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Appendix A – Specification

Background

The Office for Product Safety & Standards (OPSS) was established by BEIS in January 2018 to enhance consumer protection and drive forward increased productivity, growth and business confidence.

In order to design policies, guidance and campaigns that will be cost effective for OPSS and useful to consumers, we need to understand how consumers think. In particular: how people perceive product risk across different products, what they think their responsibilities are and how this ultimately impacts their choices.

As set out in the 2018-2020 strategy, OPSS is committed to making the best use of data and evidence to drive decisions and interventions. The OPSS C-19 Product Safety Assessment evidence collation used a range of sources including Trading Standards intelligence, social media monitoring, open source research, ports reporting and inputs from subject matter experts to define the risk levels linked to the COVID pandemic and the implications for product safety. It also included behavioural insight statistics through consumer surveys. However, these assessments did not include behavioural impact research answering the strategic question of why people think that way. The OPSS evidence base of how risk is perceived for certain products is low, if non-existent. This piece of work aims to fill in this evidence gap and create a baseline understanding of how consumers view risk.

The proposed research project would consist of two online surveys, each surveying 1000–1500 consumers on a range of potential hazards residing within products. These include: products, and/or the technologies involved in their production, and/or their functionalities based on OPSS priority areas and horizon scanning activities (approx. 15) (e.g. 3D printing, smart clothing, hoverboards, automated vacuum cleaners, fitbit, etc...). For each hazard respondents will be asked to provide their judgments on a range of dimensions (e.g. controllability, awareness, likelihood of harm to health, seriousness of harm to health, natural/manmade, knowledge – personal risk, knowledge – scientific risk, newness, immediacy of effects, benefits, tolerance).

Without knowing why, the UK population perceives risks from products, OPSS work could be inherently reactive based on market issues and specific product problems. The survey results are valuable for building our data capability, however the analytical aspect of the work (risk perception tool) will allow OPSS to become a pillar for knowledge dissemination among consumers. The model could allow OPSS to proactively test processes, strategies, product safety problems and how they impact risk perception behaviour on a granular or population level. This project will allow OPSS to develop our behavioural insights capability and develop cost effective interventions across a range of policy areas and markets.

We want to increase our data capability as behavioural insights decision-making has been proven as a cost-effective technique for improving public services and delivering positive results for citizens and society ⁽¹⁾. The risk perception approach (psychometric method of

1 <https://www.bi.team/publications/the-behavioural-insights-team-annual-report-2017-18/>

OFFICIAL-SENSITIVE (COMMERCIAL)**UK Shared Business Services Ltd (UK SBS)**

capturing public risk perceptions) that will be used in this project has a long-established history (60 years) in the behavioural sciences dating back to the 70s and 80's (^{2,3,4,5}). The risk perception approach that will be examined, has been used in understanding public perceptions of risk regarding nuclear power^{6,7}, nuclear weapons (⁸ genetically modified crops^{9,10}), and discussed most recently regarding food safety (¹¹).

Findings from the research will inform all product safety policy and communication workstreams by providing OPSS teams with information on consumers' behaviour around risk. The baseline information could be used as a benchmark for future surveys so we can track how people's perception of risk changes over time. The model will be used to establish a risk profile baseline for risk assessments undertaken by the OPSS Risk division.

Aims and Objectives

The principal objective of this research is to understand consumer perception of risk and risk responsibilities. The aims of the project are:

- To produce a literature review that includes review of publications around the topic. The structure of which should be outlined, along with the details of a design of the first experiment, before end of July 2021
- To quantify consumers perceptions of risk by product type
- To inform the accuracy of OPSS risk measurement systems
- To develop a quantitative risk baseline tool outlining consumers perception of risk responsibility in the product safety system
- To produce recommendations on next steps
- To understand why, based on psychological and cultural analysis, the pattern of risk perceptions might differ for different product, technologies involved in the production of products, where products are purchased

Questions we would like to be answered through the evaluation are;

² <https://science.sciencemag.org/content/236/4799/280>

³ <https://link.springer.com/article/10.1007/BF00143739>

⁴ https://link.springer.com/chapter/10.1007/978-94-010-1276-8_2

⁵ <https://psycnet.apa.org/record/1980-20983-001>

⁶

https://heionline.org/HOL/Page?handle=hein.journals/ajic9&div=19&g_sent=1&casa_token=VG3B0Byvm0UAAAAA;jL2khSiWCTa6sCVYpwwqoK6r1P54p103XHps6vQhb-qZF-Q1UiQKocOGttenM3id2sFOIZC_sg&collection=journals

⁷ <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1559-1816.1996.tb00079.x>

⁸ <https://www.pnas.org/content/117/34/20474.short>

⁹ https://www.sciencedirect.com/science/article/abs/pii/S0950329305001515?casa_token=5iLeTe8zBAEAAAAA:44xI05jM-x6UGmnSFywBe3rg1mfsYQ60C5Z_BcnMU5UZ2xM7N0ZevOp12HrdP5oGbWlKMrw8DmM

¹⁰ <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1539-6924.1996.tb01095.x>

¹¹ https://www.sciencedirect.com/science/article/abs/pii/S0924224420305392?casa_token=7yuVdfZnvJ0AAAAA:pt-otscd8R_9-UTMCy_S5EeOriYshY1UmV5XaMtvZ23JvSm-Vxxd_epmpXQnNvGuLWohZ-19oA

OFFICIAL-SENSITIVE (COMMERCIAL)**UK Shared Business Services Ltd (UK SBS)**

- To what extent does the level of awareness of hazards impact judgements of risk?
- To what extent does the level of knowledge of hazards impact judgements of risk?
- To what extent does perceived controllability impact judgements of risk?
- To what extent does the level of awareness of hazards impact tolerance of risks?
- To what extent does the level of knowledge of hazards impact tolerance of risk?
- To what extent does perceived controllability impact tolerance of risk?
- To what extent does the level of awareness of hazards impact attributions of responsibility to different actors in the system (consumers, regulator, manufacturers) for products varying by level of perceived risk?
- To what extent does the level of knowledge of hazards impact attributions of responsibility to different agents in the system (consumers, regulator, manufacturers) for products varying by level of perceived risk?
- To what extent does the level of perceived controllability of hazards impact attributions of responsibility to different agents in the system (consumers, regulator, manufacturers) for products varying by level of perceived risk?
- To what extent is there convergence across respondents by judgements of risk based on different product categories (e.g., cosmetics, white goods, DIY tools)
- To what extent is there convergence across respondents by judgements of risk based on different avenues by which products are purchased (high street vs. online).

We would like these questions to be answered for a range of potential hazards residing within products. These include products, and/or the technologies involved in their production, and/or their functionalities based on OPSS priority areas and horizon scanning activities (approx. 15) (e.g. 3D printing, smart clothing, hoverboards, automated vacuum cleaners, fitbit, etc...). For each hazard respondents will be asked to provide their judgments on a range of dimensions (e.g. controllability, awareness, likelihood of harm to health, seriousness of harm to health, natural/manmade, knowledge – personal risk, knowledge – scientific risk, newness, immediacy of effects, benefits, tolerance).

Without knowing why, the UK population perceives risks from products, OPSS work could be inherently reactive based on market issues and specific product problems. The survey results are valuable for building our data capability, however the analytical aspect of the work (risk perception tool) will allow OPSS to become a pillar for knowledge dissemination among consumers. The model could allow OPSS to proactively test processes, strategies, product safety problems and how they impact risk perception behaviour on a granular or population level. This project will allow OPSS to develop our behavioural insights capability and develop cost effective interventions across a range of policy areas and markets. We want to increase our data capability as behavioural insights decision-making has been proven as a cost-effective technique for improving public services and delivering positive results for citizens and society.

Suggested Methodology

We would like to ask that bidders have a background in using ‘Prolific academic’ and ‘Qualtrics’, or equivalent, and to demonstrate a strong research track record of peer-reviewed publications in international high impact journals. These tools are widely used in the academic field to analyse behavioural insights (^{12, 13, 14}). The added value to OPSS is

¹² <https://www.sciencedirect.com/science/article/abs/pii/S2214635018302636>

¹³ <https://link.springer.com/article/10.3758/s13428-015-0578-z>

¹⁴ <https://onlinelibrary.wiley.com/doi/abs/10.1002/mar.21159>

OFFICIAL-SENSITIVE (COMMERCIAL)**UK Shared Business Services Ltd (UK SBS)**

both the generation of user data and the development of a novel risk baseline tool/model. The latter stipulates the need for appropriate scientific expertise and input. We would like to ask bidders to demonstrate their competence in fulfilling these requirements that will allow them to fulfil the aims and objective of this proposal.

The suggested methodology is to conduct two online surveys conducted through a platform such as 'Prolific Academic' which is online software that enables us to ask a representative sample size of people reflecting that of the UK populous (over 47,000 UK residents are on the Prolific Academic participant panel). The design of the survey will be informed by the technical project manager working alongside contractors. Before the two surveys are implemented, piloting work will be carried out to ensure that the participants fully understand the instructions and the risk perception questions being asked of them. We suggest that Principal Components Analysis (PCA) – a statistical procedure for handling high dimensional data set to be used within this study as it has shown to work well in similar academic surveys. It can reduce the large set of qualities (e.g. familiarity, awareness, controllability) into a smaller set (termed 'principal components') which can explain most of the variance in the original judgments that are provided by respondents. It is anticipated that the majority of the questions asked in the survey will be closed questions. It is expected that bidders need to provide assurances that both ethics considerations and GDPR policies are complied with. The winning bid is expected to go through best practice ethics and data protection (DP) quality assurance processes in line, or going beyond, BEIS ethics and DP requirements. It is expected that the winning bid will offer a theoretical and formal approach to understanding risk perception in the domain of product safety, and that the bidders will have an established record of published work that will ground the findings from the empirical work, to not only answer what patterns of risk perceptions are attached to different product types but also why the patterns emerge in the way that they do. We expect this to be addressed from the lens of psychological research on risk perception, and cultural dynamics.

Deliverables

Phase 1

Week 1 to 4 review of the literature

Phase 2

Week 5 to 8 Piloting of materials for use in online survey 1

Week 9 to 12 Piloting of materials for use in online survey 2

Week 13 to 19 run and analyse online survey 1 (nationally representative sample)

Week 20 to 26 run and analyse online survey 2 (nationally representative sample)

Week 27 to 40 Formal computational models/statistical modelling of the survey data (risk perception baseline tool)

Week 44 Original data sets which will be made publicly accessible and which will not have any IPs, so that OPSS will have shared ownership of the data

Week 44 to 52 A peer-reviewed journal publication outlining critical analysis of risk perception levels based on survey responses

OFFICIAL-SENSITIVE (COMMERCIAL)

UK Shared Business Services Ltd (UK SBS)

Week 50 to 52 A report to OPSS summarising: critical findings, recommendations regarding risk perceptions of the public, and risk communication strategies to target different groups, or types, of hazards associated with a range of products

Week 50 to 52 A PowerPoint presentation for OPSS summarising key findings and recommendations

Terms and Conditions

Bidders are to note that any requested modifications to the Contracting Authority Terms and Conditions on the grounds of statutory and legal matters only, shall be raised as a formal clarification during the permitted clarification period.

OFFICIAL-SENSITIVE (COMMERCIAL)**UK Shared Business Services Ltd (UK SBS)**

Appendix B – Supplier Proposal

PROJ1.1

Stage 1. Literature Review

We will conduct a literature review to draw together existing research within the risk and product safety domains, which will provide context for the project and inform precise methodology.

At the beginning of the project, we will have a planning meeting within the project team to map out a draft of the structure of the literature review, highlighting key areas of research to include, for instance the psychometric model of risk perception and the modelling of social risk responses. This discussion will form the basis of the scoping document, which will be circulated to OPSS, for finalisation within the initiation meeting. This will ensure that our planned approach for the review meets the requirements, as well as enabling us to agree progress and reporting dates.

A comprehensive literature search will then be undertaken, identifying research relevant to consumer risk and responsibility perceptions relating to the areas identified in our initial meeting, as well as identifying models of risk perception. We will use the commonly used online academic databases Web of Science and PsychInfo as well as Google Scholar to search for relevant literature, using our academic expertise to ensure we locate literature which meets the specification. In addition, we will also perform a reverse search from core references to ensure we capture the range of literature. We will then present a review of this research, highlighting instances where psychological and cultural evolution perspectives can be combined to provide novel insights into the understanding of consumer perceptions of risk and responsibility.

Stage 2. Background and Approach – Understanding Consumer Perceptions of Risk

We will carry out an online survey to examine how people characterise the risk associated with different products, informing our understanding of the ways consumers perceive risk.

The subjective nature of risk was first highlighted in the pioneering research of Fischhoff et al. [1], which employed the psychometric paradigm. This paradigm involves asking individuals not just how they perceive a risk, but also to characterise the ‘personality of hazards’ by asking participants to rate hazards on a series of characteristics, such as familiarity, controllability and severity, thought to influence risk perception and acceptance levels [2]. They found risk perceptions were primarily explained by two components, termed dread risk and unknown risk: the greatest perceived risk was associated with high dread and low levels of knowledge/familiarity [1], [3], [4]. Dread risk relates to the potential of catastrophic, or fatal consequences, a lack of perceived control, and the uneven distribution of risks and benefits. Unknown risk relates to those risks which are poorly understood, new, unknown to science and to those exposed, unobservable and have delayed consequences.

The psychometric approach has been used to explore risk perceptions worldwide [5]–[9] and across a number of different domains, such as natural hazards [10], nano-technology hazards [11] and lifestyle/household hazards [12]. Indeed, the authors have applied the method to the domain of food safety and high impact weather events [13]. Its success as an approach across a variety of different domains and cultures is largely due to its utility in allowing one to compare perceptions for different hazards. Within the current proposal, the paradigm will be applied to household products and technologies. Aside from its versatility, a further reason for choosing to use this methodology is because of its value in

OFFICIAL-SENSITIVE (COMMERCIAL)**UK Shared Business Services Ltd (UK SBS)**

“accounting for risk perceptions of novel hazards” [14, p. 11]. The approach will allow us to identify the key, psychological meaningful components of risk perceptions associated with different products, which will enable future risk management and communication strategies to be specifically tailored in a pre-emptive fashion.

Using an online survey following the psychometric methodology, a nationally representative sample of participants (n= 1000) will be presented with a series of products (to be selected in accordance with OPSS priorities) and asked to rate them on a series of characteristics, such as: level of existing personal and scientific knowledge, newness, controllability, the likelihood/seriousness of harm and perceived benefits¹⁵, using a seven-point Likert scale. The proposed characteristics have been identified as relevant from our extensive knowledge of previous literature employing this approach, but the final selection will also be informed by collaborators at OPSS and the results of the literature review. Participants will also be asked to rate each product according to the level of perceived responsibility for protection from harm (i.e., self, regulator and manufacturer), as well as giving an overall risk rating for each product [15]–[17]. Finally, participants will be asked to rate how different sources (friends, family, direct experience, media warnings etc) have contributed to their risk perceptions, again using a seven-point Likert scale.

The richness of data derived from use of the psychometric paradigm means that we will be able to analyse the data in different ways. Given the OPSS’ interest in quantifying consumer risk perceptions according to product type, we propose aggregating the data across individuals (see [18])¹⁶ and using principal components analysis to categorise the product characteristics into a smaller set – ‘principal components’, which account for most of the variance in people’s perceptions of these products. Following this analysis, each product will be given a score according to the identified components, enabling the creation of a taxonomy of products, where one will be able to clearly map the similarities and differences between products in the component space. Furthermore, by collecting overall risk and responsibility ratings for each product, we will use regression analyses to identify the precise characteristics which predict overall risk perceptions and agent responsibility judgements [15], [16], [19], investigating the influence of both individual level and specific product level characteristics. In addition to providing OPSS with insights about risk/responsibility perceptions of specific household products, data from this study will then be used to inform the development of the model in Stage 4.

Stage 3. Background and Approach – Tolerance of Risk

We will conduct an online experiment to examine how willing consumers are to tolerate risks associated with various product attributes when buying a product.

One of the key elements for successful risk management and communication strategies is knowing the level of risk people are willing to tolerate [20]. This information can then be used to prioritise risk assessment, management and intervention strategies in a proactive, rather than reactive way. Building on insights from Study 1, Study 2 will systematically investigate levels of risk tolerance for products which (a) differ according to the individual level characteristics ‘knowledge’ and ‘controllability’ (as identified in the tender document) and (b) differ according to product level characteristics.

¹⁵ In the following, we refer to these as ‘individual level’ characteristics.

¹⁶ Though we can also aggregate the data across products to look at the individual data, which would allow one to ‘profile’ consumers according to levels of risk perceptions [33].

OFFICIAL-SENSITIVE (COMMERCIAL)**UK Shared Business Services Ltd (UK SBS)**

We will do so using a discreet choice experiment (DCE), a proven methodology in marketing and economic research, which is used to assess consumer preferences for particular products or services. Rather than asking consumers directly about their attitudes towards certain attributes, the methodology allows one to infer them from their choices when presented with a set of (hypothetical) options. The method is based on random utility theory, which assumes that people choose the option that yields the highest utility [21]. In a product safety context, we infer that a choice reflects the least risky option.

Examining at the ratings from the first study for knowledge and controllability, we will select four types of products which (a) considerably differ on these characteristics and (b) come from a range of product categories. For each product type, participants will be presented with different product options, varying on a number of attributes (to be selected in collaboration with OPSS) such as: how the product was purchased (online versus shop); age of the product (new versus second-hand); intended audience for use (e.g., children, teenagers, working age adults, the elderly) and origin (produced in UK versus non-UK with [potentially] less regulated safety standards) (see Table 1). Participants will subsequently be asked to complete a revealed preference measure, for instance willingness to pay (WTP) or accept [22], [23]¹⁷. Both theory and previous research suggest WTP is connected to levels of risk tolerance, such that individuals who are more risk tolerant will pay less to reduce or mitigate a risk versus individuals who are less risk tolerant [23]. Using a logistic regression model to analyse the data, we will be able to determine which product attributes are important to consumers, how important each attribute is relative to another and how participants trade-off different attributes. These findings will inform our understanding of how knowledge of a product and product characteristics such as place of purchase and product age influence how much risk consumers are willing to tolerate when buying products. Data from this experiment will also feed into Stage 4.

Table 1. Example of task.

Imagine you are trying to buy a [PRODUCT 1]. You have the following four options:

	Product A	Product B	Product C	Product D
Place of purchase	Online	Online	Store	Store
Age of product	New	Second-hand	New	New
Origin	Non-UK	UK	UK	Non-UK
Intended audience for product use	Adult	Adult	Child	Adult

Stage 4. Models of Cultural Evolution.

While Stages 2 and 3 will inform us about the individual decisions made by participants, as well as what and who they are influenced by, Stage 4 will allow us to make inferences about

¹⁷ Given the potential confound of some of the product attributes on price independent of risk, we will include all possible product combinations, with analysis focused at the individual product type level.

OFFICIAL-SENSITIVE (COMMERCIAL)**UK Shared Business Services Ltd (UK SBS)**

how these individual-level traits affect societal attitudes. To do this, we will construct cultural evolutionary models of attitudes towards risk.

Cultural evolution borrows from evolutionary theory, but rather than examining the change over time in genetic traits, instead examines how traits that are inherited by learning from others change in frequency within a population (<https://doi.org/10.1017/S0140525X06009083>). Its mathematical roots in evolutionary theory allows it to provide a powerful framework for studying how human behaviour and attitudes change over time. The cultural traits that we will examine are peoples' feelings of the dread and knowledge concerned with particular products (or equivalent components as identified from Stage 2). For each individual, a particular product will have a score for each of these two components. This score will change over time, as a result of: individual's interactions with their social network; with their direct experience with a product; their exposure to broadcast media; risk management/communication efforts specifically targeting (e.g.) dread/knowledge; high profile 'public outrage' incidents or product safety incidents, see [24]. Our model will examine how appropriate and inappropriate attitudes to risk can spread through a population, and how changing the information available to people might influence societal attitudes.

The model will be constructed as an agent-based simulation, structured by a social network. In an agent-based simulation, the behaviour of each individual, and interactions between individuals are explicitly simulated. Our model will be developed from an existing programming framework developed by the team (<https://github.com/rflachlan/SongABCJPPF>). This framework allows: (a) the simulation of large populations – we will simulate populations of 100,000 individuals, and (b) the ability to simulate many populations in parallel. This greatly increases our ability to make inferences about the certainty of particular outcomes, given particular inputs. The interactions between individuals will be shaped by their social network. This network will be simulated using realistic parameters for human social network topology (e.g., distributions of node degrees, average clustering coefficients and shortest path lengths) drawn from the literature (e.g. <https://doi.org/10.1126/science.1116869>). Each run of the simulation will progress for 10,000 epochs, each of which corresponds to one potential social interaction, or one individual experience with the product. In any particular social interaction, individuals' perceived knowledge of an item can increase, while their dread of an item will be adapted by the information they receive from their source.

Our model will be refined based on findings in Stage 1 and parameterised based on our findings in Stage 2 and 3. In particular the weightings of different sources of knowledge about a device will be used to shape the pattern of interactions. We will examine how changing the topology of networks (e.g., to mimic modern social media versus traditional social networks), changing the pattern of broadcast media (penetration, breadth and persistence) and the frequency of personal interactions shape the evolution of risk attitudes across the network. We will use Approximate Bayesian Computation (<https://doi.org/10.1146/annurev-statistics-030718-105212>) approaches to fit the outcome of our models to the perception of risk measured in Stages 2 and 3.

Set out how your methods meet the project objectives

Objective Number & Description	How these methods meet project objectives
1. To produce a literature review that includes review of publications around the topic. The structure of which should	Our team has considerable experience of carrying out literature reviews for a range of public sector stakeholders (e.g., the Food Standards Agency [FSA], British Geological Survey [BGS], Defence Science Technological Laboratory [DSTL]), specialising in

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<p>be outlined, along with the details of a design of the first experiment, before end of March 2021.</p>	<p>the domain of risk. We will complete a thorough literature review, using the online databases Web of Science, PsychInfo and Google Scholar, as well as reverse searching core references to ensure the depth of literature is captured. The review will conclude with a detailed proposal for the first study, which answers the questions within the tender.</p>
<p>2. To quantify consumers perceptions of risk by product type.</p>	<p>Our team has extensive knowledge and experience of research investigating risk perceptions. Study 1 will employ the psychometric paradigm, which enables one to quantify risk perceptions according to product characteristics, and 'score' individual products or product types according to risk perceptions. Study 2 will allow for further quantification using a choice paradigm.</p>
<p>3. To inform the accuracy of OPSS risk measurement systems.</p>	<p>The literature review will include a consideration of existing risk measurement systems used by other organisations. The final project report will also provide reflections on how risk measurement systems could be improved, drawing on our findings.</p>
<p>4. To develop a quantitative risk baseline tool outlining consumers perception of risk responsibility in the product safety system.</p>	<p>We will use insights from the literature review and the two studies, as well as the team's extensive expertise in computational modelling to develop a model of consumer perceptions of risk and responsibility, which will form the main part of this objective. We will consult with OPSS and other relevant stakeholders throughout the development of the model, incorporating additional ideas/feedback as they arise.</p>
<p>5. To produce recommendations on next steps.</p>	<p>We will produce a summary report, with a dedicated section reflecting on the findings from the literature review, two experiments and the model, including recommendations for next steps. We will also include a section considering future research questions the OPSS could consider. Recommendations for next steps will also be included in the end of project presentation. We will work flexibly with OPSS to offer further meetings to discuss these recommendations, as required.</p>
<p>6. To understand why, based on psychological and cultural analysis, the pattern of risk perceptions might differ for different product, technologies involved in the production of products, where products are purchased.</p>	<p>The literature review will consider existing research relating to consumer perceptions of risk and responsibility and will reflect on instances where psychological and cultural perspectives can be integrated to give greater insight into understanding of consumer behaviour. We have opted to use methodologies in Studies 1 and 2 which allow us to unpick not just <i>how</i> consumers perceive product risks, but also <i>why</i> they do so. Findings from these studies will inform the development of a model of how risk perceptions might differ according to product characteristics and over time (Stage 4), answering the question of 'why' further.</p>

OFFICIAL-SENSITIVE (COMMERCIAL)

UK Shared Business Services Ltd (UK SBS)

Sample

We have opted to use Prolific Academic to recruit a nationally representative sample according to age, gender and ethnicity (n=1000). We chose this platform given Prolific was specifically developed as an online participant pool for sound scientific research [25]. Studies have consistently shown the Prolific platform to be superior compared to other crowd-sourcing platforms in terms of usability, participant naivety and data quality [25], [26]. Indeed, as researchers, we have vast experience of using the platform to collect reliable, high quality data [27]–[29]. Using the Prolific platform also means that we can collect data online, making the process quicker and less vulnerable to external factors such as Covid-19, which makes in-person testing unviable. Overall, use of Prolific Academic maximises the efficiency and value of the research proposed in this bid, in that it frees up time from data collection which can be spent on other elements of the project.

The early psychometric research used sample sizes of under 100 (e.g., [1]), with more recent research using similar (e.g., [5]) or slightly larger sized samples (ranging from around 300-500 participants [12], [30]). Clearly, the bigger and more representative the sample, the more reliable the conclusions which can be drawn, which is why we moved away from the small samples used in the previous literature and proposed a much larger sample size for both experiments (n=1000), following our previous research with the FSA, which used the psychometric paradigm. Recruiting 1000 participants enables a high-powered study, whilst still delivering the best possible value for OPSS.

A further advantage of using Prolific is that it allows for the collection of longitudinal data. Whilst some previous studies using the psychometric paradigm looked at changes in perceptions across time [5], [30], these studies did not always use the same hazards and/or the same participants. The nature of principal components analysis means that the ability to draw conclusions over time is limited, given these characteristics. Using Prolific for data collection means that we could access the same participants at a later date for data collection, should this be of interest to OPSS. This functionality is rare with other (potentially cheaper) data collection platforms.

One potential risk of using Prolific Academic is that there will not be enough participants to be representative of the population. Prolific state that their maximum deliverable nationally representative sample size is 1500 (active members), which is why we have pared back the sample size, to allow for more sampling, if required. A further risk is that the sample might not be representative of the national population on *all* demographics – for instance, our sample will all be members of the Prolific platform, though obviously this is not the case for the whole of the UK population. We consider the resulting risks and potential impact to be minimal – the sample obtained will be much higher than the majority of previous, peer reviewed research using the psychometric paradigm, and the latter factor is a limitation of any data collection platform.

Managing a Consistent, Quality Approach

The authors have extensive experience of producing quality research, with a strong record of peer-reviewed publications in high-impact journals. We are therefore confident of the quality of approach we will take in this project. However, we will include a number of additional strategies to further ensure this. At the start of the project, we will have a meeting with OPSS to discuss our approach and planned timeline, with agreed dates for progress reports. We will have regular team meetings both as part of the project team, but also as part of lab meetings, to allow for additional opportunities to discuss our approach for the project with other academics, providing a further level of quality control. We will also schedule regular meetings with the technical project manager and other interested parties at OPSS to ensure that there are opportunities for feedback. We have also built-in time to pilot the planned

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studies, the results of which will again be discussed with the technical project manager/OPSS prior to running them. Once we have decided and agreed upon the methodology, we will also pre-register the research protocol on the Open Science Framework, to ensure scientific rigour. We will also follow established guidelines for constructing and reporting models [31].

Methodological Challenges

Identified Challenge	Management Strategies
Online nature of data collection – potential lack of environmental control and participant engagement	We have opted to use Prolific Academic, one of the most reliable online panels [25], [26] for data collection. We have costed in paying participants above the minimum stipulated hourly rate to increase engagement. Given the nature of the topic, we are confident that the studies will be of interest to participants. Piloting the studies also means we can ensure maximal participant engagement, by selecting only relevant questions, identifying and fixing usability issues etc. We will also include attention check questions to monitor participant engagement, excluding participants who fail these checks to maintain high quality data.
Rich set of research questions	The tender outlines a rich set of questions to be answered as part of the evaluation, including a consideration of many different factors relating to risk perceptions. We have deliberately chosen methodology which enables us to answer these questions at an appropriate level of detail without being too long and cumbersome for participants, so as to maximise levels of interest and engagement.
Collection of self-reported data	Many psychological studies are often criticised for collecting self-reported data, which may be vulnerable to bias, for instance asking participants directly about their preferences/attitudes. We have deliberately planned to use methodology which unpicks consumer perceptions in more subtle ways (e.g., psychometric paradigm, DCE), allowing us to answer not just how consumers perceive product risk in a particular way, but also why they do so.
Novel approaches	Part of our project includes taking a novel approach to the investigation of consumer risk perceptions, combining both psychological and cultural evolution perspectives. This presents a potential challenge given its innovative nature, but we are confident that this is more of an advantage than a challenge. To manage this potential challenge, the development of the methodology and approach will be grounded in literature and theory identified in Stage 1. We will also seek input in planning both from academics within our lab groups, but also in collaboration with the OPSS technical project manager and other interested stakeholders. Finally, we will pilot the methodology to ensure it is robust and meets the specifications as desired.

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Dissemination

As noted in the specification, we will deliver a PowerPoint presentation for OPSS to summarise our key findings and recommendations. However, we are happy to present our findings over the course of the project at departmental meetings etc, as required. We will also work with OPSS to identify other potential audiences outside of the department who might be interested in the results, such as HSE. We are able to provide these findings in a variety of formats, such as lay summaries, white papers, posters, presentations and via social media, to be decided in partnership with OPSS.

The authors have extensive experience of disseminating research findings as part of their work with organisations such as the FSA, the BGS, the Met Office, DSTL, and as a member of the UK Natural Hazards Partnership (NHP). Indeed, their previous research findings have contributed to public policy, for instance forming part of the European Food Safety Authority (EFSA) guidelines for communicating uncertainty [32].

There is also the potential to present the findings at international Psychology conferences, such as the Society for Judgement and Decision-Making, as well as the opportunity to publish in a high impact, applied psychology journals, such as the 'Journal of Applied Psychology' or the 'Journal of Experimental Psychology: Applied'.

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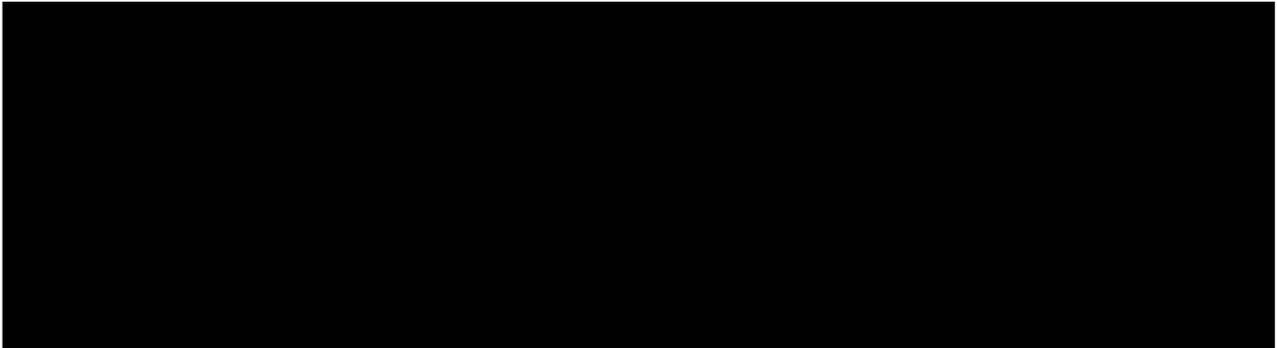
PROJ1.2 Staff to Deliver

██████████ is a ██████████ Royal Holloway University of London. His research focuses on cultural evolution of communication traits, incorporating computational modelling, data-oriented and experimental approaches. His work has been featured in textbooks, reviews of the field of cultural evolution and the media (NY Times, National Geographic, Daily Mail etc), and has been cited more than 1600 times with an H-index of 22. He has been funded, as PI or co-PI by grants from BBSRC and NWO (Netherlands). ██████████ is also the developer of the collaborative open-source bioacoustics software ██████████ which is used worldwide and has led to more than 100 publications.

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His research has developed different techniques to study the spread of behaviours and attitudes through populations from mathematical population genetics models to agent-based simulation models. In a recent bibliographic review of the cultural evolution research field worldwide (Youngblood and Lahti, 2018, Palgrave Communications), he was identified as a core author leading one topic area of the field. A particular expertise is in constructing models of cultural evolution that can be connected to empirical data. For example, he has pioneered the application of Approximate Bayesian Computation to simulations of cultural evolution, allowing the inference of learning processes underlying cultural phenomena. Through his computational expertise, he has also been able to develop highly efficient simulations that allow the simulation of large populations of individuals. For example, a recent modelling paper (Zandberg et al., Subm. Phil. Trans. Roy. Soc. B), was able to simulate the entire global population of humpback whales in order to examine cultural evolution of their songs.

His work is inherently inter-disciplinary, connecting computational and mathematical topics with psychological and biological approaches. He has successfully collaborated with researchers from linguists to examine the cultural evolution of word meanings, to population geneticists and genomicists to examine the evolution of fungi. His most relevant publications in international high impact journals include:



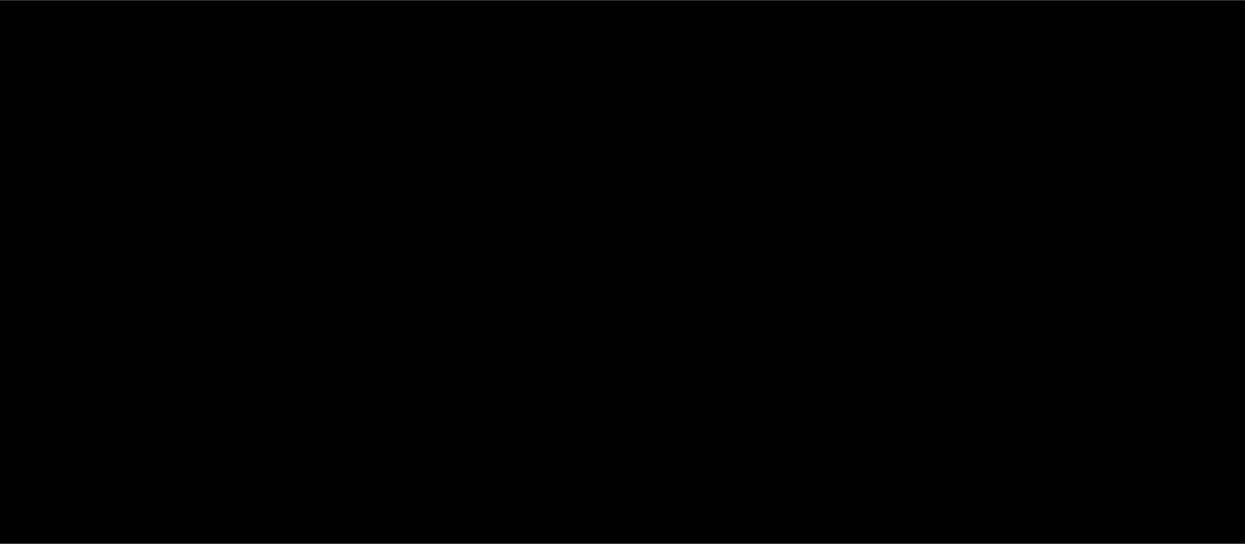
██████████ is currently a ██████████ in the ██████████ ██████████ University College London. ██████████ experimental work focuses on the communication and understanding of risk and uncertainty information, across a variety of domains, including natural hazards, food safety and medicine. She has extensive experience of carrying out inter-disciplinary, applied research, having collaborated with a range of public sector organisations, including the: UK Met Office, Department for Business, Energy & Industrial Strategy, Food Standards Agency (FSA), Defence Science and Technology Laboratory (DSTL), as well as charitable organisations, including The Samaritans and Big Lottery Fund. Her expertise lies in using behavioural science methods to study judgement and decision-making, running experiments both in the lab and online using Qualtrics and Prolific Academic. She is adept at analysing large amounts of data, using both quantitative and qualitative techniques.

Her previous work with the FSA involved undertaking a comprehensive literature review of the psychological factors which could affect the food risk assessment process. This involved the synthesis and critical evaluation of research from a range of disciplines, including policy. Following this, she developed a research programme to investigate how the risk assessment process could be improved. Part of this programme involved use of the psychometric paradigm to explore public risk perceptions of new food products and technologies, employing a nationally representative sample.

In ██████████ current research collaboration with the UK Met Office and meteorological organisations in South East Asia, she has utilised the psychometric paradigm to garner new insights into how the risks associated with high-impact weather are perceived by both

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forecasters and stakeholders. Her most recent, relevant peer-reviewed publications in international high-profile journals include:

**Any support that would be needed and from whom, in order to undertake and complete this project**

Generally, the support required to undertake and complete the project falls under the bracket of engagement with OPSS. Access to experts from OPSS would be useful to ensure we have a thorough understanding of the types of risk assessment and risk management decisions/activities OPSS engage in. To ensure that the research carried out is of maximum value and utility to OPSS, input from OPSS will be required to ascertain the specific products/technologies to be featured in the experimental work. Similarly, feedback from OPSS would be useful to inform the development of the model illustrating how consumers perceive risk.

Ensuring continuity of service

In the unlikely case of unforeseen circumstances (e.g., illness, accident) leading to staff unavailability, we have a number of contingency plans in place to ensure the project is delivered on time. Should the PI become unavailable, oversight of the project would transfer to a colleague within the institution. Royal Holloway has considerable expert resources to draw upon in psychological research, such that the impact on the project would be minimal. Moreover, both team members have ongoing collaborations with other experts in risk and cultural evolution, who could be invited on to the project if required. In the event of the post-doctoral researcher becoming unavailable, the team have an extensive network of contacts and access to mailing lists (e.g., that of the Society for Judgment & Decision Making), which will expediate the identification of a suitable individual to cover. Should there be an issue of long-term unavailability, there exists the possibility of advertising the role across mailing lists (including jobs.ac.uk; the mailing list of the Society for Judgment & Decision Making), as well as directly contacting colleagues to encourage newly graduating PhD students/post-doctoral researchers reaching the end of contracts to apply. Existing PhD students and MSc students could also be approached to undertake different parts of the project. In the case of all of these contingency plans, regular meetings will be held both within the project team, but also with the technical project manager at OPSS to maintain clear oversight of the activities and deliverables, and to ensure OPSS are happy with the contingency actions.

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PROJ1.3 Understanding the Project Environment

Background

The Office for Product Safety and Standards (OPSS) is responsible for regulating all consumer products (excluding vehicles, medicine and food) across the UK. This involves protecting consumers, enabling them to make informed decisions, as well as supporting business confidence, productivity and growth. The 2019-2020 delivery report highlighted the aim of increasing OPSS' reputation "as a regulator that is proportionate, innovative, risk-based and science-led" (p.2). Part of their four-pillar strategy towards achieving this goal involves the use of scientific data and evidence to drive decision-making and interventions, as well as to evaluate impact ('analyse'). The OPSS are already well on their way in this endeavour with their established research programme. Work so far has included: surveying 4000 consumers to understand attitudes towards product safety, registration and recalls; surveying key stakeholders to understand engagement to fire safety information on furniture; a review of best practice in design/writing of instruction manuals for domestic products; a review of safety implications from use of virtual reality systems and an investigation of the effectiveness of product recall notices. The current project represents a further venture into collecting scientific data and evidence to develop OPSS' behavioural insights capability.

The OPSS are currently working in a challenging environment, with many competing demands for their attention and resources. As technology continues to advance, new consumer products are continually entering the market, bringing with them the potential of new risks which must be assessed and managed. Aside from identifying safety issues associated with new and emerging risks, OPSS must also continue to understand risks and investigate safety issues associated with current products and technologies. Incidents such as the Grenfell Tower fire have brought concerns regarding the safety of household appliances and consumer products to the forefront of the public's minds. Coupled with the COVID-19 pandemic and the end of the transition agreement with the EU, the issue of public safety has never been more prominent. The OPSS now have the unique opportunity to move towards a more agile, proactive regulatory approach, which is not just able to improve safety outcomes and allow for more efficient, cost-effective management of resources, but also able to increase public trust and confidence in OPSS. Better understanding of consumer and business' attitudes towards risk and their behaviours is key to the development of more effective management and intervention strategies.

Interpretation of the project and what is required.

Given the above context, the OPSS has commissioned this research project to provide an evidence base not just of *how* consumers perceive product risk and responsibilities for these, but also *why* they do so. More specifically, the project aims to provide an understanding of how and why risk perceptions differ according to different products, technologies and place/method of purchase, drawing on psychological and cultural perspectives. Specifically, the project asks for an understanding of how psychological factors such as level of awareness, knowledge and perceived controllability of hazards influence risk perceptions, tolerance of risks and attributions of responsibility. Additionally, the project requires a mapping of how judgements of risk converge or differ according to product category and how the product is purchased.

The project requires scientific expertise and a strong research track record. The project entails the design of two online surveys, recruiting a nationally representative sample of participants from a platform such as Prolific Academic. These studies will be based on the notion of risk as psychologically constructed, assuming that risk perceptions reflect factors other than simply probability of occurrence. The project also requires the development of a theoretical, formal model of how consumers perceive product risk.

Relevant knowledge to project/policy area (data sources/relevant research)

Our team has considerable experience of undertaking literature and evidence reviews, both within academic research, as part of high-impact journal publications, but also within public sector research. The team have written reviews within the domain of risk for a range of clients including the Food Standards Agency, the British Geological Survey, Defence Science Technological Laboratory and the UK Met Office. As members of academic institutions, the team have access to all of the major academic databases and search engines to facilitate the writing of the literature review and the planning of the empirical work. As a result of this, and other related work, we have strong knowledge

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and understanding of how people think and reason about risk, which we are able to apply to the project.

The team have extensive knowledge of experimental approaches which can be utilised to provide behavioural insights pertaining to judgement and decision-making. The team are well versed in applying these behavioural science techniques to real-world problems, such as 'how can we improve the effectiveness of food safety risk communications?' and 'how can we improve understanding of high impact weather warnings?' Not only have results from this research extended theory on how the public understand probability information, but insights have also been used to inform public policy, forming part of the European Food Safety Authority (EFSA) guidelines for communicating uncertainty. This research was conducting using platforms such as Qualtrics and Prolific Academic for recruiting participants and data collection.

A particular strength of the team is their ability to construct models of cultural evolution, which can be connected to empirical data. Their previous work has involved the development of models within a wide variety of contexts, meaning the team are well-placed to apply their expertise to the risk domain. In addition, the team's computational expertise means that these models can simulate large populations of individuals, which will be of particular value given the project will be focused on the general public's risk perceptions.

The team also have ongoing collaborations with the OPSS, meaning they already have good working relationships with many of the people who will be involved in the project. Moreover, these collaborations have given us valuable insight into the policy area, how the OPSS work and the challenges they face as a regulator. Our involvement in them demonstrates that we have the expertise to deliver a successful project, as detailed below.

The first project concerns the evaluation of the 'Intelligent Regulatory Information System', a data-sharing project between regulators. The system involves a desktop tool for stakeholders to search information on company compliance relating to a range of regulatory areas, including health and safety, food hygiene, trading standards, licensing, fire and rescue etc. This project involves use of Qualtrics to design and administer the evaluation survey, as well as working with a range of stakeholders to gather feedback.

The second project concerns the evaluation of the OPSS Product Taxonomy, a taxonomy of consumer products (excluding medicines and food) to aid the navigation of the product risk landscape. This involved a review and synthesis of literature on existing product taxonomies, as well as psychological literature on reasoning, categorisation and the communication of risk information. Examining the taxonomy has given us insight into how risk experts categorise products and associated hazards, which is particularly useful given the current project will consider these issues in relation to the general public. In addition, the project has provided us a better understanding of the types of tasks that OPSS engage in as part of product regulation, as well as an insight into the processes OPSS use in developing tools to facilitate these tasks.

How the bidder will ensure successful delivery of the project.

Having demonstrated the depth of knowledge and expertise we have which will contribute to the successful delivery of the project, we have a number of additional procedures and measures in place to ensure its success. We will:

- Have an initiation meeting with OPSS at the beginning of the project to agree (a) the project objectives and precise outputs and (b) a project plan which sets out deliverable deadlines, which include time for both internal review and external review/feedback from OPSS.
- Ensure an effective time management programme is in place, such that all project deliverable deadlines and time allocated to the project is diarised, ensuring this time is protected.
- Have regular team meetings to reflect on project progress, discuss methodology, materials, analysis, findings etc. These meetings will involve cross-checking with the project plan and agreed methodology, checking that necessary data for the project is being collected and appropriate analytical methods used.
- Regularly meet with OPSS to report progress, discuss methodology, materials, findings etc, gather feedback. The precise nature and frequency of these reports will be discussed and agreed with OPSS according to their requirements.

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- Prior to being sent to OPSS, all outputs will be peer-reviewed within the team. There are also numerous opportunities to review project plans and outputs as part of regular lab meetings with other academics within the UCL and RHUL Psychology departments, and also with collaborators working on related projects. This will ensure that the quality of the work and outputs are of the highest quality.
- In any written report, we will outline our methodology clearly and highlight any assumptions underlying it. We will clearly identify the information and data sources featured. We will clearly explain the rationale behind analysis techniques. Where relevant, we will clearly describe any gaps in the data, as well as highlighting limitations to generalisability.

We have also put in additional quality assurance/management measures in place:

- Active use, monitoring and sharing of project plan to map progress against project objectives and deadlines.
- Version numbers and dates will be applied to documents to ensure that all work is carried out on the most recent version. These documents will be backed up regularly.
- Initial assessment of risks which might affect successful delivery of the project, including the production of a risk register outlining mitigation strategies to be actioned if required. Throughout the project, we will continue to maintain and update this register, identifying emerging risks, and deal with any that emerge.

As has been the case in our previous work with OPSS, we envisage having a close working relationship with OPSS to facilitate successful delivery of the project. Working in partnership with OPSS will ensure that we fully understand the requirements of the projects and meet them. By building in regular opportunities to reflect on progress with OPSS and gather feedback, we ensure that any potential issues are identified quickly, with solutions identified and implemented as soon as they are agreed with OPSS.

Quality Assurance - Ethics

As members of academic institutions, the team have extensive knowledge and experience in conducting research which conforms with ethical principles and standards, GDPR and the Data Protection Act 2018. Royal Holloway is committed to undertaking research to the highest level of integrity and ethical responsibility, in accordance with the internationally agreed Concordat to Support Research Integrity (2019). This concordat aligns with the ethical principles outlined in the GSR Professional Guidance 'Ethical Assurance for Social Research in Government' and in some cases goes beyond them. In the below, we outline how we will adhere to these principles.

1. Sound application and conduct of social research methods, and interpretation of the findings

We have outlined our approach (see PROJ1.1), which is based on well-established social science methodology and has been designed to meet the research objectives specified in the tender. Our findings will be presented clearly, tailoring our reporting according to the audience, to ensure maximum accessibility. Our work will also be peer-reviewed.

2. Participation based on informed consent

All participants will be presented with a comprehensive information sheet before they begin the study, which will clearly highlight that their participation is voluntary and that they have the right to not answer individual questions, and the right to withdraw from the study at any point without penalty. This will also highlight that the data collected will be stored

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anonymously, such that individual responses will not be traceable back to the individual. The information sheet will also include a privacy notice, which will outline the lawful basis for processing participants' personal data. They will also be given contact details of the researchers in order to ask any questions they might have or raise concerns. After reading this information sheet, all participants will have to complete a series of informed consent questions before they can proceed with the study. Participants will be fully debriefed at the end of the study, and presented with the researchers' contact details should they have further questions or concerns.

3. Enabling participation

We have opted to use Prolific Academic, one of the most reliable online panels for data collection and we will be recruiting a nationally representative sample, thus maximising diversity. We have costed in paying participants above the minimum stipulated hourly rate to increase participation. We will also pilot the studies to identify and fix usability issues, check accessibility etc to ensure any possible barriers to participation are minimised.

4. Avoidance of personal and social harm

Before conducting any research, we will complete an ethics application, which will consider all possibilities of personal and social harm related to participation, and how these can be minimised. Given the nature of the topic and the fact that many products of interest will be part of participants' everyday lives, we anticipate the likelihood of personal and social harm to be very low. To further reduce the level of harm, and risk of intrusion, we will work to ensure that: our methodology is suitable to the research question and the study is not unnecessarily lengthy. We will also complete a Data Protection Impact Assessment as part of our ethics application.

5. Non-disclosure of identity

In order to ensure that the sample is nationally representative, we will collect demographic data concerning age, gender and ethnicity. No personally identifying data will be collected. All data will be stored anonymously, and individual responses will not be traceable back to individuals. Participants will be informed of this both at the beginning and end of the study.

PROJ1.4 Project Plan and Timescales

Based on the tender requirements, we have developed the below project plan, assuming a project start in June 2021 (some meetings have already occurred) and finishing 31st March 2022. We have asterisked the key milestones and deliverables. At the start of the project, we will have a meeting with OPSS to discuss our approach and planned timeline, with agreed dates for progress reports. As well as our regular meetings, throughout the course of the project, we will work flexibly with OPSS to offer meetings as and when required.

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	2021								2022		
	Mid-May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March
1. Project Initiation											
Planning meeting											
Scoping document for literature review											
initiation document		*									
<i>Outputs: Project initiation document, scoping document for review</i>											
2. Literature Review											
Literature search											
Write literature review		*									
<i>Output: Literature review, with recommendations and detailed method for empirical work</i>											
3. Study 1 - Consumer Perceptions of Risk and Responsibility											
RHUL ethics application for Studies 1&2											
Pilot of materials											
Data collection											
Data analysis											
Summary of findings					*						
<i>Outputs: Open access methodology, dataset, draft report of findings</i>											
4. Study 2 - Consumer Tolerance of Risk											
Pilot of materials											
Data collection											
Data analysis											
Summary of findings						*					
<i>Outputs: Open access methodology, dataset, draft report of findings</i>											
5. Modelling of Data - Towards an Understanding of Consumer Risk Perception											
Model development											*
Model testing/evaluation											*
<i>Outputs: Model of consumer risk perceptions, report</i>											
Reporting											
Draft report											
Draft journal article											
Journal article ready for submission/review											*
Final report (including findings, modelling, recommendations, suggestions for next steps)											*
End of project presentation											*
<i>Outputs: Draft and final reports/journal article; presentation slide deck</i>											
Ongoing Activities											
Production of progress reports (fortnightly/monthly - tba w/OPSS)											
Ad-hoc calls/emails/meetings											
<i>Outputs: Progress reports, emails, materials for meetings as required.</i>											

Key risks

Identified risk	Likelihood of risk (high, medium, low)	Impact of risk (high, medium, low)	Risk management strategy
Challenges related to Covid-19	Medium	Medium	Both team members have been working from home for the last year, in line with official advice. The team have access to computer equipment, video-conferencing software and to the university library resources, meaning the project can still be

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			run from home.
The project team are unable to fulfil the delivery obligations, due to unforeseen circumstances (e.g., accident, illness).	Low	Medium	The project has several contributors with overlapping skills, so knowledge is shared across the research team. Furthermore, we have access to active collaborators, and a wider network of academics who may be approached as sub-contractors should longer term cover be necessary. Any changes will be communicated to the project manager at OPSS to facilitate mitigation.
Problems with recruiting participants for the two studies.	Low	High	Prolific Academic has a pool of over 40,000 active users, and can provide a nationally representative sample of up to 1,500 participants. We set n=1000 participants to allow for more sampling, if required. The team also have experience of working with other participant platforms, such as Dynata which can also provide access to nationally representative samples.
Not completing tasks to timescale	Low	High	We have developed a work plan for which to judge progress against. This involves a breakdown of tasks for each stage of the project, ensuring we can plan and identify any issues early, should they arise. The project team will have regular meetings with the OPSS technical project manager. Any issues will be raised at the earliest opportunity so solutions can be discussed and agreed.
Poor treatment of participants/data	Low	Medium	Royal Holloway complies with regulations and legislation that govern the conduct of research, including General Data Protection Regulation (GDPR) and the Data Protection Act 2018 (DPA). This applies across all stages of the research process, including recruitment, consent, data collection and storage.
Lack of information provided to OPSS to assess project progress.	Low	Medium	We plan to provide OPSS with progress reports on a fortnightly/monthly basis, (frequency tba). We will have regular meetings with the OPSS technical project manager and other interested parties to gather feedback and ensure the project is progressing as planned.
Technical/IT failure	Low	High	Royal Holloway have IT support on hand to provide help. All work will be regularly backed up and stored securely and remotely. All systems are protected by anti-virus software.



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