

- 1-7 (Never – Every day)

Risk probability

How likely do you it is that you will be exposed to harmful levels of: [environmental risk]?

- 1-7 (Not at all likely – Very likely)

Risk severity

If you were to experience negative health effects from any of the following, how severe do you think they would be?

- 1-7 (Not at all severe – Very severe)

Affect towards environmental risk

How would you say [environmental risk] makes you feel?

- 1-7 (very positive – Very negative)

-- next page --

In general, do you do anything to prevent or reduce your exposure to electromagnetic fields (EMFs)?

- Yes
- No

[If No:] Could you briefly write down these actions?
[open text response]

[Socio-demographics]