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Are scientists perceived as credible experts?

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Abstract

Science is widely embraced as an important prerequisite for innovation, and there is widespread support for public investment in science on that basis. It remains less clear to what extent the general public also perceives science as a relevant source of expertise on technological development and innovation. Drawing on representative panels from two European countries (the United Kingdom and Sweden), we investigate whether scientists are perceived as credible senders of messages regarding future technological development and its consequences. We apply a conjoint analysis methodology. Specifically, we estimate the credibility of scientists by comparing how respondents' assessments of societal challenges statements change with the attribution of that statement to scientists, compared with attribution to other type of expert groups (government, businesspersons, and issue advocates). While our study identifies positively framed predictions about new technology and innovation as a domain where scientific expertise is perceived as enjoying relatively high credibility, actors representing business and special interest groups are overall perceived as more credible conveyors of 'bad news', of negatively framed messages about the future. Implications for our understanding of the social contract of science are discussed.

Keywords: scientific experts; expertise; trust in science; SDGs; emerging technologies

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1. Introduction

The current support for science mostly builds on a narrative derived from the linear model of innovation, with science driving technological innovation. Increasingly, science (and science spending) has also been set in the context of grand societal challenges and it is in such context that public opinion of science and technology is polarised (Nelkin, 1995). Trust in science and scientists surfaced as a key factor behind responses to and behaviour during the COVID pandemic (Sulik et al., 2021), and mistrust of science is considered key to a wide range of other important global challenges, ranging from the denial of climate change to hesitancy towards vaccines (Wright, 2022; Mann and Schleifer, 2020). Such discussions go beyond the role of science as an "input to innovation" but also require scientists to provide insights and advice on socially oriented questions, such as the diffusion and use of new technologies. While science and scientists continue to inspire confidence and trust in the general public (Dommett and Pearce, 2019), we know only little about whether scientists are perceived as credible experts on new science and technologies' interaction with society. Are such expectations on scientists already part and parcel of what Gibbons (1999) and Martin (2003) call 'the social contract of science'[1]?

Understanding and facilitating linkages between academic science and innovation and technological change is of longstanding interest in science and innovation studies. The literature dedicated to this theme has focused on two broad topics. The first of these regards scientific research and scientific expertise as drivers and enablers of technological development. Notable classic work in this literature includes Pavitt's (1984) taxonomy on the sources of innovation across industries and the chain-linked model (Kline & Rosenberg, 1986). The second broad topic concerns the organisation of science-innovation interfaces. Literature in this stream tends to be more normative in spirit, with intentions to provide managers and policymakers with insights and recommendations. Cornerstone work in this stream includes presentations of conceptual frameworks such as Mode 2, innovation systems and triple helix (Gibbons et al., 1994; Hekkert et al., 2007; Etzkowitz & Leydesdorff, 2000), and more recently calls for transformative innovation policy (Schot & Steinmüller, 2018).

Relatively little attention has been directed towards empirical assessment of how the general public perceives the credibility and relevance of science and scientist as sources of expertise beyond strictly technical issues. A few recent studies have shed light on how scientific expertise informs central policymaking (e.g. Youtie et al., 2017; Irwin et al., 2021). Flink and Kaldewey

[1] By 'social contract', we here refer to ideas and narratives that constitute implied agreements between the general public and publicly funded scientists (Arnott, 2021).

(2018) discuss the concepts of "frontier research" and "grand challenges" and argue that these concepts are important components of contemporary pluralistic representations of the social role of science and, by extension, for scientists. This literature seems to implicitly assume that the legitimation of science primarily concerns scientists and policymakers. However, there has been very little systematic enquiry into how the general public perceives the role of academic scientists in contemporary innovation and technological change, beyond trust in generic representations of science.

In this paper, we shed some light on this issue by examining the public's perceptions about academics as experts and arbiters of future technological development and its social consequences, and the contexts where the credibility of scientific claims may be questioned. Prior research has analysed the credibility of different institutions and found evidence of a trust or credibility gap, with some actors perceived as relatively more or less trustworthy or credible (Priest et al., 2003; Sanz-Menéndez and Cruz-Castro, 2019). In line with the approach in Sanz-Menéndez and Cruz-Castro (2019) who looked at climate change, we maintain a constant scientific statement, and investigate whether perceptions of credibility change when attributed to different actors. Specifically, we compare academic scientists to other actors considered as experts associated with government, industry, and independent issue advocates[2] in specific societal challenges. Based on this, the main research question of this paper is: Do we perceive scientists as more credible than other actors? And if so, when are scientists more credible?

Our empirical analyses is based on unique population data from the UK and Sweden utilizing a conjoint analysis experiment. We find that scientists enjoy a certain credibility premium over other stakeholders, specifically in the case of the UK. However, further analysis shows that this premium only exists when the message conveyed is framed as positive, emphasising opportunities for technology to address societal challenges. Statements problematizing social issues are perceived as more credible when originating from businesspersons or other issue advocates, and scientists messages are only superior to government stakeholders. These findings contribute insights to the discussion about science in society. Specifically, our analysis offers novel insights into public perceptions of science as a source of reliable expertise.

[2] Based on Prakash and Gugerty (2012) we define "issue advocates" as those individuals or groups who actively support, promote, and work towards advancing a particular cause, concern, or topic of importance. They engage in various activities such as raising awareness, lobbying, campaigning, and mobilizing public support to bring attention to specific issues. Issue advocates often strive to influence public opinion, policy decisions, and social attitudes regarding the particular matter they are advocating for. Their goal is to effect meaningful impact and address the challenges or issues they are passionate about.

The paper proceeds as follows: Section 2 discusses how previous work has investigated credibility and trustworthiness of science and scientists and outlines our approach to the topic. In Section 3, we discuss the two national settings that we investigate. Section 4 presents our methodology, and Section 5 our results. Finally, Section 6 concludes the paper with a discussion of key results and their implications.

2. The credibility and trustworthiness of science and scientists

Giddens (1990: p.34) defines trust as 'confidence in the reliability of a person or system, regarding a given set of outcomes or events'. He argues that trust is a key requisite in technologically advanced societies because of the time and space distance between those who are experts in the system and those who are subject to the decisions and practices of 'expert systems'. These experts provide an indispensable bridge between complex and uncertain sources of knowledge and the public who seek guidance on how to act on such knowledge (Jasanoff, 2005). Key reasons for wider interest in the credibility of science and in attitudes towards science, are thus related to the engagement of the public in decision-making processes related to science and technology (Lee and Kim, 2018; Sauermann et al., 2020), the potential impact of scientific discoveries in the presence of positive attitudes to science (Pechar et al., 2018) but also due to the challenges of communicating academic research and engaging the wider public (Pieczka and Escobar, 2013).

Stylized findings from these studies are typically based on survey questions enquiring about direct assessment of trust. Results tend to reveal a dominance of positive assessments in public attitudes towards science. For example, Allum et al. (2008), in their meta-analysis reviewing links between public attitudes and public knowledge about science, conclude a positive relationship but highlight that this varies across different science and technology domains. On the contrary, the Eurobarometer survey (European Commission, 2021) suggests that fifty percent of respondents agree that scientists can no longer be trusted to tell the truth about controversial scientific and technological issues, due to their dependence on money from industry (only 21% disagree). In the same survey, 45 % agree with the statement that scientists look at very specific issues and do not consider wider perspectives (25% disagree).

This literature has also investigated differences in attitudes to science and scientists between countries. For example, Bauer et al. (1994) reported that attitudes to science show a curvilinear relationship with levels of industrialization. Differences also emerge among groups of individuals based on the level of education, religion, and gender (Hayes and Tariq, 2000; Sanz-Menéndez and Cruz-Castro, 2019; McPhetres and Zuckerman, 2018). Attitudes to science tend to be positively associated with scientific literacy and education (Allum et al., 2008; NASEM, 2016). In general, results suggest that scientifically literate people have more positive attitudes to science, but are not necessarily more positive about specific technological applications or specialized areas of scientific research (Evans and Durant, 1995). More highly educated respondents are also more likely to agree that scientists should intervene in political decisions (European Commission, 2021). Linkages between political orientation and attitudes have received significant attention, with several studies reporting evidence of decreasing trust in scientists among individuals with right-wing political opinions (e.g. Mann and Schleifer, 2020). For instance, Gauchat (2012) reports that between 1974 and 2010, US respondents identifying as conservative moved from having the highest trust in science, relative to liberals and moderates, to the lowest level of trust. This pattern also prevails in recent studies on attitudes to scientific evidence regarding climate change and the Covid-19 pandemic (Mann and Schleifer, 2020; Sulik et al., 2021). Finally, some authors argue that attitudes towards science might be influenced by the research topic and that individuals' trust in science varies across domains and issues (Pechar et al., 2018). For instance, as demonstrated by Pechar et al. (2018), a greater scepticism towards scientists is observed amongst those with more left-wing opinions in debates on genetically modified food.

The methodological approach in the majority of the studies presented above is common: nationally representative sample surveys are frequently used as a way to study public opinions including either "open" or "closed" questions (see Bauer and Falade (2021) for a comprehensive list of better-known surveys in the field). Although this approach remains important for our understanding of what people think about the public debate (Osborne and Rose, 1997) and facilitates comparison over time and space (de Jong and van Drooge, 2020), they suffer from important limitations. First, several authors have highlighted the limitations of this approach to inferring absolute and relative orderings of public choices (Schuman and Scott, 1987). Second, the broad categorization of "experts" could challenge the uniformity of public views as respondents could imagine an expert as "an academic, a scientist in a lab coat or a member of the public with encyclopaedic knowledge about their favoured hobby" (Dommett and Pearce, 2019; p. 3). Third, public trust in science is not a homogeneous construct and individuals may trust science on some issues but not others, depending on how the source and implications of that science correspond to the individual's prior attitudes and values (Pechar et al., 2018). In fact, Tranter (2023) concludes that trust in scientists varies considerably according to the type of science examined. This indeed highlights shortcomings in the measurement of the constructs as raised by Pardo and Calvo (2002) who concluded that instruments to examine the relationship between scientific knowledge and attitudes towards science were fuzzy and, as a consequence, the empirical support for some published results was limited.

In order to address these limitations, we propose an alternative to the direct (abstract) assessment of credibility based on an experimental bottom-up approach called ‘conjoint analysis’. As starting point for such an approach, we take the perspective of credibility research which posits that actors form perceptions of trustworthiness on the basis of attribution of competence and intentions (e.g., Rousseau et al. 1998). In the context of expert opinions, these assessments translate to views on the relevance and depth of expertise, and on the integrity and objectivity of the expert (Critchley, 2008; Hendriks et al., 2015; Ziman, 2002). The purpose of a conjoint analysis approach is to examine such attributions by comparing whether and how the evaluation of one and the same statement varies when attributed to different actor types. Specifically, we will compare the credibility of a set of claims about future global challenges when these claims are said to come from academic scientists rather than from actors representing government, industry, or other interest groups. If the classification of an expert as an academic scientist triggers attribution of objectivity and associations with a relevant type of competence, we should expect to find that a statement is more credible when associated with science than with other spheres of society. In addition to the source of the message, we can consider its framing as positive or negative, which can increase or decrease support for a message (Brewer and Ley, 2014). Specifically, positive settings emphasise opportunities for technology to address societal challenges, while negative settings emphasise the threats that technologies pose to society. In essence, a conjoint analysis allows us to explore not only the attitudes of different social groups towards science but towards the attributes of science as a process and domain of knowledge.

3. Setting

We decided to conduct our investigation in two countries in northern Europe: the United Kingdom (UK) and Sweden. Both countries are characterized by a relatively high level of generalized social trust (“trust in others”), as measured by the World Value Survey[3], but differ in tradition when it comes to trust in authorities and – perhaps most markedly – in the government. Survey polls consistently put Sweden on very high measures for trust in government, whereas the UK has among the lower levels in Europe (OECD, 2021). Some historical hints on the credibility in science and scientist in both countries are presented below.

[3] http://www.worldvaluessurvey.org/

3.1 The UK

The UK is a leading science nation with many of its universities ranking highly in international league tables and attracting large numbers of international students and scholars. The 1980s presented a pivotal time in the UK with policies aimed at directing science towards societal relevance (Senker, 1998). This included the Royal Society report "The Public Understanding of Science" (or Bodmer Report), which encouraged research and policy action on the topic in the UK. The report came at a time when there were concerns that the public interest in science and scientists' engagement with the public were at a low (Sturgis and Allum, 2004). Accordingly, it called for scientists to communicate the benefits of their research and for a more science literate public, to shift the public's attitudes towards science (Bauer, 2009).

Surveys on public understanding or attitude to science in the UK go back to the 1980s, when they showed that attitudes depend on the specific technologies and type of scientific research (Evans and Durant, 1995), with some perceived as clearly useful and others contentious (Ziman, 1991). In the 1990s negative attitudes towards science and technology increased such as during the Bovine Spongiform Encephalopathy (BSE, also known as 'mad cow disease') scandal and with the debate around genetically modified food (Bauer, 2009; Sturgis and Allum, 2004). The decline in trustworthiness of science and scientific institutions was highlighted in the 2000 House of Lords Report 'Science and Society', and in 2002 the research councils and the Office of Science and Technology made new recommendations for dialogue with the public (Pitrelli, 2003; Smallman, 2017). From the early 2000s, the UK government programme 'Sciencewise' for instance invited the public to discuss new science and technologies to get their view. Analysing these dialogues, Smallman (2017) found that the public held overall positive attitudes towards science but also emphasised the unpredictability of risks. This contrasted with expert dialogues which generally consider any risks as manageable (Smallman, 2017). A 2001 OST and Wellcome Trust report similarly claimed that the UK public was overall more accepting of science than in prior years, but more questioning about its benefits (OST and the Wellcome Trust, 2001).

Since 2000, the UK government commissions public attitudes to science surveys every three to five years. The most recent 2019 report shows a very positive attitude towards and high trust in science, but also confirms that views differ by type of science and technology. For instance, the attitude towards renewable energies has become more positive over time, but there are also concerns about inequalities with regard to some emerging technologies (BEIS, 2020). The latest survey enquired about trust in different types of experts and showed that scientists working in universities are more trusted than scientists working for environmental groups and charities, and these in turn are more trusted than scientists working for the government and in the private sector. Experts are very visible in Britain and survey evidence does not suggest that there is a crisis of trust (Dommett and Pearce, 2019). The COVID-19 pandemic may even have seen a positive shift in the attitude towards science and scientists (Jensen et al., 2021).

3.2 Sweden

During the 20th century, Sweden moved in quick pace from a largely agricultural society to a country characterized by industrialisation. A number of industrial firms achieved significant success in international markets on the basis of advanced technological knowledge, and the good fortune of remaining largely untouched by two world wars that crippled neighbouring countries. Swedish self-understanding and sources of national pride thus shifted from the military accomplishments of viking age raiders and 17th century Carolean armies to the achievements of engineers developing cars, wheel bearings, power transmission technology and robotics for the world market (Löfgren, 1993).

Sweden was hence imprinted with a national identity where science and engineering knowledge played an important role (Axell & Hallström, 2015). The country's international position as home of the Nobel prizes contributed to strengthening this connection, by recurrently manifesting the importance of science and of Sweden as a nation that counted despite its limited population and peripheral geographic status. Another important symbol was national telecom champion Ericsson, that since the 1990s has played an important role in the provision of mobile telephony technology worldwide.

Throughout the last decades, the status of Sweden as a forerunner in technology has been reinforced by repeatedly featuring as a top-country in international benchmarks such as the 'European Innovation Scoreboard' published by the European Commission (2023) and the 'Global Innovation Index' published by the World Intellectual Property Organization (Dutta et al., 2021). This is reflected in a study on perceptions of science and technology in society (OECD, 2015), where Sweden has the second highest rate of respondents expressing a dominantly positive view, exceeded only by neighbouring Baltic state Estonia.

During the last decade, the trustworthiness and relevance of scientific expertise has increasingly been questioned, e.g. in controversies over climate change policy or COVID-19 response strategies. Sweden is also not unaffected by the 'culture war' tensions that play an increasing role in many western countries, or by mounting concern about Artificial Intelligence (AI) development and tech-related privacy violations. However, such controversies do not seem to have yet made permanent impact on the sentiments of the Swedish public (Esaiasson et al., 2021). The most recent edition of the biannual survey of public attitudes to science ("VA-

Barometern") shows stable or even positive patterns of trust and confidence in science and technology (Vetenskap & Allmänhet, 2023). The same study shows that more than 4 out of 5 Swedes have confidence in academic scientists, 3 out of 5 have confidence in privately employed scientists, whereas fewer than 2 out of 5 express the same confidence in politicians in parliament.[4] Furthermore, a large majority of respondents (70 – 80 percentages) agree with statements that scientific and technological development has made life better in the last decade, and is likely to do so in the near future.

4. Empirical strategy

To assess the credibility of scientists, when compared with other types of actors or stakeholders, we employ a choice-based conjoint analysis survey. Conjoint analysis is an experiment technique that presents survey participants with different scenarios. It is thus able to obtain more comprehensive opinions from survey participants. This method allow us to move away from the more abstract and post-hoc types of questions ("Do you trust science?") that have been used in most existing survey studies, and to minimize social desirability bias and other individual response style biases inherent in traditional Likert scale surveys (Zizzo, 2010). It is also more realistic in that it forces respondents to assess a set of scenarios as a whole and excludes omitted variable bias by construction as respondents evaluate the same 'profiles' (Hoenig and Henkel, 2015). The method thus seems particularly suitable to assess the credibility of scientists against other stakeholders. Conjoint analysis has been widely used in marketing research to investigate consumer preferences (e.g. Green and Srinivasan, 1990; Eggers et al., 2022) but is little used in innovation studies despite its potential. The few recent exceptions include studies on technology forecasting (Hoisl et al., 2015), venture financing (Hoenig and Henkel, 2015), and standardisation (Wiegmann et al., 2022).

Our study utilizes a population-based conjoint analysis. Performing a survey experiment on a representative sample, as opposed to laboratory settings, gives high external validity and generalizability. In our case representative samples of the UK and Swedish general public, drawn from panels maintained by a third-party survey company, are presented with different technological scenarios related to different global challenge statements (emerging technologies and sustainability). In the experimental approach, respondents are randomly presented with different scenario attributes (sender type and positive vs. negative framing in our case) and asked

[4] While the study shows a low level of trust in politicians relative to scientists, general trust in the government is high in international comparison (Erlingsson, 2021).

to assess the credibility of these different scenarios. By analysing the expressed credibility, we can shed light on the importance attached to each attribute.

In selecting the hypothetical statements for each scenario, our starting point are the UN Sustainable Development Goals (SDGs). Based on the UN's description of the goals, we created and tested statements that fit with our research aim while relating directly to the focus of the respective goals. This entails identifying issues where respondents may not have very strong pre-conceived views, yet could be expected to know and understand sufficiently much so as to relate to and assess the credibility of a statement on each issue. This contrasts with prior studies that have e.g. asked about climate change (Sanz-Menéndez and Cruz-Castro, 2019). By anchoring the scenario we use in these goals, we ensure a broad representation of socially relevant issues and global challenges. Note, however, that there was no explicit mentioning of the SDGs, neither as an overarching concept, nor in relation to the specific issues, in the survey instrument. The statements were verified with the third-party survey company that conducted the survey (see next section) to ensure that they were perceived as realistic. The questionnaire was originally developed in English and translated into Swedish by members of the research team who are proficient in both languages.

Each statement is defined based on two attributes. The fist attribute in each scenario refers to the stakeholder or sender of the statement. Specifically, we compare scientists with three other types of stakeholders, hailing from the business domain, from the sphere of government, and independent issue advocates. The second attribute of each scenario refers to the framing. In order to investigate if the perceived credibility of sender types varies with the framing of the message, we constructed two versions of each statement. The first version has a positive framing, where new technology has a positive social impact. In the second version, the same technological change is presented with a negative framing (future threats or deficits). All statements and scenarios are presented in Table 1. The right-most column of the Table shows the relationship between scenarios and the SDGs.

[Insert Table 1 about here]

When presenting the survey to the respondents each statement was linked to one choice set, that is, one stakeholder/sender type and either a positively or a negatively framed version of each scenario. The statement attributes are summarised in Table 2. Annex I provides an example of how the questions were presented in the survey.

[Insert Table 2 about here]

Stakeholder-statement combinations were quasi-randomly assigned to respondents.[5] They are required to rate the credibility of each of the eight statements, and these assessments form the basis of our analysis (the operationalization of the credibility measure is explained below).

5. Data

Participants to the survey experiment are drawn from representative panels from the UK and Sweden maintained by the company YouGov. In total, 9,008 citizens were selected for participation (3,008 in Sweden and 6,000 in the UK). Respondents who were excluded due to failure to complete on time, or as a consequence of responses not passing quality control (very quick answers, streaking, 'mechanical' response patterns), were replaced with a person with similar characteristics from YouGov's panelist registers.

Data was collected online in Nov-Dec 2021. The questionnaire included two main groups of questions: those related to the credibility of scientist and demographic variables for each respondent. Credibility-assessment of each scenario-stakeholder combination was made using a 7-point Likert scale, ranging from 'completely convincing' (7) to 'completely unconvincing' (1).

Table 3 shows how assessments are distributed across scenarios. As we can see, all statements divide respondents between positive and negative assessments of credibility. For two of the technical scenarios (wastewater reuse and smart city), the majority of the assessments are positive (57.2% and 60.9% respectively). For the issue AI-enabled legal support, negative assessments dominate (56.1%), with over a third indicating that they find the statement completely unconvincing.

[Insert Table 3 about here]

Since there is an overall variation in the credibility of different scenarios (across stakeholder types and framing), we normalise each credibility assessment. More specifically, we centralise the original variable around "0" by computing the difference between each respondents' original credibility assessment answer and the average credibility assessment for the same scenario. The skewness statistic (-0.2) and the Shapiro-Wilk test for normal data (W=0.985; p-value=0.000) suggest that this new centralised credibility-assessment variable can be considered as normally distributed.

Further, the scenarios in the survey included an additional dimension where each stakeholder type is referred to as either an individual representative for each domain (professor at a major

[5] An entirely random assignment of stakeholder-statement combinations would yield eight different survey variants. However, for simplicity in distribution, four survey variants were used.

university, well-known entrepreneur, government expert, campaigner), or is incorporating an organisational dimension within that domain (panel of scientists, industry association, government agency, private think tank/NGO). A dummy variable *Organisation* is included as control to account for the distinction between individual vs. organisations in the credibility questions.

The survey company returned the profile of the respondents, which identifies six characteristics: *age* (years old), *gender* (male/female), level of education, income level, political orientation and the NUTS 1 *region* where they live. Categories included for education, income, political orientation and regions are detailed in Annex II. In order to make the UK and Swedish case comparable, we combined some of the original categories identified. In this way, *education* includes four categories namely elementary, secondary school, post-secondary school and university education. *Income* includes three categories: lower income (less than 75% of the median), middle income (between 75% and 200% of the median) and higher income (higher than 200% of the median). Political orientation distinguishes between Left-wing (combining very and fairly left-wing from the original UK categorisation), slightly left-of-centre, centrist, slightly right-of-centre, right-wing (combing fairly and very right-wing from the original UK categorisation) and 'don't know'.[6] Survey weights are available, allowing us to achieve national-level representativeness in terms of regions, gender, age and education.

Finally, the survey contained a manipulation check question, which helps to assess if respondents understood the experimental prompt (Kane and Barabas, 2019). This check showed that 873 individuals answered that they "did not register that some of the statements [that they had assessed] were attributed to scientists". Responses from these individuals were consequently not used for analysis. A further 2,019 individuals had not (in questions asked by YouGov in advance) agreed to provide information on their education and/or income, and data for these individuals could therefore not be used in our main regression analysis where these factors are used as control variables. The final sample used in this study contains 6,198 complete responses (62.3% from the UK and 37.8% from Sweden). This gives us data on 49,584 choices based on the eight scenarios presented to each respondent.

[6] Descriptive statistics of respondents' profiles are presented in Annex III.

6. Results

6.1 Main results

In our analysis we model the respondents' credibility assessment as a function of the type of stakeholder, including a set of respondent-level control variables (gender, age, education, income and political orientation) as well as the scenario control of individual/organisation stakeholder specified in the question. Since the dependent variable follows a normal distribution, these models are estimated using ordinal least square (OLS) regression models. We present results on key variables separately for the UK and Sweden in Table 4. Annex IV shows results from a base estimation of all individual-level control variables on assessments.

Model 1 of Table 4 presents results for assessment effects associated with stakeholder types. We find that statements are assessed as more credible when associated with *scientists* (the reference category) than when the same statements are associated *with a businessperson, an issue advocate* or *government officials,* but this is only true for the UK case. For Sweden, *scientists* are only more credible than *government officials,*[7] but there are no significant differences when compared with other types of stakeholders. However, the results of Model 2 suggest that these averages hide substantial differences in stakeholder effects by the framing of the statements, as indicated by significant interaction effects. In all cases and across issues, a *negative* framing increases the credibility of a statement. Considering the effect for scientists, we see that a negative framing increases the credibility of their statements by approximately 0.3 points in the case of the UK and 0.14 points in the case of Sweden. To support interpretation, we represent graphically the interaction effects for both countries in Figure 1. In the UK, for positively framed statements, the domain of science is perceived as more credible than the business and government domains or issue advocates. For negatively framed statements, we find the reverse pattern and in this case *businessperson* and *issue advocate* are considered more credible than *scientists*. In Sweden, there is only a contingency effect of framing for the stakeholder type *issue advocate*.

[Insert Table 4 about here]

[Insert Figure 1 about here]

Control variable estimates (see Annex IV) show that respondents in their 50s and 60s on average are more sceptical in their credibility assessment in both countries. For both UK and SE, political views to the 'centre' are positively associated with assessments of statement credibility, while

[7] Indeed, in Sweden, *government officials* are systematically less credible when compared not only to *scientists* but also when compared to *businesspersons*.

extreme political views are associated with negative credibility assessment. In the case of Sweden, women assign higher credibility to statements compared to men, while there is no difference for the UK. In Sweden, respondents also assess statements as more credible when they include an organisation as stakeholder rather than an individual, while this is not the case for the UK. Finally, we note that respondents generally do not differ in their assessments by their level of education, although there is a slight tendency for UK citizens with shorter university degrees to be more sceptical towards the statements.[8]

6.2 Robustness analysis

We take measures to ensure the robustness of our main results to alternative model specifications. Of particular interest is to investigate whether our main results are affected by the exclusion of observations due to individuals not having provided information about their education (Model 1, Annex V) or income (Model 2, Annex V). In the case of income we are able to increase the sample by about 30%, by adding assessments from individual where such information is missing. We thus re-estimate the models of Table 4 with the corresponding control variable excluded. The results are very close to those of our main analysis. The only notable differences in Model 1 and Model 2 are that the estimates on *businessperson* in the UK and *issue advocate* in Sweden are not significant, but the signs remain. Instead for the Swedish case, results now confirm that *scientists* are more credible than *government officials* when the income variable is not taken into consideration.

It also seems important to explore to what extent our main results are driven by general attitudes towards scientists. While more accentuated in e.g. a US context than in the two European countries that we study, negative attitudes towards scientists as being subject to political and ideological biases have been mounting over the last two decades (Gauchat, 2012; Mann & Schleifer, 2020). We are interested in exploring whether the pattern of negative perceptions of scientists' credibility as bearers of negatively framed messages is driven by a group or respondents who are generally sceptical towards scientists' objectiveness.

To explore this, an additional question was included in the survey about the objectivity of scientists: "Do you perceive professors at UK [Swedish] universities to be ideologically driven, rather than open-minded?". We code individuals who replied positive to this question as

[8] In unreported results, we also investigate whether education affects the estimated relative credibility of our different stakeholder types. We find that university educated respondents indeed assign higher credibility to scientists than other respondents. This is interesting since it mirrors a pattern from studies of trust in science, where such trust is generally found to be higher among the highly educated (Bak, 2001; Quesnell. 2015). It is reassuring that our method of indirect preference investigation replicates well-established results from a literature where the analysis draws on direct, self-reported assessments.

considering scientists as ideologically driven *(*value 1 in a dummy variable called *ideology)*. Descriptively, 40% of UK respondents and 30% of Swedish respondents consider academic scientists as ideologically driven. Results reported in Model 3 of Annex V shows that respondents who view scientists as ideologically driven have lower relative assessments of scientists' credibility – in particular for positively framed scenarios. However, the pattern of our main results remains the same when controlling for this factor.

6.3 Additional analysis: individuals vs organisations and credibility of scientist in social scenarios

Extending our main results, we also undertake a series of additional analyses. First, we investigate further the individual vs organisation dimension of the stakeholders, i.e. whether a sender type is being presented as an *organisation* rather than an individual (e.g. *panel of scientist* rather than *scientist)* affects the assessments, across stakeholders and framings (Table 5). The organisation level was significant for the Swedish case in our main results but not the UK. In Table 5 we can see that for the UK, negative statements by an organisation are perceived as more credible than those by an individual, for all stakeholder types except government. In the case of Sweden, the shift to organisation level is only significant in the case of industry representatives and government where the organisation is more credible than the individual regardless of statement framing.

[Insert Table 5 about here]

In a second set of further analyses, we replicate our main results using data on three additional social issues (health, education and employment) related to the SDGs, which were not designed around topics of technological change but instead concerned with socially oriented scenarios (see Table 6). This distinction allows us to compare the credibility of stakeholders for social scenarios with our main results for technological ones.

[Insert Table 6 about here]

Table 7 repeats our main regression analysis (Table 4) for these social scenarios. We find that regardless of the country, statements assigned to *scientists* are perceived as significantly more credible than those assigned to *government officials* but as less credible than statements assigned to *businessperson* and *issue advocate* (Table 7 Model 1). When framing is considered results for the UK and Sweden diverge (Table 7 Model 2; Figure 2). While negative framing further reduces the credibility of *scientists* and *government officials* for the UK, in the case of Sweden these stakeholders are no longer perceived as less credible than *businessperson* or *issue advocate*. Overall, it is noteworthy that for social scenarios, the assessment of credibility of scientists is lower than is the case for technological scenarios, where scientists were perceived as most credible. In the case of the UK, this negative credibility assessment is even more pronounced for negatively framed statements, contrary to what we saw in technological scenarios. For Sweden, the negative credibility assessment is observed for positively framed social statements only, but scientists are considered slightly less credible regardless of framing compared to technological scenarios.

[Insert Table 7 about here]

[Insert Figure 2 about here]

7. Conclusions

The present study investigated whether the perceived credibility of a claim about the consequences of technological development changes when it is attributed to an academic scientist rather than to a non-academic source. Results from a conjoint analysis experiment using data from surveys to representative panels of the UK and Swedish general populations paint a mixed picture of the status of scientists as experts and arbiters of future technological development. Among the UK public, a statement is perceived as more credible if coming from a scientist rather than from experts representing government, business or other private interests. We identify positively framed predictions about new technology and innovation as a domain where scientific expertise is perceived as enjoying relatively high credibility, compared to other types of experts. However, actors representing business and special interest groups are overall perceived as more credible conveyors of 'bad news', of negatively framed messages about the future. Among the Swedish public, we detect no difference in credibility between scientists and actors from industry. Only government actors are perceived as less credible for all types of statements, while issue advocate actors are perceived as less credible conveyors of negatively framed messages.

Overall, our results suggest that scientists are held in relatively high regard as experts on the social consequences of technological development. However, there is no such thing as an interpretative prerogative reserved for academic scientists: there is clearly room for entrepreneurs, industry representatives and non-academic experts to contribute to and shape debates about technology. It is possible that these latter groups are particularly credible when advancing critical concerns rather than optimistic interpretations because the former is perceived as more genuine social engagement. It is also possible that audiences associate positively framed messages from business actors with them "selling" a future that benefits their business.

In further exploration, we find that the relatively positive perception of scientists as interpreters of technological development does not carry over from the technological domain to more socially (and, as such, more politicised) oriented statements about education, healthcare and employment – at least not for positively framed messages. This is somewhat problematic – it could be argued that it is precisely for arbitration in politically controversial issues that scientific, impartial evaluation is needed most. While the methods of social science clearly enjoy a lower degree of epistemological hegemony than those practiced in the "hard" sciences, we must still ask whether more can be done to have scientists in all domains earn the trust of the public. Here, our findings can be related to contemporary debates about the appropriate role of academic scientists as 'activists' and 'advocates' that is challenging traditional Mertonian norms of 'disinterestedness' (Frickel, 2018; Macfarlane, 2023). Scientists face a delicate balancing problem when seeking to avoid falling short in relevance on the one hand and credibility on the other. A question arises what universities, scientific organisations and governments can do to help scientists balance these concerns?

With our results documenting differences between positively and negatively framed messages, between technological and social issues, and between the UK and Swedish contexts, our study must be argued to highlight the complexity behind public perceptions of scientific expertise. Research investigating public perceptions based on traditional attitude questions such as "Do you trust science/scientists?" is likely to underestimate that complexity, and to overlook important differences between the public's trust in science as a process and scientists as arbiters of future technological development.

Our findings may inform discussions about how communication of scientific knowledge can be strengthened. However, the study also leaves several questions unanswered. Our two-country analysis reveals both similarities and differences in the estimated credibility of scientists, as compared to other types of participants in public debate. Repeated measurement in these two countries, and comparison with other countries, would allow to investigate whether the credibility of scientists responds significantly to particular controversies or correlates to other measures of public opinion in a systematic way. We also suggest that further work is needed to extend our understanding of *what types* of contemporary questions and issues surrounding new technology and innovation the general public perceives as being informed by scientific expertise in important ways. Further work is also called upon to investigate the mechanisms behind the difference in credibility by the (positive or negative) framing by stakeholder groups. Finally, we believe that such efforts would benefit from distinguishing between perceptions of competence on the one hand and intentions on the other. This would be valuable in pushing the analysis of country difference further, but also probably necessary to shed further light on the role of framing. Does the credibility premium of negatively framed messages stem from differences in the perception of competence (e.g. better ability to predict problems than positive developments) or intentions (e.g. weaker tendency to self-serving bias)?

We hope that the present study can spur renewed interest in public perception of scientific expertise - and, more generally, in the social contract of science - in the innovation studies community. Indeed, we believe that these issues are something of a blind spot in the literature on science and innovation, and we see significant need for scholars on science and innovation to engage with issues about public perceptions of science and scientific expertise. More specifically, we see three strands of literature where increased focus on these aspects are likely to bring fresh and much-needed insights.

The first of these is the literature on science policy. Scholarship on science policy based in economics, management and innovation studies has focused on identifying the types of policy that are economically sensible and effective, effectively taking public trust (and, in extension, political support) in public spending on science more or less for granted. Engaging a little closer with public perceptions may help scholarship in this stream increase its contribution to policy formation (Giffoni & Florio, 2023).

The second literature strand concerns the third mission of universities (Sánchez-Barrioluengo, 2014), academics' interest in making an impact beyond the confines of academia (Salter et al., 2017) and academic engagement beyond direct relationships with industry (Perkmann et al., 2015; Rauchfleisch et al., 2021). Work on these topics have exclusively investigated the 'supply side' – i.e. the incentives, motivations and activities of academics. The 'demand side' of the equation, in the form of the general public's interest and expectations, is only indirectly present in these pertinent research streams.

Finally, innovation scholarship discussing the relationships between science and innovation has largely ignored the role of scientific expertise in shaping public opinion and understanding of the consequences of innovation (Kayser, 2017). By connecting the pieces of how scientists, science funders and the general public understands the role of science and scientific expertise in informing the wider society about the social implications of innovation, we can better understand what the social contract of science looks like. These insights should be mirrored in state-of-the-art innovation studies research on how science does and does not underpin and relate to technological development, in order to inform discussion of how that contract can be upheld, reformed, or re-interpreted. This endeavour is particularly important in face of increasing signs of political tensions around (and within) academia and, specifically, an increasing divide between people, by political orientation, in their level of trust in scientists and the institutions that represent them (Gauchat, 2012; Jo, 2024).

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Table 1: Technological Scenarios

	Positive framing	Negative framing	SDG
AI decision support	We know that management and R&D teams that are more diverse tend to outperform teams where people have very similar backgrounds. New AI technology and decision support systems can reduce the need for diversity, which will significantly strengthen innovation and competitiveness in industries which traditionally have struggled with diversity.	We know that management and R&D teams that are more diverse tend to outperform teams where people have very similar backgrounds. New AI technology and decision support systems can reduce the need for diversity, which risks reducing industry efforts to increase diversity and curb a development towards more diverse workplaces.	5: Gender equality 10: Reduced inequalities
Wastewater reuse	By 2030, wastewater reuse will be standard in new residential buildings, and this type of technology will also be installed in many existing buildings. Together with other water recycling techniques, this will strongly alleviate current concerns about water shortage.	Water shortage is a significant problem, and wastewater reuse technology is unfortunately not being implemented at sufficient speed. Unless new regulation is implemented, it will take another decade before this type of technology can be made standard in new residential buildings.	6: Clean Water and sanitation
Smart city	The 'smart city' of the future will collect data on citizens' movements using devices like connected sensors, lights, utility meters or smart parkings. By 2030, data collected will help to optimize the efficiency of city operations, for example, reducing traffic congestion and reducing the length to search for an open car spot.	With devices like sensors, lights, utility meters or smart parkings connected to the internet, it becomes possible to collect data on how people move within cities. By 2030, the data collected e.g. by connecting CCTV to facial recognition technology seriously threatens the privacy of [UK/Swedish] citizens.	11: Sustainable cities and communities
Electronics recycling	In the near future, you will be paid a significant amount of money for recycling electronic devices such as mobile phones, e-watches, and power band bracelets.	The cost of recycling electronic devices such as mobile phones, e-watches, and power band bracelets will significantly increase in the near future.	12: Responsible consumption and production
AI-enabled legal support	The use of artificial intelligence in supporting legal decision making, e.g. as AI lawyers and judges, will make access to justice more affordable and less biased and therefore ensure greater fairness.	The delay in implementing artificial intelligence in legal decision making, e.g. as AI lawyers and judges, deprives us of the opportunity to create a fairer legal system.	16: Peace, Justice and Strong Institutions

Table 2: Statement attributes

Attribute	Attribute level
Stakeholder/sender type	Scientist Businessperson Government official Issue advocate
Framing	Positive Negative

Table 3: Assessments of technological scenarios

	Completely Unconvincing	Unconvincing	Somewhat unconvincing	Neither convincing nor unconvincing	Somewhat convincing	Convincing	Completely Convincing
AI decision support	10.3 %	14.5 %	18.6 %	32.9 %	16.0 %	6.1 %	1.5 %
Wastewater reuse	3.6 %	6.1 %	12.4 %	20.6 %	33.0 %	18.4 %	5.8 %
Smart city	4.2 %	6.8 %	11.6 %	16.5 %	31.2 %	19.4 %	10.4 %
Electronics recycling	5.9 %	10.9 %	17.9 %	22.3 %	27.0 %	12.8 %	3.3 %
AI-enabled legal support	17.9 %	18.3 %	19.9 %	23.2 %	13.8 %	5.2 %	1.8 %

Table 4: Main results using an OLS regression.
Dependent variable: credibility of scenarios combining stakeholder type and framing.

	UK		SE	
	(1) Model 1	**(2) Model 2**	**(1) Model 1**	**(2) Model 2**
Stakeholder type (Ref: Scientists)				
Businessperson	**-0.051***	**-0.078***	-0.005	0.061
	[0.03]	**[0.04]**	[0.04]	[0.06]
Government official	**-0.209*****	**-0.305*****	**-0.095****	-0.061
	[0.03]	**[0.05]**	**[0.04]**	[0.07]
Issue Advocate	**-0.114*****	**-0.134*****	-0.048	**0.100***
	[0.03]	**[0.05]**	[0.04]	**[0.06]**
Framing				
Negative framing		**0.306*****		**0.137****
		[0.04]		**[0.06]**
Negative framing x Businessperson		**0.218*****		-0.098
		[0.06]		[0.08]
Negative framing x Government official		**0.158****		-0.058
		[0.07]		[0.09]
Negative framing x Issue Advocate		**0.207*****		**-0.300*****
		[0.07]		**[0.09]**
Individual-level control variables	YES	YES	YES	YES
Scenario-level individual/organisation	YES	YES	YES	YES
Log-likelihood	-36,800	-34,900	-21,000	-20,700
df	35	39	32	36
P-value	0.000	0.000	0.000	0.000
Observations	19,290	19,290	11,700	11,700

Note: Survey weights applied. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.01

Table 5. Additional analysis: Organisation vs individuals

	UK	SE
Stakeholder type (Ref: Scientists)		
Businessperson	-0.076	-0.029
	[0.06]	[0.08]
Government official	**-0.373*** **	**-0.151***
	[0.07]	**[0.09]**
Issue Advocate	**-0.158*** **	0.069
	[0.06]	[0.08]
Framing		
Negative framing	**0.236*** **	0.114
	[0.06]	[0.08]
Negative framing x Businessperson	**0.248*** **	-0.073
	[0.08]	[0.11]
Negative framing x Government official	**0.271*** **	0.011
	[0.09]	[0.12]
Negative framing x Issue Advocate	**0.176** **	**-0.334*** **
	[0.09]	**[0.11]**
Organisation		
Organisation	-0.054	-0.02
	[0.06]	[0.07]
Organisation x Businessperson	-0.002	**0.180***
	[0.08]	**[0.09]**
Organisation x Government official	0.137	**0.180***
	[0.08]	**[0.10]**
Organisation x Issue Advocate	0.047	0.062
	[0.08]	[0.09]
Interactions		
Negative x Organisation	**0.141***	0.047
	[0.08]	[0.10]
Businessperson x Negative x Organisation	-0.061	-0.051
	[0.11]	[0.15]
Government official x Negative x Organisation	**-0.227** **	-0.139
	[0.12]	[0.14]
Issue Advocate x Negative x Organisation	0.062	0.067
	[0.11]	[0.14]
Individual-level control variables	YES	YES
Scenario-level individual/organisation	YES	YES
Log-likelihood	-34,900	-20,700
df	46	43
P-value	000	000
Observations	19,290	11,700

Note: Survey weights applied. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.01

Table 6. Social scenarios

	Positive framing	Negative framing	SDG
Social scenarios			
Private health care	Private health care providers deliver higher quality than public providers, and competition between private and public providers greatly increases the overall quality of the UK health system.	Private health care providers deliver higher quality than public providers, and current restrictions on competition between public and private providers reduces the overall quality of the UK health system.	3: Ensure healthy lives and promote well-being for all at all ages
Vocational training	In the near future, young people do not need to go through the type of long, theoretical university educations that are commonplace today to get good jobs.	Too many young people spend too many years studying theoretical subjects without a matching labour market. A shift towards shorter, more vocational education would benefit the economy.	4: Quality education
Self-employment	Experiences from self-employment are valued by employers. Therefore, setting up a business may be a great way for unemployed persons to strengthen their long-term career prospects.	Self-employment may be a viable option to avoid unemployment, and experiences from self-employment are also valued by employers. Therefore, it is troubling that so few unemployed are setting up their own business.	8: Decent work and economic growth

Table 7: Additional analysis: Replication of results using socially oriented scenarios

	UK		SE	
	(1) Model 1	**(2) Model 2**	**(1) Model 1**	**(2) Model 2**
Stakeholder type (Ref: Scientists)				
Businessperson	**0.411*** **	**0.217*** **	**0.429*** **	**0.699*** **
	[0.04]	**[0.06]**	**[0.05]**	**[0.08]**
Government official	**-0.129*** **	**-0.148*** **	**-0.118** **	-0.095
	[0.04]	**[0.06]**	**[0.06]**	[0.07]
Issue Advocate	**0.430*** **	**0.269*** **	**0.416*** **	**0.789*** **
	[0.04]	**[0.06]**	**[0.06]**	**[0.08]**
Framing				
Negative framing		**-0.232*** **		**0.684*** **
		[0.06]		**[0.08]**
Negative framing x Businessperson		**0.407*** **		**-0.748*** **
		[0.08]		**[0.10]**
Negative framing x Government official		0.054		-0.078
		[0.09]		[0.11]
Negative framing x Issue Advocate		**0.356*** **		**-0.910*** **
		[0.09]		**[0.11]**
Individual-level control variables	YES	YES	YES	YES
Scenario-level individual/organisation	YES	YES	YES	YES
Log-likelihood	-36,800	-34,900	-21,000	-20,700
df	35	39	32	36
P-value	0.000	0.000	0.000	0.000
Observations	19,290	19,290	11,700	11,700

Note: Survey weights applied. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.01

Figure 1. Interaction effects between stakeholders type and framing

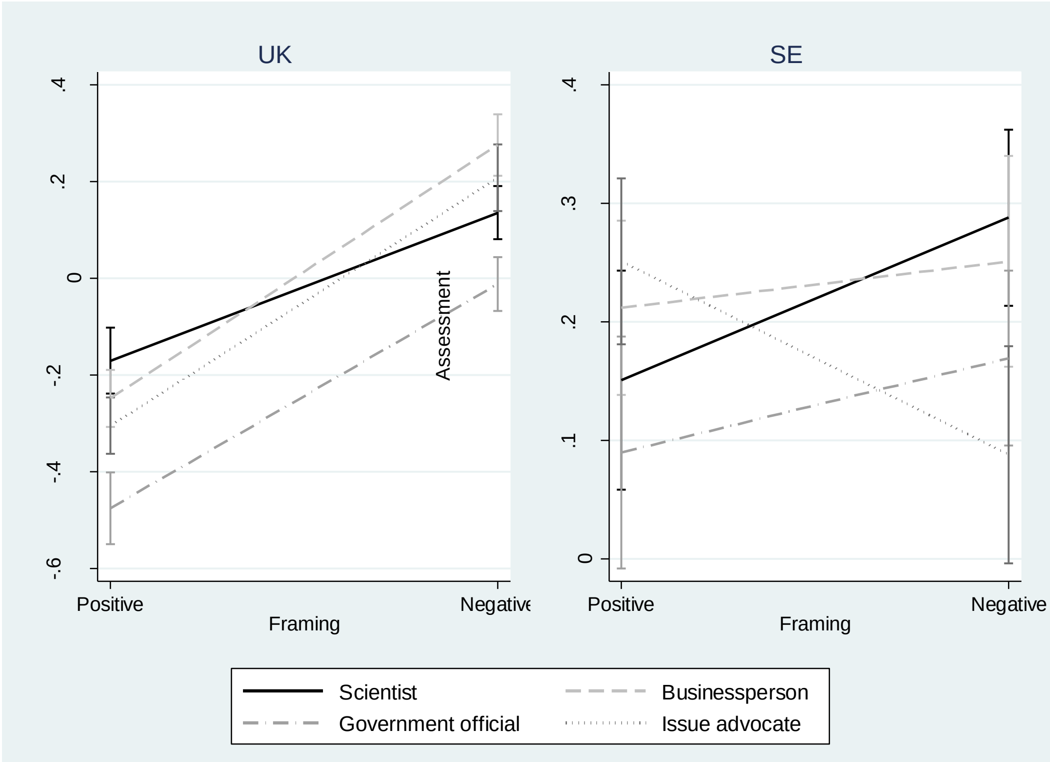
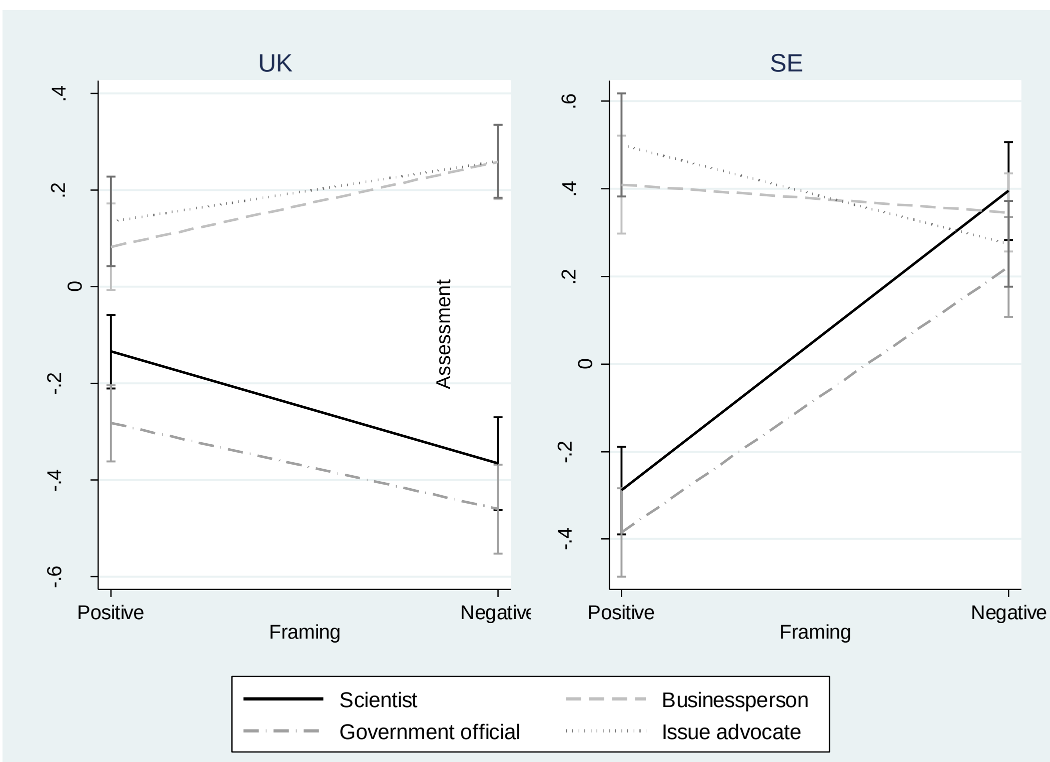


Figure 2. Interaction effects between stakeholders type and framing in social issues



Annex I. Instructions and examples of questions combining scenarios-stakeholders type presented in the survey.

Instructions

In modern life, we are confronted by a great variety of opinions. We are interested in studying how claims about the future made by different types of experts are received.

In what follows, you will be presented with a series of statements and claims. Please consider these statements carefully, and evaluate how credible you find them.

Do not use any further information than your existing understanding (i.e. do not search the web for complementary information). Consider how you would have *spontaneously reacted* to the statement if you came across it in your daily media flow. Is the statement convincing? Does it come from a reliable type of source?

This is an example of how a statement may look:

A representative for a forest industry association claims that over the next 10 years, wood-based products are likely to replace plastic in almost all types of consumer products packaging

For each statement, you will be asked to provide an assessment by indicating which of the following best corresponds to your view of the statement.

I find this statement …

Completely unconvincing	Unconvincing	Somewhat unconvincing	Neither convincing nor unconvincing	Somewhat convincing	Convincing	Very convincing
☐	☐	☐	☐	☐	☐	☐

Examples of questions presented to one respondent

Question 1. With devices like sensors, lights, utility meters or smart parkings connected to the internet, it becomes possible to collect data on how people move within cities. A professor at a major university claims that by 2030, the data collected e.g. by connecting CCTV to facial recognition technology seriously threatens the privacy of UK citizens.

I find this statement …

Completely unconvincing	Unconvincing	Somewhat unconvincing	Neither convincing nor unconvincing	Somewhat convincing	Convincing	Very convincing
☐	☐	☐	☐	☐	☐	☐

Question 2. A government expert claims that in the near future you will be paid a significant amount of money for recycling electronic devices such as mobile phones, e-watches, and power band bracelets.

I find this statement… …

Completely unconvincing	Unconvincing	Somewhat unconvincing	Neither convincing nor unconvincing	Somewhat convincing	Convincing	Very convincing
☐	☐	☐	☐	☐	☐	☐

Annex II. Original respondents profile categories.

	UK	Sweden
Education	<1> No formal qualifications <2> Youth training certificate/skillseekers <3> Recognised trade apprenticeship completed <4> Clerical and commercial <5> City & Guilds certificate <6> City & Guilds certificate - advanced <7> ONC <8> CSE grades 2-5 <9> CSE grade 1, GCE O level, GCSE, School Certificate <10> Scottish Ordinary/ Lower Certificate <11> GCE A level or Higher Certificate <12> Scottish Higher Certificate <13> Nursing qualification (e.g. SEN, SRN, SCM, RGN) <14> Teaching qualification (not degree) <15> University diploma <16> University or CNAA first degree (e.g. BA, B.Sc, B.Ed) <17> University or CNAA higher degree (e.g. M.Sc, Ph.D) <18> Other technical, professional or higher qualification <19> Don't know <20> Prefer not to say	<1> Folkskola/Grundskola <2> Gymnasium/Realskola <3> Eftergymnasial utbildning <4> Eftergymnasial yrkesinriktad utbildning <5> Universitets- eller högskoleutbildning, 1-2 år <6> Universitets- eller högskoleutbildning, 3-4 år <7> Universitets- eller högskoleutbildning, 5 år eller längre <8> Forskarutbildning (tex. PHD) <9> Vill ej uppge
Income	<1> Lower income: less than 75% of the median <2> Middle income: between 75% and 200% of the median <3> Higher income: higher than 200% of the median <98> Prefer not to say/Don’t know	<1> Låg inkomst: mindre än 75 % av medianinkomsten <2> Medelinkomst: mellan 75 % och 200 % av medianinkomsten <3> Hög inkomst: mer än 200 % av medianinkomsten <98> Vill inte uppge/Vet ej
Political orientation	<1> Very left-wing <2> Fairly left-wing <3> Slightly left-of-centre <4> Centre <5> Slightly right-of-centre <6> Fairly right-wing <7> Very right-wing <8> Don’t know	<1> Högerorienterad <2> Något högerorienterad <3> I mitten <4> Något vänsterorienterad <5> Vänsterorienterad <6> Vet inte

Region	<1> North <2> Midlands <3> East <4> London <5> South <6> Wales <7> Scotland <8> Northern Ireland	<1> Stockholm <2> Norra mellersta Sverige <3> Norra Sverige <4> Södra mellersta Sverige <5> Skåne, Halland och Blekinge

Annex III. Descriptive statistics of respondents' profiles

Variables	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
	Full sample		UK		Sweden	
Age	49.3	17.4	48.7	17.4	50.4	17.3
Gender (Male)	0.51	0.50	0.52	0.50	0.51	0.50
Education						
Elementary school	0.09	0.28	0.04	0.19	0.16	0.37
Secondary school	0.36	0.48	0.37	0.48	0.30	0.46
Post-secondary education	0.10	0.31	0.07	0.25	0.16	0.37
University 1-2 years	0.45	0.50	0.52	0.50	0.37	0.48
Income						
Lower income	0.28	0.28	0.32	0.47	0.16	0.37
Middle income	0.43	0.43	0.47	0.50	0.39	0.49
Higher income	0.29	0.45	0.21	0.41	0.45	0.50
Political orientation						
Left-wing	0.19	0.40	0.23	0.42	0.12	0.33
Slightly left-of-centre	0.16	0.37	0.16	0.37	0.17	0.37
Centrist	0.18	0.38	0.17	0.38	0.19	0.37
Slightly right-of-centre	0.18	0.38	0.17	0.38	0.22	0.42
Right-wing	0.13	0.34	0.11	0.36	0.17	0.38
Don't know	0.16	0.36	0.17	0.38	0.13	0.33
Region						
UK North	0.16	0.36				
UK Midlands	0.11	0.31				
UK East	0.06	0.24				
UK London	0.08	0.28				
UK South	0.15	0.36				
UK Wales	0.03	0.17				
UK Scotland	0.06	0.23				
UK Northern Ireland	0.02	0.13				
SE Stockholm	0.07	0.26				
SE North central	0.06	0.23				
SE North	0.04	0.19				
SE South central	0.11	0.30				
SE South	0.06	0.24				

Annex IV. Full results

	UK		SE	
	M1	M2	M1	M2
Businessperson	**-0.051***	**-0.078***	-0.005	0.061
	[0.03]	**[0.04]**	[0.04]	[0.06]
Government official	**-0.209*****	**-0.305*****	**-0.095****	-0.061
	[0.03]	**[0.05]**	**[0.04]**	[0.07]
Issue Advocate	**-0.114*****	**-0.134*****	-0.048	**0.100***
	[0.03]	**[0.05]**	[0.04]	**[0.06]**
Negative		**0.306*****		**0.137****
		[0.04]		**[0.06]**
Businessperson*Negative		**0.218*****		-0.098
		[0.06]		[0.08]
Government official *Negative		**0.158****		-0.058
		[0.07]		[0.09]
Issue advocate*Negative		**0.207*****		**-0.300*****
		[0.07]		**[0.09]**
Organisation [N/Y]	0.027	0.027	**0.090*****	**0.090*****
	[0.02]	[0.02]	**[0.02]**	**[0.02]**
Age [Ref. 22 or less]				
23-27	-0.053	-0.04	-0.029	-0.022
	[0.08]	[0.08]	[0.11]	[0.11]
28-32	-0.098	-0.098	-0.13	-0.126
	[0.07]	[0.07]	[0.11]	[0.11]
33-37	-0.08	-0.087	-0.101	-0.094
	[0.07]	[0.07]	[0.11]	[0.11]
38-42	-0.104	-0.097	-0.133	-0.126
	[0.07]	[0.07]	[0.11]	[0.11]
43-47	-0.084	-0.09	-0.006	-0.001
	[0.07]	[0.07]	[0.10]	[0.10]
48-52	-0.167**	-0.170**	-0.089	-0.083
	[0.07]	[0.07]	[0.11]	[0.11]
53-57	**-0.200*****	**-0.208*****	**-0.219****	**-0.214****
	[0.07]	**[0.07]**	**[0.11]**	**[0.11]**
58-62	**-0.189*****	**-0.192*****	-0.113	-0.113
	[0.07]	**[0.07]**	[0.10]	[0.10]
63-67	**-0.193*****	**-0.197*****	**-0.269*****	**-0.267*****
	[0.07]	**[0.07]**	**[0.10]**	**[0.10]**
68-72	**-0.167****	**-0.165****	-0.104	-0.103
	[0.07]	**[0.07]**	[0.10]	[0.10]
73-77	-0.051	-0.073	-0.128	-0.126
	[0.08]	[0.08]	[0.10]	[0.10]
78-82	0.113	0.122	-0.044	-0.04
	[0.11]	[0.11]	[0.12]	[0.12]
83+	0.147	0.131	-0.035	-0.039
	[0.12]	[0.13]	[0.23]	[0.23]
Male [N/Y]	-0.021	-0.021	**-0.069****	**-0.068***
	[0.03]	[0.03]	**[0.03]**	**[0.03]**
Regions [UK ref: North // SE ref: South]				
UK Midlands	0.048	0.04		
	[0.04]	[0.04]		
UK East	0.035	0.029		
	[0.05]	[0.05]		
UK London	0.034	0.031		
	[0.05]	[0.05]		
UK South	0.014	0.006		
	[0.04]	[0.04]		
UK Wales	0.049	0.047		
	[0.07]	[0.07]		
UK Scotland	0.003	0		
	[0.05]	[0.05]		

UK Northern Ireland	0.032	-0.004		
	[0.07]	[0.07]		
SE North central Sweden			-0.065	-0.061
			[0.05]	[0.05]
SE North Sweden			-0.042	-0.037
			[0.07]	[0.07]
SE South cental Sweden			-0.035	-0.035
			[0.05]	[0.05]
SE Skane, Halland and Blekinge			-0.017	-0.015
			[0.05]	[0.05]
Political orientation				
Left-wing	**-0.113****	**-0.106****	0.054	0.062
	[0.05]	**[0.04]**	[0.08]	[0.08]
Slightly left-of-centre	0.005	0.006	0.116	0.117
	[0.05]	[0.05]	[0.08]	[0.08]
Centrist	-0.05	-0.037	**0.138***	**0.141***
	[0.05]	[0.05]	**[0.07]**	**[0.07]**
Slightly right-of-centre	**-0.144*****	**-0.138*****	0.057	0.058
	[0.05]	**[0.05]**	[0.07]	[0.07]
Right-wing	**-0.120****	**-0.118****	-0.057	-0.051
	[0.06]	**[0.06]**	[0.08]	[0.08]
Education [ref: University >2years]				
Upper secondary school/Secondary school	-0.045	-0.044	-0.023	-0.026
	[0.07]	[0.07]	[0.05]	[0.05]
Post-secondary education	-0.1	-0.096	-0.046	-0.044
	[0.09]	[0.09]	[0.06]	[0.06]
University/College courses 1-2 years	**-0.117***	**-0.118***	-0.008	-0.011
	[0.07]	**[0.07]**	[0.05]	[0.05]
Income [ref: Lower income]				
Middle income (75%-200% of the median)	-0.019	-0.018	0.02	0.02
	[0.03]	[0.03]	[0.05]	[0.05]
Higher income (>200% of the median)	0.01	0.017	**0.141*****	**0.143*****
	[0.04]	[0.04]	**[0.05]**	**[0.05]**
Constant	**0.265*****	0.082	**0.258****	0.166
	[0.10]	[0.10]	**[0.12]**	[0.13]
Log-likelihood	-3.51E+04	-3.49E+04	-2.07E+04	-2.07E+04
df	35	39	32	36
p-value	0	0	0	0
Observations	19290	19290	11700	11700

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Annex V. Robustness checks

	Model 1[a]		Model 2[b]		Model 3	
	Excl. Education		Excl. Income			
	UK	SE	UK	SE	UK	SE
Stakeholder type (Ref: Scientists)						
Businessperson	-0.053	0.062	-0.06	0.075	**-0.172*** **	-0.087
	[0.04]	[0.06]	[0.04]	[0.05]	**[0.05]**	[0.07]
Government official	**-0.280*** **	-0.059	**-0.284*** **	**-0.126** **	**-0.335*** **	-0.079
	[0.05]	[0.07]	**[0.05]**	**[0.06]**	**[0.06]**	[0.08]
Issue Advocate	**-0.112** **	**0.102* **	**-0.124*** **	0.084	**-0.194*** **	0.004
	[0.04]	**[0.06]**	**[0.04]**	[0.05]	**[0.06]**	[0.07]
Framing						
Negative framing	**0.331*** **	**0.138** **	**0.335*** **	**0.130** **	**0.216*** **	0.036
	[0.04]	**[0.06]**	**[0.04]**	**[0.06]**	**[0.06]**	[0.07]
Negative framing x Businessperson	**0.177*** **	-0.099	**0.191*** **	-0.108	**0.345*** **	0.055
	[0.06]	[0.08]	**[0.05]**	[0.07]	**[0.07]**	[0.09]
Negative framing x Government official	**0.130* **	-0.06	**0.148** **	0.032	**0.223*** **	0.02
	[0.07]	[0.09]	**[0.06]**	[0.08]	**[0.08]**	[0.11]
Negative framing	**0.167*** **	**-0.302*** **	**0.196*** **	**-0.272*** **	**0.397*** **	-0.085
	[0.06]	**[0.09]**	**[0.06]**	**[0.08]**	**[0.08]**	[0.10]
Ideology						
Ideology					-0.098	**-0.255** **
					[0.07]	**[0.11]**
Ideology x Businessperson					**0.232*** **	**0.465*** **
					[0.09]	**[0.13]**
Ideology x Government official					0.077	0.062
					[0.11]	[0.15]
Ideology x Issue Advocate					0.151	0.303**
					[0.10]	[0.13]
Negative x Ideology					**0.227** **	**0.318** **
					[0.09]	**[0.14]**
Negative x Ideology x Businessperson					**-0.315*** **	**-0.479*** **
					[0.12]	**[0.17]**
Negative x Ideology x Government official					-0.165	-0.25
					[0.14]	[0.21]
Negative x Ideology x Issue Advocate					**-0.468*** **	**-0.675*** **
					[0.14]	**[0.20]**
Individual-level control variables	YES	YES	YES	YES		
Scenario-level individual/organisation	YES	YES	YES	YES		
Log-likelihood	-37,000	-20,700	-44,700	-24,700		
df	36	33	37	34		
P-value	0.000	0.000	0.000	0.000		
Observations	20,430	11,700	24,820	14,010		

Note: [a]Model includes income as control and all other control variables (organization, age, male, regions, political orientation) but excludes education. [b]Model includes education as control and all other control variables (organization, age, male, regions, political orientation) but excludes income. Survey weights applied. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.01

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