Public uncertainties in relation to COVID-19 vaccines in the United Kingdom

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Abstract: Uncertainties about COVID-19 vaccines and variants have been linked to vaccination refusal on a significant scale. To optimise public health communication on vaccination and inform vaccination policy, it is necessary to understand the substantive nature of these uncertainties. Our study, using a corpus of texts from 324 UK citizens, examines these uncertainties. The results suggest that major public uncertainties regarding COVID-19 vaccines are expressed in terms of: (1) concerns about the safety of the vaccines; (2) concerns about the effectiveness of the vaccines; (3) perceived lack of trustworthiness and/or competence of actors in the vaccination process; (4) concerns about the logistics of the vaccination roll-out; and (5) uncertainty about the longer-term need for vaccines and social consequences. Public uncertainties regarding COVID-19 are complex and will continue to evolve. Policy responses must be informed by an understanding of the factors that instigate and maintain uncertainties in individuals and the wider society.

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Introduction

When COVID-19 was designated a global pandemic, most nations struggled to contain the virus. Large-scale vaccination was widely identified as a principal means of reducing both disease incidence and the risk of mortality in those infected. At the end of 2020, the first vaccines against COVID-19 began to emerge. The Oxford-AstraZeneca and Pfizer/BioNTech vaccines were approved for use in the United Kingdom in December 2020, with Moderna following in January 2021. Subsequently, attempts were made to vaccinate large parts of the adult population, with other vaccines also being deployed as they became available. Unsurprisingly, the potential impact of vaccination hesitancy (frequently abbreviated to 'vaccine hesitancy') or refusal upon the ability of countries to manage the spread of COVID-19 became a major concern. It was, at the time, unclear how many people would be vaccinated. Uncertainties that people had about COVID-19 vaccines and variants have been linked in the United Kingdom with vaccination refusal on a significant scale (Paul *et al.* 2021; Soares *et al.* 2021).

Vaccine hesitancy is a long-standing public health issue, including in the United Kingdom (Breakwell & Jaspal 2023). Research into attitudes and uptake in the context of other vaccines, such as Measles, Mumps, Rubella (MMR), show the powerful effects of misinformation, decreased knowledge and mistrust (Torracinta *et al.* 2021). All of these factors can generate vaccine uncertainty. Research on public acceptability of COVID-19 vaccination suggests that it is related to various social psychological issues (e.g., Bertin *et al.* 2020; Breakwell & Jaspal, 2023). Uncertainties about COVID-19 vaccines appear to be a key barrier to their acceptance. It is noteworthy that uncertainties about vaccines and about vaccination may be related but are not synonymous. The present study, using a corpus of short written texts from 324 individuals recruited in the United Kingdom, examines what uncertainties people have about COVID-19 vaccines and, coincidentally, about vaccination in general. To optimise public health communication on vaccination and inform vaccination policy it is necessary to understand the substantive nature of these uncertainties. Since the processes of COVID-19 vaccine choice and roll-out differed across the United Kingdom, we use qualitative thematic analysis and tenets of social representations theory to examine the specific elements of uncertainty in relation to COVID-19 vaccines.

COVID-19 vaccination hesitancy and socio-demographic factors

Many studies on the prevalence of vaccination hesitancy have used quantitative survey methods. A non-probability survey conducted in the United Kingdom just before the COVID-19 vaccination roll-out found that 16.6 per cent of respondents

were very unsure about being vaccinated and that 11.7 per cent were strongly hesitant (Freeman *et al.* 2020). Moreover, Neumann-Böhme *et al.* (2020), from a survey of seven European countries in April 2020, found that, in the UK sample, 79 per cent of respondents indicated that they would get vaccinated, 15 per cent were unsure and 6 per cent stated they would refuse.

In a nationally representative sample in the United Kingdom and Ireland, Murphy *et al.* (2021) found that females, younger people and those from lower socio-economic backgrounds were more likely to be vaccine hesitant and resistant, and that decreased trust in healthcare professionals and scientists were predictors of vaccine hesitancy. Moreover, those who relied on the mainstream media to acquire information about COVID-19 were less likely to be vaccine hesitant and resistant. These findings are consistent with those of Robertson *et al.* (2021), who also found that, although vaccination hesitancy was relatively low (18 per cent) in their UK sample, some ethnic minority groups (namely, Black, Pakistani and Bangladeshi respondents) had the highest levels of vaccination hesitancy. Some of the social psychological underpinnings of vaccine hesitancy in ethnic minorities in the United Kingdom have been examined elsewhere (Jaspal & Breakwell 2023).

Recent research into vaccination hesitancy has also focused upon the COVID-19 booster vaccine, showing the continued relevance of this issue. In their analysis of data from 22,139 fully vaccinated adults in the United Kingdom, Paul & Fancourt (2022) found that 4 per cent of the sample reported that they were uncertain about having the COVID-19 booster vaccine and that 4 per cent were unwilling to have it. Respondents who reported having no pre-existing health condition were more likely to report uncertainty or unwillingness. Lower levels of education, lower socio-economic status and being aged below 45 were also associated with increased uncertainty. In another study, Paul *et al.* (2021) found a 16 per cent prevalence of mistrust about vaccines in their sample, which was associated with lower levels of education, lower annual income and poor knowledge of COVID-19. Concerns about future unforeseen side effects constituted a major determinant of uncertainty regarding vaccination.

It is important to note that surveys of vaccination intentions and attitudes that focus on socio-demographic differences rarely examine the substantive details of the uncertainties about COVID-19 vaccines that their respondents hold. This is the focus of the present study.

Vaccine acceptance and social psychological processes

Social psychological processes appear to contribute to vaccine acceptance (Breakwell & Jaspal 2023). For instance, Robertson *et al.* (2021) note that belief in conspiracy theories regarding the origins of coronavirus (e.g., as a man-made laboratory-based

creation) is associated with decreased vaccine acceptance in UK-based research (see also Salali & Uysal 2022). Freeman *et al.*'s (2020) study echoed findings elsewhere that perceptions concerning the collective importance, efficacy, side effects and speed of the vaccine development predicted vaccination willingness. They also suggested that 'excessive mistrust' (i.e., belief in conspiracy theories, negative perceptions of healthcare professionals and negative healthcare experiences) predicted hesitancy. Similarly, Bertin *et al.* (2020) found in French samples that the endorsement of both COVID-19 conspiracy beliefs and general conspiracy beliefs were negatively related to vaccine acceptability.

Troiano & Nardi (2021) reviewed COVID-19 vaccine acceptance internationally and found that the most common reasons for refusing vaccination were: opposition to vaccination in general (an 'anti-vaxxer' stance); concerns about the safety and effectiveness of the vaccines (associated with believing that they were developed hastily compared to other vaccines); believing the virus harmless and, thus, that being vaccinated is futile; generally lacking trust in authorities (political, scientific, health-related); and conspiracy theorising regarding coronavirus itself.

Many competing representations of vaccination in general have emerged and have shaped both acceptability and uptake in the general population (Bish *et al.* 2011; Larson *et al.* 2014). Neumann-Böhme *et al.* (2020) found in several European countries that concerns about the efficacy and side effects of the vaccines constituted a key impediment to their acceptance. Similarly, Sherman *et al.* (2021) found that beliefs that the vaccine would cause side effects or be unsafe, and perceived deficiency in the information required to take an informed decision, were associated with lower vaccination intention in their UK sample.

In a qualitative study of twenty individuals in Bradford in the United Kingdom, where there was relatively low uptake of the COVID-19 vaccines, Lockyer *et al.* (2021) found that exposure to COVID-19 misinformation resulted in confusion, distress and mistrust in relation to the vaccines. Participants expressed safety concerns, negative accounts of others being vaccinated and negative beliefs that they themselves held about the vaccines, all of which decreased their own likelihood of being vaccinated. In their survey study based on data collected in late 2020, Jaspal & Breakwell (2022) found that access to social support was conversely associated with vaccination likelihood. They attributed this to the emergence and endorsement of vaccination as a collective social norm within support networks.

A qualitative study of twenty-four healthcare workers from two London hospital trusts revealed uncertainties in relation to the long-term safety of vaccines due to the belief that government decisions regarding the vaccination programme had not been based on evidence-based science; this adversely impacted the healthcare workers' level of trust and confidence in the programme (Manby *et al.* 2022). Similarly, another

qualitative study of sixteen ethnic minority individuals in the North East of England indicated mistrust based upon a perceived lack of scientific research underpinning vaccination development (Eberhardt *et al.* 2023). Brown *et al.* (2022) used interpretative phenomenological analysis to examine qualitative interviews regarding concerns about COVID-19 vaccine development. They found that uncertainties regarding the pandemic were associated with the desire for credible information regarding vaccines, which at the time they felt was unavailable. Specifically, there was a recurrent theme of uncertainty in relation to the speed of vaccine development.

A common thread runs through these studies: vaccination hesitancy is linked to belief systems that contest the effectiveness and safety of the vaccines but also tie into mistrust of information provided by those authorities responsible for managing the pandemic because those authorities are themselves mistrusted (Breakwell 2021). Indeed, in their study of 22,421 participants in the United Kingdom, Chaudhuri *et al.* (2022) found that negative attitudes (including mistrust) towards public officials and the government were associated with lower willingness to be vaccinated. Similarly, Roberts *et al.* (2021) found that lower levels of trust in decision-making and institutional truthfulness were associated with increased likelihood of vaccine refusal.

Social context and culture are also key determinants of how individuals will react to uncertainty in relation to vaccination. Lu (2022) observed that, in view of prevalent concerns about side effects associated with COVID-19 vaccination, people in cultures that are less tolerant of uncertainty are more likely to express vaccination hesitancy. Uncertainty is a significant component of thinking about vaccination hesitancy and thus must be investigated.

Studies do not generally differentiate between people who are certain that vaccines are ineffective and unsafe and those who simply say that they are not sure whether they are ineffective and unsafe. Yet this is a crucial distinction for public health interventions. The messages that will persuade the uncertain to be vaccinated will need differ from those directed at people who are certain in their negative beliefs. Redressing uncertainty is, in itself, an important task – one that is impossible without understanding the substance and content of those uncertainties.

Vaccination uncertainty and social media

Social media representations of the vaccines may have an important role to play in initiating and shaping uncertainties about vaccination. In their study based on a representative sample of 5114 individuals from the United Kingdom, Chadwick *et al.* (2021) found that news avoidance, social media dependence and conspiracy theorising were all associated with higher levels of exposure to online discouragement of

vaccination. A qualitative study of healthcare workers in London showed that the spread of misinformation regarding vaccines online was related to lower trust and confidence in the vaccination programme, especially among those at a junior level and those from ethnic minority backgrounds (Manby *et al.* 2022). Interestingly, Piltch-Loeb *et al.* (2021) found that those acquiring information from traditional societal channels of information, such as television and national and local newspapers, were more likely than those who relied on social media to accept the vaccine.

Social media usage may stimulate uncertainty about vaccines in at least three ways. First, they may offer many different, often contradictory, representations of the vaccines without guidance on their relative viability. Second, they may provide channels for vociferous one-sided anti-vaccination rhetoric. The anti-vax messages may not persuade but may confuse and create doubt or mistrust in those who would otherwise accept vaccination by offering apparently plausible reasons for doubt (Breakwell 2021). Third, they embolden people to acknowledge their own uncertainty by revealing how many others seem to share that uncertainty. Once it is openly shared, uncertainty can be regarded as socially justified or at least permissible.

Social representation processes and vaccine uncertainties

Moscovici (1988) argued that something unfamiliar is subjected to societal interpretations through negotiation and contention that produce social representations of it. A social representation is said to consist of a network of ideas, values and practices. Social representations enable people to make sense of the novel and previously unknown. Social representations often involve making something unfamiliar understandable by associating it with something already commonly understood (this is called *anchoring*) or, if it is inherently abstract, by linking it with something more concrete (this is called *objectification* and frequently involves the use of metaphors).

Social representations of COVID-19 and its vaccines have been studied as they have evolved (Páez & Pérez 2020). Social representations of the disease will evolve over many years (Jaspal & Nerlich 2020). It is already evident from the work on conspiracy theorising concerning most aspects of the pandemic (e.g., Douglas 2021) that the development of widely accessible, but competing, social representations of COVID-19 vaccines (e.g., Cordina *et al.* 2021) will heavily influence the forms and levels of uncertainty citizens have about vaccines.

Even when social representations of an object (e.g., vaccines) exist, individuals do not necessarily become exposed to them, or choose to pay attention to them, or, indeed, accept their veracity. Many factors will determine how an individual is affected by the existence of a social representation (Breakwell 2015a). One important factor concerns how the social representation relates to the individual's desire

to maintain self-esteem, self-efficacy, positive distinctiveness and continuity and thus identity resilience. Identity process theory (IPT) (Jaspal & Breakwell 2014; Breakwell 2015b) predicts that individuals will try to actively manage their engagement with social representations and their implications in order to maintain a positive evaluation of their identity (see also the article by Breakwell, this issue). When conflicting social representations of an object are present the individual has greater agency in determining what to access, accept and use.

Our study was designed to explore the diverse range of uncertainties that individuals are now recognising exist, with a view to identifying what social representational content and structure is emerging. We address this empirical question by drawing upon Breakwell's (2014) notion of personal representations, that is, 'the manifestation of a social representation at the level of the individual' (p. 120). Indeed, the present study was intended to elicit individuals' own personal uncertainties concerning COVID-19 vaccines. Identifying the prevailing uncertainties about COVID-19 vaccines is an important part of predicting how people will respond both immediately and in the medium term. Therefore, in this study we examine the personal representations evinced by individuals in their reported uncertainties, that is, those that they aware of, understand and accept (Breakwell 2014).

The present study

It is necessary to distinguish between being uncertain about whether to have any particular COVID-19 vaccination (sometimes labelled 'vaccine hesitancy') and uncertainties about the COVID-19 vaccines themselves. This distinction is important because uncertainties about vaccines may contribute to the social representations that people are motivated to accept and use about being vaccinated (see Breakwell 2014). This in turn will guide cognition, affect and, crucially, behaviour in relation to vaccination.

Our study was exploratory, aimed specifically at elucidating people's uncertainties about COVID-19 vaccines. Respondents provided free text responses within a survey questionnaire to a single question and we used thematic analysis to determine the range of different uncertainties that were described and their clustering within themes. Recognising the range and relationships of these uncertainties may provide the basis for more targeted health communication campaigns to improve vaccination uptake (Chevallier *et al.* 2021). In general, the studies reviewed in this article would suggest that uncertainties would focus upon two domains: efficacy and side effects. The aim is to understand emerging personal representations of uncertainty and their constituent elements.

Methods

Ethics approval

Nottingham Trent University's Schools of Business, Law and Social Sciences Ethics Committee provided ethics clearance for this study (REF: 2021/30). The study was conducted in accordance with the British Psychological Society Code of Ethics and Conduct. Participants provided electronic consent before completing the study.

Participants

Data collection took place in March 2021. By 26 March in the United Kingdom 45.2 per cent of the population had received one dose and 4.4 per cent had received two doses of a COVID-19 vaccine (NHS England 2021).

Using Prolific, an online participant recruitment platform, a sample of 324 (147 identifying as male, 173 as female, 4 non-disclosed) was recruited in the United Kingdom. The mean age of the sample was 32.02 years (*SD* = 10.679). The age range in the whole sample was skewed to people under the age of 50.

All respondents were asked to read the following text:

> The COVID-19 vaccines are new. They have only recently been authorised for use by medical authorities. Different vaccines have been reported to have varying degrees of effectiveness. The timetable for the vaccination being available for everyone is unclear. In your view, what are the five biggest uncertainties about the COVID-19 vaccines?

The factual statements about vaccines at the start of the question were presented in order to encourage people to acknowledge their uncertainties rather than to suppress them. It was also designed to allow for a range of uncertainties that respondents considered important to be described. Participants were asked to produce a short summary of the crux of their uncertainties and thus did not elaborate on them. Consequently, the analysis presented in this article does not provide a fine-grained linguistic analysis of the material they provided but rather a broader thematic analysis. It should also be noted that the timing of asking this question is an important determinant of the nature of participants' response. At the time, the COVID-19 vaccines were relatively unknown. This study therefore provides an empirical snapshot of uncertainties at that point in time.

Analytic approach

Qualitative thematic analysis, which has been described as 'a method for identifying, analysing and reporting patterns (themes) within data' (Braun & Clarke 2006, p. 78),

was used to analyse the data, using the analytic principles outlined by Jaspal (2020). In this study, themes in participants' reported uncertainties concerning COVID-19 vaccines were identified. A realist epistemological stance was employed and, accordingly, participants' reports were considered to reflect underlying cognitions. In particular, in the analysis, there is a focus upon experiential themes, that is, 'subjective viewpoints such as intentions, hopes, concerns, beliefs, and feelings captured in the data' (Ronkainen & Wiltshire 2021: 164). Clearly, other dimensions of participants' meaning-making, such as inferential themes and dispositional themes, which are also of relevance to realist enquiry, should be examined in data generated through other means. The approach we employed is useful in examining personal representations. Consistent with the qualitative thematic analysis approach employed, there was no attempt to quantify the 'prevalence' of particular observations (Braun & Clarke 2006; Jaspal 2020).

On the basis of prior research, summarised earlier in this article, we expected themes to have the following characteristics:

Structurally:
- Uncertainties expressed through unanswered questions.
- Uncertainties pertaining to the past, present and future.
- Uncertainties that involve direct personal consequences and those that affect others or society generally.

Content concerning:
- safety
- effectiveness
- logistics.

The corpus of textual data was analysed by the second author. Both researchers subsequently reviewed and discussed the analysis. The aim was to curb any potentially idiosyncratic interpretations of the data and to reach consensus and thus agree upon a single set of themes.

During each reading of participants' comments, all uncertainties listed by respondents were noted. These were examined to determine commonalities across exemplars. These were then collated into potential themes, which captured the essential qualities of the responses with the original research questions in mind. The list of themes was reviewed rigorously against the data to ensure their compatibility and specific extracts were listed against each corresponding theme. Five superordinate themes that reflected the analysis were specified and are described next.

Results

As stated, responses fell into five superordinate themes (some respondents produced several answers that fitted within a single theme). Within each theme, there were subsets of uncertainties. The majority of the uncertainties were posed as questions. The objective of this qualitative study was to examine the structure and content of uncertainties regarding vaccines rather than to quantify how many people described each uncertainty theme. However, it is noteworthy that virtually everyone mentioned theme 1 (safety) and theme 2 (effectiveness). The majority of respondents mentioned some aspects of themes 3, 4 and 5.

Each of the five themes encompasses a variety of important questions. The questions listed are excerpts taken from the texts produced by respondents.

1. **Uncertainties about the safety of the vaccines**

   Respondents expressed uncertainties about the safety of the vaccines, which featured concerns regarding the speed at which the vaccines had been developed, the risk associated with use of an mRNA base and possible side effects, especially for particular groups. Overall, there was a perception that the vaccines would not be safe for use in the general population.

   - Have they been tested/trialled rigorously? How could they be developed so quickly? Respondents knew that they were being told that the vaccines had been trialled sufficiently, but they were uncertain about how this could have been achieved so quickly.
   - Is the use of an mRNA base for vaccines scientifically sound? Respondents were unfamiliar with the technology and were uncertain about the meaning of the information that they had available.
   - What side effects do they have (immediate or long term)? Particular concerns raised included potential interactions with other medications, allergies and effects on fertility or mental health. References to previous unanticipated long-term side effects of medication were made (e.g., the effects on foetuses of thalidomide). It is notable that this is an example of anchoring described in social representations theory.
   - Do they pose a differential risk for varying subgroups (e.g., the immune-suppressed, disabled, Black, Asian, and Minority Ethnic (BAME) people, pregnant women, children)? In posing this question, respondents were not simply repeating issues that were being raised in the media at the time. Some respondents gave examples from their personal experience of people, from such categories, who had become ill after having the vaccine.

- What is in it? The fact that different vaccines were based on differing complex biotechnologies raised for some respondents an uncertainty about what was actually in any one of them and why they were different. Not knowing what they were being expected to have injected into themselves bred other uncertainties about the unknown effects of the vaccines.

2. **Uncertainties about the effectiveness of the vaccines**

The effectiveness of the vaccines was pervasively questioned in participants' accounts of their uncertainties. These focused upon how well the vaccine would work, whether it would work equally as well across all groups and how long the vaccine would last.

- What is the evidence that they are effective?
- Are they effective for everyone?
- Does everyone need to have the vaccine?
- How do they work for people who have already had COVID-19?
- Will the virus adapt to vaccines?
- Which vaccine is best?
- Will vaccines be effective against new variants?
- What is the risk of a new deadly variant arriving before the vaccine roll-out is complete?
- Can foreign vaccines that are imported cause or introduce new variants?
- Can different vaccines be mixed?
- Is one dose effective? This uncertainty was associated with uncertainties about implications of the decision taken by some governments to offer one dose or to lengthen the gap between dose 1 and 2.
- What is the right dosage and what is the wastage rate?
- How quickly do these vaccines 'wear off'?
- Do vaccines protect or prevent? Does it stop you catching the virus or passing it on? Particular concerns included how long after vaccination before protection develops; if vaccinated can you still transmit the virus; effects on death rates; do they stop the spread of COVID-19; and do they provide herd immunity.
- Will life get back to normal once everyone is vaccinated? This clearly ties into the broader question of whether the vaccines solve the crisis.

Most of these effectiveness uncertainties are clearly linked to questions about the factors that may directly influence both the efficacy and effectiveness of the vaccines. Yet, it is notable that respondents were also indicating how uncertain they were about the longer-term societal effects of the use of the vaccines.

3. **Uncertainties about the trustworthiness and/or competence of actors in the vaccination process**

    There were concerns about the trustworthiness of actors involved in the vaccination process, most notably scientists and politicians but also pharmaceutical companies. It appeared that vaccination uncertainty was being anchored to general mistrust of these actors.

    •   Are the data on vaccines trustworthy? Are data on the vaccines being deliberately misrepresented? This question was sometimes voiced with others that suggested the respondent believed misrepresentation was occurring.
    •   Scientists have hidden motives. Who can give us unbiased science information?
    •   Are the companies producing them to be trusted?
    •   Are pharma companies indemnified?
    •   Is the government acting quickly enough and in the right way? This was often associated with fairness and equality issues in the prioritisation of the subgroups to be vaccinated.
    •   Can government figures on the numbers vaccinated be trusted?
    •   Is there corruption behind the scenes?
    •   Did scientists/medics know about COVID-19 long before disclosure (tied to speed of development of vaccines)?

    Some of the questions just listed are not concerned with uncertainties about the vaccines per se but rather about the legal and socio-political context in which vaccine information was produced. Other responses, not phrased as questions, emphasise these concerns:

    •   Journalists speculating mean the public is poorly informed.
    •   Information is confusing, unreliable, missing and/or conflicting.
    •   Disinformation and fake news effects on public confidence and behaviour.

4. **Uncertainties about the logistics of the vaccination roll-out**

    In view of the novelty of COVID-19 vaccines and the unprecedented challenge posed by quick vaccination roll-out in order to manage the pandemic, respondents expressed uncertainty about the logistics of the vaccination roll-out.

    •   How many will get the vaccine?
    •   How fast will the roll-out be?

- Will the NHS 'break'? This clearly echoes a phrase repeatedly used in mass media at the time predicting that the NHS could not cope with the demands of vaccination roll-out and COVID-19 patient treatment.
- Will people behave irresponsibly after having the vaccination?
- What does vaccination cost?
- How will vaccines be distributed globally?
- How will shortages and availability be handled?
- How will anti-vax sentiment be dealt with?
- Who will refuse vaccination?

5. **Uncertainties about longer-term need for vaccines and social consequences**
   A common source of uncertainty focused upon how long the pandemic would actually last – more specifically, whether there would be a long-term need for vaccines and, if so, what the social consequences of this need would be.

- Will vaccination be mandatory in the future?
- Will we need vaccine passports?
- Will we have to take them forever?
- Will they be annual? How often will they be needed?
- Who will have to pay for vaccination in the long term?
- Will people be reckless if they believe everyone is vaccinated?
- What will be the impact on travel – in the present and over time?
- Will the vaccinated be tracked?
- What are the ethics of testing for the virus? What are the ethics of compelling vaccination for those incapable of informed consent (e.g., children)?
- With vaccination, will other precautionary behaviours be unnecessary?

Discussion

The thematic analysis reveals the complexity of the web of uncertainties about COVID-19 vaccines in a relatively young sample of people in the United Kingdom. Although there were relatively few participants aged 50 and over, we believe that the focus on younger people is also valuable, especially as there was generally less concern about the effects of COVID-19 infection in this population (i.e., lower perceived risk) (Barber & Kim 2021). Furthermore, in the United Kingdom, younger people were more likely to have been infected during the Delta variant period, indicating that the infection rate was higher for this group (ONS, 2023). There is also evidence that in the United Kingdom younger people were generally more vaccine hesitant

(Murphy *et al.* 2021; Paul & Fancourt 2022). It is also noteworthy that the data were collected at one point in time – in March 2021 when the COVID-19 vaccine roll-out was not yet complete. This empirical snapshot of COVID-19 uncertainties is important because it tells us about the content of a nascent common social representation regarding people's vaccination concerns at an early point in the pandemic and the lessons learned could in turn enhance future pandemic preparedness, including future vaccination roll-out. Indeed, the commonality of uncertainties between COVID-19 vaccines and those in relation to other diseases is striking (e.g., Torracinta *et al.* 2021).

The question we asked participants was designed to elicit the most important uncertainties that they recognised. Although we provided examples of uncertainties expressed in public discourse concerning the vaccines at the time, some of which were also cited by participants themselves, there were others. The data may not reflect all of their uncertainties – some of those omitted by participants may be of little personal significance even though they exist. This study deals only with those that matter to participants and that they decided to disclose. Although it is acknowledged that they may have had other uncertainties, it is likely that participants were disclosing the vaccine uncertainties that they subjectively deemed to be significant at a specific point in time during the pandemic. These uncertainties would undoubtedly be shaped, at least in part, by broader social representations circulating at that time. Social representations, of course, evolve and develop in accordance with time and context (Jaspal & Nerlich 2020).

Our sample was concerned not only with issues of safety or effectiveness, even though these were present. These uncertainties were located in the context of uncertainty about the trustworthiness of those people and organisations determining what vaccines were used and how they were used (Breakwell 2021). Participants were looking towards the future implications of vaccination for the behaviour of other people and for legislative, health and commercial systems. Respondents' answers show the complexity of the public uncertainty. The distinct elements concerning safety, effectiveness, trustworthiness, logistics and the long-term need of the vaccines reflected the personal representations of uncertainty observable in the sample.

The amount of mass media emphasis upon COVID-19 vaccines, and specifically upon the questions surrounding their development and use, had, by the time of data collection, offered ample opportunity for respondents to be exposed to aspects of alternative and elaborate social representations of the uncertainties attached to the vaccines. However, no single dominant (hegemonic) social representation of the COVID-19 vaccines had emerged. Personal representations appeared to coalesce around safety, effectiveness, trustworthiness, logistics and the long-term need of the vaccines. Individuals are likely to differ in the elements of the available social representations that they access and use (Breakwell 2014). Our analysis is not

focused on these individual variations. The thematic analysis produces a composite image of the contributions from all of our respondents. The aim of this study was to examine themes that might contribute to an emerging social representation of vaccine uncertainty. However, during the process of the analysis it was clear that there was variation across individuals in the uncertainties they reported. In future research it would be valuable to examine this individual-level variation, which could be explained in terms of identity processes since individuals will select, reject and use those social representations that provide them with a positive sense of identity (Breakwell 2015a).

Social representations can be described in terms of their core and peripheral components (Abric 1993). Our analysis does support our initial expectation that safety, effectiveness and logistics questions would be important domains for vaccine uncertainty. These could be regarded as elements in the core system of the social representations of the vaccines. They have, of course, been reflected in debates concerning other vaccines (Chatterjee & O'Keefe 2010). These themes clearly subsumed many subsidiary issues. In addition to what was happening in the present (e.g., who was eligible for the vaccination), these were couched in terms of both what had already happened (e.g., where did the virus come from?) and what would happen in the future (e.g., would vaccination be made mandatory?). Personal representations of uncertainties stretch through time. They also encompass uncertainties that have direct personal relevance (e.g., if I'm vaccinated, will I be able to travel abroad?) and those that impact on the broader community (e.g., how will anti-vax sentiment be dealt with?). These corollary questions or elaborations could be considered the peripheral system of the social representation. They also show the multiple levels at which vaccination hesitancy must be considered, as well as the multiple levels of identity – individual and collective – that matter (Breakwell 2021).

Any social representation of vaccine uncertainties may be expected to evolve as the COVID-19 pandemic and its management changes. Social representations respond to events (even if only to deny the reality of an event). Consequently, we would expect that, while the core system of social representations of vaccine uncertainties may remain, the peripheral system would be reshaped. For example, the uncertainties concerning the greater mobility rights allotted to the vaccinated might be alleviated by clear government guidelines. Thus, the focus of uncertainty may be readjusted. It will require time series data to monitor how these changes in the social representations of uncertainty evolve. The uncertainties expressed by participants at this particular point in the pandemic focused largely on concerns in relation to safety, effectiveness, trustworthiness, logistics and the long-term need of the vaccines, but the salience of these elements of uncertainty may have changed during the course of the pandemic as novel information came to light and as some information was revealed to be (in)accurate.

In any pandemic context, the evolution of uncertainties needs to be studied over time, ideally using longitudinal methods.

The most notable feature of the way in which uncertainties were expressed in our study is that they were mostly presented in the form of questions. A minority of respondents, having stated a question, went on to elaborate why they thought it important (e.g., the information provided is confusing, unreliable, conflicting or missing). The vast majority simply listed their uncertainties. There seem to be several types of question that appear. It is possible to distinguish between the unanswered and the unanswerable questions or between the unanswered questions and the questions with unaccepted answers. It seems reasonable to assume that respondents recognised these distinctions but this does not mean that the questions lost their significance in precipitating vaccine hesitancy. Simply recognising that no one could answer their questions could give rise to doubt about the value of being vaccinated. The apparent inability or unwillingness of recognised authorities to offer answers could also engender mistrust and further uncertainty (Vullioud *et al.* 2017). Indeed, Breakwell & Jaspal (2021) found mistrust and uncertainty in regard to COVID-19 to be strongly related.

The range and complexity of uncertainties were wider than those we originally expected, namely uncertainties expressed through unanswered questions, uncertainties pertaining to the past, present and future, uncertainties that involve direct personal consequences and those that affect others or society generally, and uncertainties around the safety, effectiveness and logistics of the vaccines. The majority of respondents presented a list of related and interacting uncertainties and these were well articulated. There was much coherence in responses. People apparently had previously thought about these uncertainties and this is not surprising given the active social representation processes ongoing in public debates (Nerlich & Jaspal 2021). Rationality rather than emotion was at the forefront of participants' responses. They did not spontaneously report their emotional reactions to their uncertainties, nor did they suggest how they would like their uncertainties to be addressed.

Our data do not provide a direct insight into how uncertainties might be assuaged. Others have sought to address this question using other research methods (e.g., Brown *et al.* 2022). However, they do reflect the notion that people in the United Kingdom were very alert to the complex questions surrounding the vaccines. The findings of this study tell us that concerns about safety, effectiveness, trustworthiness, logistics and the long-term need of the vaccines could become barriers to getting vaccinated. This suggests that assuaging these concerns directly could have a positive effect on people's decision-making in relation to vaccination. However, in order to establish how this awareness might motivate willingness to get vaccinated and subsequently to follow behavioural guidelines, it will also be important to examine the association of uncertainty with key emotions (e.g., fear). Powerful negative emotions, such as fear and

anxiety, can block the assimilation or use of information that might reduce uncertainty and improve vaccine take-up (Meijnders *et al.* 2001). Incidentally, social representations can also precipitate particular emotional responses, essentially shaping the way in which people 'ought' to feel in response to a stimulus (Wagner & Hayes 2005).

Our qualitative thematic analysis revealed a common pattern of vaccine uncertainty and the five themes that we identified represent the basis for a nascent common social representation of vaccine uncertainty present in the United Kingdom. These results are important because they enable us to identify the content of this representation. The uncertainties described include themes that cover the broad societal significance of usage of the vaccines and the trustworthiness of their developers, manufacturers, distributors and advocates. Uncertainty centred on mistrust, not only of the vaccines themselves but of the system offering them, is common and may be a crucial factor in shaping vaccination choices (Moore *et al.* 2021; Petersen 2021). Indeed, in addition to concerns about the vaccines themselves, participants expressed uncertainties regarding the trustworthiness and/or competence of different actors in vaccination process, the logistics of the vaccination roll-out, and the longer-term need for vaccines and their social consequences. These uncertainties all concerned the broader system offering the vaccines.

However, it is not inevitable that these uncertainties will result in vaccination refusal. People regularly make choices in favour of some course of action despite their uncertainties because they are driven by social or institutional pressures (see Breakwell *et al.* 2021). Although the effects of unwarranted certainty cannot be deduced from this study due to its design, there is some evidence that communicating with unwarranted certainty about vaccines can lead some people to report a greater loss of trust and vaccination intention – perhaps because the source of the information is generally not trusted (Batteux *et al.* 2021). In three experimental studies, Vullioud *et al.* (2017) found that participants were more likely to follow advice received from a confident (versus unconfident) source, but that, once the advice was revealed to be misguided, they shifted their trust to the initially unconfident source. This shows the mutability of trust based upon levels of uncertainty – in both the source and the perceiver. We need more evidence on the relationship between different forms of vaccine uncertainty and actual decision-making and action. Future research should examine how patterns of uncertainty about vaccines are related to degree of uncertainty about vaccination intentions and, indeed, actual refusal of vaccination.

The personal representations of vaccines reported by respondents are not static. New contributions to it are made and other elements are discarded all the time. This is a typical product of social interactions. Indeed, social representations differ in their status – they may be coercive and pervasive or contested and peripheral (Moscovici 1988). Individuals in our sample reported only aspects of social representations of

vaccines operating in their social context. An image on a screen is made of many individual pixels, each playing its part, and each subject to removal and substitution so that the image can change. Personal representations of vaccine uncertainties will be comprised of many elements metaphorically similar to those pixels. Most individuals will 'see' and report only some of those pixels. The reasons for focusing on some pixels over others cannot be deduced from this study, but IPT (Breakwell 2015b) proposes that these differences between people will not be random. They may be motivated by the individual's desire to maintain self-esteem, self-efficacy, positive distinctiveness and identity continuity. People do have the room to choose elements to concentrate on and, in so doing, justify or motivate their course of action regarding vaccination.

Limitations

Before drawing conclusions from our study, we wish to acknowledge that conclusions are inevitably affected by the design and method we adopted. First, using an online survey recruitment method is likely to explain the skewed age range of the sample (to those below 50 years). This study provides insight into some of the key uncertainties expressed by younger people and the findings cannot be generalised to other age groups. It is unclear whether including an older age range would have substantially changed our findings. However, the cost-benefit of vaccines for older age groups could be an important factor in shaping social representation access and use. This is an important agenda for research into vaccine uncertainties. Second, the technique for eliciting uncertainties may influence the conclusions that can be drawn. We used a direct question about vaccine uncertainties that was designed to indicate that uncertainties could be expressed. We were aware that this might have primed a particular focus on the novelty and effectiveness of the vaccines. In practice, if there was a framing effect, it did not deter people from reporting a broad range of uncertainties beyond that frame. This study should be complemented by other more 'bottom-up' approaches to data generation. Third, it could be argued that we focus too exclusively in this study on uncertainties. It may have been valuable also to ask about certainties. Comprehensive social representations of the vaccines would be likely to include both certainties and uncertainties, though it is possible that, in this highly contested domain, finding any social representation in which certainties and uncertainties were given equal space would be difficult. Fourth, it should be noted that participants were asked to summarise their main uncertainties. This generated brief observations, which precluded a fine-grained linguistic analysis of their accounts. Future research should examine these uncertainties using other data generation methods, such as interviews, whose data would be suitable for other data analytic techniques, such as

discourse analysis. Finally, the data do not provide insight into the affective dimension of the uncertainties expressed. Indeed, this is an important aspect of uncertainties (Breakwell 2021).

Conclusions

This study provides some insight into vaccine uncertainties in a relatively young sample of individuals in the United Kingdom. Respondents were clearly aware of a large range of uncertainties that can be organised around five themes: safety, effectiveness, trustworthiness, logistics and societal consequences. They were concerned with uncertainties lying in the past, present and future. They posed the questions that they felt were unanswered or not answered acceptably. They showed that they regarded it as legitimate to ask and to want answers to these questions.

The novelty of this study lies in its identification of the content of a nascent common social representation of vaccine uncertainty at one particular point during the pandemic. This can enable policymakers to focus on addressing these uncertainties with confidence in view of the scientific evidence, while noting that these uncertainties will inevitably evolve in accordance with time, space and individual identity concerns (Breakwell 2021). Failure to provide answers inevitably strengthens the basis for vaccine hesitancy or refusal, especially in view of research demonstrating that one is more likely to follow the guidance from a confident information provider, provided of course that the advice is not later revealed to be misguided (Vullioud *et al.* 2017). The identification and contextualisation of uncertainties in a time of great risk and danger is very important in shaping attitudes and behaviour.

Personal representations of the uncertainties of COVID-19 vaccines have many implications for health policy and its implementation, both in the COVID-19 pandemic and in future pandemics. It would be beneficial to focus upon addressing major uncertainties in relation to COVID-19 vaccines in public health communication. Campaigns to promote COVID-19 (and perhaps other forms of) vaccination should actively engage with the uncertainties that surround vaccines. Acting quickly throughout the pandemic and its aftermath to give information and reassurance that can be validated and deemed trustworthy seems essential (Vullioud *et al.* 2017). Our study showed fairly consistent patterns of uncertainty in sample. Although our study focused upon the United Kingdom, it should be noted that that uncertainties do not respect national borders, so policymakers should work together internationally to address uncertainties. The international decision to shift categorisation of COVID-19 variants from country names to letters of the Greek alphabet was an example of this (Breakwell *et al.* 2022). The mass media and the social representations that they

disseminate operate across geographical, cultural and linguistic boundaries. There is a need for ongoing monitoring of emergent uncertainties throughout a pandemic. Preparedness for future pandemics will involve establishing international systems for tracing uncertainties to their sources and tracking their development over time and geographies. It will require nations to work together to assuage uncertainties using multiple channels of communication, ensuring public engagement.

It is unlikely that ignoring public uncertainties or labelling them as a product of ignorance or derived from ulterior motives will be helpful (Jaspal & Nerlich 2022). Stigmatising uncertainty will not make it go away. In fact, responding to uncertainty aggressively or with disdain may just confirm public doubts about the trustworthiness and motives of the authorities promoting vaccination. It may further substantiate the conspiracy theories that have abounded during the pandemic. Our work emphasises that uncertainties do not sit in isolation, they form systems manifested in many questions and sustained by social representation processes. They may also reflect individuals' own identity concerns.

The results of this study suggest that responses to uncertainties need to be informed by gaining an understanding of the factors that instigate and maintain uncertainties in individuals and in wider society. Monitoring of uncertainties needs to sit alongside modelling their sources. We did not model in this article the influences (e.g., social media exposure, interpersonal contacts, educational experiences, emotional states or traits etc.) that may have influenced individuals' personal representations of the uncertainties surrounding COVID-19 vaccines. This needs to be done systematically to support pandemic control policies in the future. While vaccine uncertainties may not always be the sole or direct predictors of acceptance of vaccination (Breakwell & Jaspal 2023), it will be important to identify when they are and how to address vaccination hesitancy moving forward.

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