To download or not to download the Covid-19 Track and Trace App? What is more influential in users' minds?

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ABSTRACT

Objectives: to investigate the role of values in technology acceptance in general and in the context of the UK Covid Track and Trace App.

Methods: A survey and interview study was conducted to elicit users' perceptions of values in general, values in relation to choice of IT products and values which were influenced the decision to download (or not) the NHS Covid-19 Track and Trace App. Other non-value issues such as utility, price and recommendations were considered.

Results: Users' value in life differ slightly from those considered important for selecting IT products. For general IT product decisions, functionality, trust and price with values equality, security and sustainability were important. For the Covid-19 App decision two values, helpfulness and equality, with recommendations/trust and operating system compatibility, were the main influences. Interview data indicated that downloader users were motivated by social responsibility and utility – being able to access workplaces and leisure venues – while non-downloaders had little perceived need for the App, combined with mistrust of the App's provenance (NHS and the Government) linked to security and privacy concerns. The implications for values in technology acceptance decisions are discussed.

1. Introduction

The importance of values in human computer interaction as influences on user interface design and product choice has been advocated in several studies (Hassenzahl, 2004; Friedman, 2008; Shilton, 2018). Values have also influenced user experience and technology adoption research as 'hedonic' constructs (Diefenbach and Hassenzahl, 2009; Magni et al., 2010). Value-sensitive design (Friedman, 2008) proposed a process for eliciting users' values, feelings and attitudes to potential designs. Values and affective responses have been investigated by Cockton et al. (2009) in worth maps, which attempt to document stakeholders' values and views about products or prototypes. While some have argued for taxonomies of values to support eliciting users' requirements in design (Friedman, 2008; Kheirandish et al., 2020), others have advocated co-design or participatory approaches where not only values but other issues, such as needs, beliefs and attitudes, should be considered in a more holistic, worth-oriented view of design (Le Dantec et al., 2009; Borning and Muller, 2012; Cockton, 2020b).

Technology Acceptance Modelling (Venkatesh and Davis 2000; Marangunić and Granić, 2015) has demonstrated the importance of perceived utility and usability in determining acceptance and probable use of IT products, although more antecedent contextual factors have been progressively added to earlier models, such as subjective norms, convenience and values including hedonism (Williams et al., 2015; Yousafzai et al., 2007). However, little consensus has emerged on the antecedent variables which should be included in TAM models and recent reviews indicate that sector specific models, i.e. in health or education may be the way forward (Nadal et al., 2020; Granić, and Marangunić 2019). In spite of these reference to values in some TAM models, the state of the art on understanding the role of values in user behavior when choosing or interacting with technology has not progressed beyond the more obvious implications of privacy and security concerns. Furthermore, the role of values, requirements and other contextual influences on users' product choice is not clear. Our goal is to provide evidence about how values and other variables may influence users' choice of IT product within the established perspective of

usability and utility (Davis, 1989; Venkatesh and Bala 2008), thereby connecting values to their implications for design.

The Covid epidemic has created a natural 'field experiment' to test the influence of values on users' decisions to download and use track and trace software. TAM has been used as a theoretical grounding in Covid App acceptance in several survey studies (Velicia-Martin et al., 2021; Fox et al., 2021; Tomczyk et al., 2021) with inconsistent results, although value-based privacy and security as well as utility and fear of Covid were common influences.

In this paper we report an empirical study on values and other variables which may influence users' decisions to download and use the UK Covid-19 Track and Trace (T&T) App, while setting our investigation into a wider perspective of how values and other variables may influence users' choice of IT products more generally. The wider perspective relates to the role of TAM (Davis, 1987; Venkatesh and Bala, 2008) and other models (Freidman and Kahn, 2007) in accounting for the diversity of issues users may consider in product choice, and the cognitive process that users may adopt in making a choice, anchored in the dichotomy of system I (fast-path) v system II (slow-path) decision making (Kahneman, 2011). Our investigation is motivated by three exploratory research questions:

RQ1. Are users' generally held values in life consistent with the values they use in decisions to adopt IT products?

RQ2. What is the relative influence of human values and other variables in determining acceptance of IT products?

RQ3. What are the influences of users' values and other variables on their decision to download and use the UK NHS Covid-19 Track and Trace App?

While the synthesis of TAM and value-based influences is the prime motivation for our study, we also wished to contrast general theories of technology acceptance, such as TAM, with a theoretical perspective on the individual's process of decision making, i.e. fast/slow-path or system I/II decisions (Kahneman, 2011), to investigate whether the range of variables that influence users' decisions on Covid App adoption in general also appear in snapshots of how individual users make adoption decisions. Decision Making Theory (Cacioppo et al., 1986; Kahneman, 2011) asserts most people, most of the time, make fast-path choices based on a few salient attributes and little conscious effort. In contrast, slow-path choices are evaluated more carefully with trade-offs and mental models of the choice space (Johnson-Laird, 1983). Given the risk and serious nature of Covid we expected download adoption decisions should be made after extensive consideration, i.e. slow-path decisions involving reasoning about trade-offs between privacy, security and other values such as public benefit (altruism), in contrast to fast-path simple trade-offs between perceived need and risk. This motivation stimulated a fourth research question and associated hypothesis:

RQ4. How are the values and other influences present in general models employed in specific instances of decisions to adopt Covid Track and Trace Apps ?

H1. People will adopt slow-path decision making for Covid App adoption more frequently than fast-path decisions.

In following sections of this paper, we first review research on values and related issues in information systems (technology acceptance models) and human computer interaction. Then we report a survey and interview study of users' perception of values and other influences in relation to users' IT product decisions generally and download decisions for the Covid-19 Track and Trace App. We conclude with a discussion on how the influence of values should be set in the context of IT product choice and users' decision making.

2. Related work

In this section we review research on values and value-oriented analysis methods in HCI and systems analysis, followed by a comparison of other decision influences on product acceptance as antecedents in technology acceptance models, with a third section on the product choice in the Covid context which frames our study.

2.1. Values and value-oriented analysis methods

Schwartz's (1999) influential value theory defined values as "guiding principles in the life of a person or group". His-taxonomy of ten basic values is organised into four higher-order motivational categories: openness to change, self-enhancement, conservation and self-transcendence. Rokeach (1973) who defined values as "enduring beliefs that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence", proposed 18 instrumental values (personal characteristics) and 17 terminal values, essentially general lifestyle goals such as happiness, pleasure, equality, freedom. Motivation theory (Maslow et al., 1987) proposed six need-based categories which intersect with Schwartz's values: physiological needs, safety needs, social belonging, self-esteem, self-actualisation, and transcendence. Related to motivation are taxonomies of needs (Sheldon et al., 2001) describing value-related constructs such as autonomy/independence, competence/effectance, relatedness/belongingness, influence/popularity, pleasure/stimulation, security/control, physical thriving, self-actualising, self-esteem/self-respect, money/luxury. In their review Cheng and Fleischmann (2010) produced a consensus summary of 16 value categories drawn from six taxonomies with a management background, five from personal psychological perspectives, including Schwartz and Rokeach, and value-sensitive design (Friedman, 2008; Friedman and Kahn, 2007). Their merged taxonomy includes a mix of personally related attitudes, such as freedom, honesty and creativity, with broader societal concerns for social order, justice and equality. In VCIA (values and culture informed approach), Pereira and Baranauskas (2015) proposed a method for analysing values, culture and ethical influences of stakeholders on requirements in participatory design.

Mougouei et al. (2018) and Whittle et al. (2019) have drawn attention to values and related phenomena, with some evidence about how values influence users' goals and decisions to accept IT products in specific domain/application contexts (Mougouei et al., 2018; Perera et al., 2019, 2020). Value-Based Requirements Engineering (VBRE: Thew, 2015; Thew and Sutcliffe, 2018) described a scenario-based analysis with a taxonomy of values and motivations as an elicitation guide, supplemented with hints on potential design implications. Values have also attracted considerable attention in AI as a consequence of bias in classifiers and ethical issues in robotics (Paiva et al., 2017; Bellamy et al., 2019). Software engineering research has favoured *a priori* value-driven analysis for operationalising the implications of values in software design (Mougouei et al., 2018; Whittle et al., 2019; Penzenstadler et al., 2018). The Schwartz taxonomy was applied in a case study deconstructing the European data privacy regulations (GDPR) (Perera et al., 2019) showing the dependencies between values such as privacy, trust, transparency, accuracy and legality. Further case studies have illustrated how the impact of values depends on organisational culture (Perera et al., 2020). Zradkovic et al. (2015) surveyed values in distance education applications, reporting that universalism (ethics), benevolence, self-determination (play), achievement and stimulation (play-fun) were important influences. Value-related social and political issues have been developed into guidelines for recognizing affective reactions among stakeholders (Ramos and Berry, 2005) and applied to analysis in terms of cultural attributes such as power distance and individualism (Viega et al., 2001). Apart from isolated examples (e.g. Krumbholz et al., 2000), few reports of value-based cultural implications have emerged,

although socio political issues including values such as sustainability can influence product design through influences of users' social norms (Van er Velden 2016)

2.2. User experience, values and worth

In human-computer interaction (HCI), value-sensitive design (VSD: Friedman, 2008) provided a process for eliciting user values with scenarios and storyboarding techniques. VSD adopted an open ended view of values with a initial taxonomy while allowing for emergence of other values through scenario analysis of product use cases. A more holistic view of value(s) as 'worth' proposed by Cockton et al., 2009 considered trade offs between positive and negative variables that contribute towards an overall assessment of product quality. Derivation of worth could be realised by articulating the impact of product design on outcomes in means end chains while worth maps (Cockton, 2020a) documented stakeholders' views about products or prototypes expressed as feelings, values and attitudes. Worth maps may include values and emotional responses, but their main focus, similar to VSD, is to elicit informal descriptions of potential products expressed in stakeholders' language of feelings, values and attitudes. Value-related constructs in User Experience (UX) that contribute to users' overall judgement of IT products, have been identified as usability, service quality (similar to utility), classic and expressive aesthetics (Lavie and Tractinsky, 2004), while pragmatics (an amalgam of utility and usability) and hedonics were proposed by Hassenzahl (2004) as antecedents to judgement of general product qualities of 'goodness' and 'beauty'. In a recall study of mobile phone experiences Tuch and Hornbaek (2015) investigated the relationship between UX hedonics and pragmatics and Herzberg's (1968) hygene factors motivation theory finding that hedonic qualities of utility and convenience tended to be more positive motivations, whereas negative perceptions of technical quality and price were more pragmatically oriented. While no overall consensus of variables influencing overall judgement has emerged in UX research (Bargas-Avilia and Hornbæk, 2011), the more important components appear to be utility/pragmatics and aesthetics/hedonics (Diefenback and Hassenzahl, 2009; Lavie and Tractinsky, 2004; Hartmann et al., 2009). In a study of product acceptance among medical students, Hart and Sutcliffe (2019) found that functionality of the device (iPAD) and apps was the most important influence on acceptance, and useful functions overcame poor perceived usability. However, contextual factors such as no perceived need, lack of training and poor fit with working practices also influenced rejection. While value analysis with *a priori* categories has influenced several studies (Nadal et al., 2019; Kheirandish et al., 2020); others have argued that values have to be analysed in context with understanding constructed with users (Le Dantec et al., 2009; Borning and Muller 2012; Cockton, 2020a). The latter more holistic views of value argue that designs need to be evaluated for their 'worth' as a contextual interpretation not only of values, but also users' needs, motivations and socio- economic limitations (Cockton, 2020b).

2.3. Technology acceptance models and antecedents

Technology acceptance models, TAM (Davis 1987; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008), have evolved from the core set of concepts: behavioural intention, PEoU (perceived ease of use), PU (perceived utility), to include other influences such as trust, risk, subjective norms and facilitating conditions (King and He, 2006; Williams et al., 2015; Venkatesh et al., 2012; Maruping et al., 2017). Model elaboration produced UTAUT, containing several variables describing user attitudes (performance and effort expectancy, hedonic motivation), user characteristics (e.g. age, gender, experience, self-efficacy and habit), and economics such as price and value (Venkatesh et al., 2003, 2012; Williams et al., 2015). Other antecedent variables that may influence behavioural intention have included user self-image, culture, predispositions towards technology (Magni et al., 2010), and

compatibility with the users' tasks and organisational setting (Yousafzai et al., 2007; Maragunić and Granić, 2015; King and He, 2006; Williams et al., 2015).

Healthcare specialisations of TAM models (HITAM: Kim and Park, 2012) have integrated health belief models with concepts such as threat/risk, personal susceptibility and efficacy into behavioural intent, augmenting other TAM antecedents such as subject norms with external influences of trust, social pressure, technology-induced anxiety and perceived personal control (Nadal et al., 2020). In a diabetes context, subjective norms and contextual influences of training, shared experience, and social influences were important antecedent influences on intent as well as interpretation of utility for e-health interventions (Van Rhoon et al., 2022). Although contextual factors ranging from value related concepts to user predispositions (attitudes) and other variables have been added to several TAM models, no consensus has emerged on how many or what type of antecedent variables should be considered beyond the core utility, usability and behavioural intention components in TAM models (Magni et al., 2010; Williams et al., 2015; Maragunić and Granić, 2015; Venkatesh et al., 2012).

2.4. Values and product choice: Covid context

In reports on Covid-19 Track and Trace apps, security and privacy concerns have been cited (Cellan-Jones and Kleinman, 2020); however, these values alone may not provide insight into the variation in success between different app designs (Panchal et al., 2021; Elkhodr et al., 2021). Preliminary experience reports have highlighted security and data privacy concerns (Urbaczewski and Lee, 2020; Ahmed et al., 2020). While these concerns have obvious value implications they do not provide insight into the variation in success between different track and trace app designs (Ming et al., 2020; Elkhodr et al., 2021). Trade-off analysis between motivations, convenience and costs may also need to be considered (Bano et al., 2020; Georgiova et al., 2021).A survey of several Covid Track and Trace apps concluded that privacy, security and personal tracking were probable public concerns (Georgieva et al., 2021). Other issues such as compatibility with mobile phone OS, battery life and accuracy of contact predictions may also be barriers to acceptance (Ahmed et al., 2020; Bano et al., 2020). Reviews of Covid-19 apps have covered a range of aims, including advice, symptom management, track and trace, epidemiology data collection, with concerns about security, privacy, data protection and legal compliance, while noting the benefits of advice and education about disease/symptom management (Ming et al., 2020; Kondylakis et al., 2020; Hatamain et al., 2021). A cross-national survey found that usefulness, information content, usability, understanding and privacy, and security were cited as the more important determinants of app adoption (Panchal et al., 2021), while Elkhodr et al. (2021) reported that privacy, reliability problems and data privacy policy were dominant concerns.

In a TAM-oriented survey Velicia-Martin et al. (2021) reported that trust, Covid risk, utility, perceived usability and attitudes, but not privacy, influenced behavioural intention; however they did not include separate values in their 'attitudes' construct. Tomczyk et al. (2021) found that utility, privacy, Covid fear, anxiety, subjective norm, hedonics, and personalization influenced intent and frequency of use. Fox et al. (2021) synthesised TAM with other theories to contrast positive attitude versus privacy concerns in decision trade-offs. They found that social influence, health benefits and privacy concerns influenced adoption intent, while willingness to rely (trust) was more important for actual usage. In an experimental study manipulating Covid fear via exposure to news stories, fear (of Covid), social conservatism and privacy were found to influence downloading (Chan and Saqib, 2021).

In conclusion, the importance of values and social issues has been recognised in several disciplines. Although there is no overall consensus about which variables are more important in product choice, the more frequently cited influences appear to be privacy/security, utility and usability judgements. Apart from obvious concerns over privacy,

security and sustainability in IT systems (Whittle et al., 2019; Perera et al., 2019; Penzenstadler et al., 2018), the role of other values is uncertain.

3. Preliminary investigation

To inform design of the study, preliminary investigations into the role of values and rationale for IT product choice were carried out in December 2019-January 2020. The interview pilot study involved six respondents (staff and postgraduate students in computer science, four male, two female, age range 22–40, mean 28; one Asian, five British, (one white, four of Asian heritage) in explaining their understanding of, and view on, the importance of values (Schwartz, 1999), generally in their life, in influencing IT product choice generally, and finally in relation to the Blackboard App which they all used. The Blackboard App was selected as the initial focus of our study; however, the onset of Covid in early 2020 hindered the subsequent study on Blackboard, but did provide an opportunity for a 'value salient' study of the Covid Track and Trace App, hence the focus in the main study. Participants were recruited by personal contacts of the study authors. In the interviews respondents were asked to explain their understanding of each value and any other factors which they considered important in determining their IT product choice generally and their overall attitude towards Blackboard.

Only a small sub-set of the Schwartz values was used or deemed relevant to IT product choice. For values in life, self-direction, security, benevolence and universalism were considered to be important, while for IT product choice only self-direction and security were important, followed by achievement, benevolence and universalism. Respondents found many of the values (universalism, self-direction) were difficult to understand. Furthermore, interpretation of values for IT products was contextualised, e.g. explanations of self-direction could be interpreted as either flexible, customisable product or no control over my own life; while benevolence might signify trust with brand/supplier, honesty, transparency, but was also used as a negative critique of inflexible software. Other factors cited were usability, utility/functionality and customisability of products. In light of interpretation difficulties with the Schwartz taxonomy, we also tested respondents' understanding of the Cheng and Fleischmann (2010) value taxonomy, the most comprehensive meta-taxonomy of values. These were considered to be clearer and easier to understand, and were adopted in the subsequent studies.

4. Main study design

Informed by the pilot study, the main investigation focused on the role of values and other factors in people's choice of IT products. The Covid crisis in 2020 provided a natural field experiment for product choice of the Covid-19 Track and Trace Application, which all people in the UK were being encouraged to use from autumn 2020 onwards. Accordingly we added the decision to download the Covid-19 App to the study. A mixed methods design was adopted (Cresswell et al., 2003) with quantitative data in the survey to capture the importance of values in users' IT product (and Covid App) adoption decision, with qualitative data in free-format responses for other reasons not included in the survey questions. The survey was supplemented by interviews to capture users' rationale for product decisions, their understanding of value concepts, and the decision-making process.

4.1. Survey design

The survey focused on values as influences on download choice. We decided not to include TAM variables in the survey because the considerable variation in TAM antecedent variables (King and He, 2006; Marangunić and Granić, 2015) would have created an over-complex questionnaire. Furthermore, since our focus was more generally on users' decision-making process we adopted a more open-ended, less

model-theoretic approach. However, we added four TAM-oriented questions informed by our pilot study (functionality, security concerns, external influences, and OS compatibility), and a free-format question to capture qualitative data on respondents' views on other important influences on their choice. This enabled us to adopt a grounded theory approach to investigate emergent themes that might be mapped to previously reported TAM antecedents. Based on the results from the preliminary study, the survey was designed with the following sections:

(i) Demographic details (age, gender, ethnicity, education).
(ii) Values in life: rating of 15 values from the Cheng and Fleishmann (2010) taxonomy on a 1 to 5-point importance scale in response to the question "guiding decisions in your life". Spirituality was omitted after considering 'not relevant' feedback from the pilot studies. Brief descriptions of each value were included (see Appendix A).
(iii) Values in determining IT product choice: rating the same 15 values in response to the question "how important is value (x) when deciding to purchase/download IT products/apps?"
(iv) Six questions on the importance of other factors in determining IT product choice: functional fit with requirements; experience with similar products; value for money; trust in supplier/brand; compatibility with other products/operating system; and external influences (word of mouth, friends/relatives, social media, press reviews).
(v) Following the final question in section (iv), respondents were asked to give up to four examples of product/app types and enter associated values in free-format answers. Finally an open-format question captured up to three other influences on app choice with a positive/negative rating.
(vi) Values in determining the decision to download the NHS Covid-19 Track and Trace App: rating the same 15 values on a 1..7 bi-polar scale (influence on decision: Very negative … Neutral … Very positive). Prior to the values a single question captured respondents' concern about the risk of Covid-19 infection.
(vii) Four questions on the importance of four other factors which may influence the Covid App download decision: functional fit with requirements; compatibility with OS; external influences (word of mouth, friends/relatives, social media, press reviews, recommendations from NHS and the Government, HMG); and security concerns (personal data, identity, tracking). A single free-format question allowed respondents to enter up to three other possible influences on download choice with a positive/negative rating. The four questions were a modified sub set of the six questions for general products (iv), omitting value for money (not relevant for free T&T App), and experience with similar products (no similar products were available at the time of the survey). The trust question was elaborated to focus on recommendations and security concerns identified in the literature review.
(viii) Three questions on download decision: download Y/N; considered download (5-point scale); continued use Y/N; followed by a free-format question to elicit reasons for continued use or not. Questions in this section were organised with appropriate conditional branching, e.g. download N, triggered the consider question but not continued use.

The survey was conducted between March and June 2021, when the UK was in the later stages of a second lockdown with a gradual relaxation of restrictions. The survey was implemented in Qualtrics and posted on the Internet with invitations to participate sent to staff and students mailing lists in Aston University. 208 respondents completed the questionnaire: 68 males, 139 females, one non-binary; age distribution range 18 to 82, mean 32. 90% of respondents had degrees.

4.2. Interviews

The role of values and other factors which might affect choice of IT products and the Covid-19 App were investigated in structured interviews with 13 participants (eight male, five female, age range 19 to 31). Interviewees were members of staff, postgraduate and masters students in the Department of Computer Science, who had not participated in the pilot study. They were recruited by advertising the study within the department and by personal contact with the researchers. Interviews aimed to explore the rationale for their choices and their attitudes towards IT products generally, specific types of product, e.g. games, and then in relation to their choice and experience with the NHS Covid-19 Track and Trace App. Interviews lasted approximately 40 min, organised into four sections: (i) interpretation of value categories and importance in lifestyle decisions; (ii) the influence of values and other factors that affect choice of IT products generally; (iii) a specific context of Covid-19 App choice and experience; and (iv) suggested improvements and arguments to persuade others, to elicit further reasons for product/app acceptance. Qualitative analysis followed a mixed methods approach (Creswell et al., 2003), using a combination of classifying utterance using pre-set variables and values adopted in the survey to create counts of the more frequent variables, with open coding of responses to classify emergent categories as well as identifying contextual issues for illustration in excerpts.

Sections (i) and (ii) were analysed by coding any difficulties reported in interpreting values in general and in relationship to IT product choice, with reference to specific values if reported. Sections (ii- iv) of the interviews were coded following a hybrid approach, with a first pass to identify values in participants' responses using the survey questions, followed by a second pass to identify contextual influences on users' decisions, following grounded theory guidelines (Holton, 2007) to identify excerpts to illustrate contextual interpretations as well as creating thematic categories from initial topic codes. Coding focused on reasons for IT product choice in section (ii), Covid App download decisions in section (iii), and suggestions for improvements plus arguments in section (iv). Responses to the free-format survey question were coded with predetermined categories from the survey (e.g. usability, privacy/security, OS compatibility, trust and external influences) and three motivational categories: positive reasons related to values; negative reasons such as fear of Covid and constraints (no choice); and an emergent positive sub-category where users cited desire to gain knowledge as a motivation so they could manage their Covid responses. Open coding was used to identify contextual influences on decision making and other possible influences on participant's choice. The more frequent emergent thematic codes included values, functionality, utility, convenience, usability/ease of use and a variety of reasons for download choice. Responses to sections (iii) and (iv) were analysed for the complexity of reasons cited for decisions and any evidence of fast- v slow-path reasoning, e.g. trade-off analysis and explanation of contextual factors indicates slower-path reasoning, and simple statements of a limited number of influences suggested fast-path. When individual participants showed evidence of both slow and fast path decisions, e.g. consider download indicated trade off analysis but the actual download decision was a simple statement, they were classified as hybrid. This analysis was not applied to sections (i) and (ii) where the interview prompts encouraged reflective, slow-path reasoning. The study was approved by the University of Aston's ethics committee.

5. Results

5.1. Survey data: values and IT products

Values in life were partially related to values for IT products; see Table 1 for the rank order of the top 50% (8) of values by importance. Six out of the top eight-ranked values appeared in the same position in both life/product value lists, although means for IT products were lower and

Table 1
Highest-ranked values (8/16) for life and IT product choice, rated on a 5-point scale where 5 = very important.

Values in Life	Mean (SD)	IT Products Values	Mean (SD)
Equality	4.50 (0.79)	Equality	4.05 (1.26)
Responsibility	4.34 (0.84)	Security	4.05 (1.16)
Knowledge	4.24 (0.81)	Sustainability	3.97 (1.18)
Honesty	4.23 (0.89)	Knowledge	3.95 (1.08)
Self-respect	4.23 (0.86)	Responsibility	3.93 (1.17)
Sustainability	4.21 (0.92)	Honesty	3.83 (1.27)
Broad-minded	4.13 (0.85)	Freedom	3.82 (1.15)
Helpfulness	4.13 (0.94)	Competence	3.72 (1.07)
Lower 8 values	2.15–4.08	Lower 8 values	2.12–3.70

standard deviations higher, indicating more variation in value attribution for product choice. Of the non-shared values, broad-mindedness and self-respect are human attributes which do not map naturally to IT products, while security may be more important for IT products than for life in general.

All of the top 50% ranked pairs of life/IT product values (e.g. equality/equality) were strongly correlated ($p<.01$). The lower 50% of ranked pairs produced fewer correlations, which were significant in only three pairs ($p<.05$, other ns). Comparing all the influences on IT product choice (see Table 2), only functional fit, trust and value for money ranked among the values, and all other variables, including compatibility and external influences on choice, were considered to be less important than nearly all values.

There were differences between ethnic groups, education and age for some values, although no consistent results emerged, e.g. Asian (Chinese and Indian) rated wealth, accomplishment, and hedonism as more important than did white Europeans, and this was consistent across values for life, IT products and the Covid App. For education differences, undergraduate participants rated hedonism more highly than did college and postgraduate students.

5.2. Effect of context on choice

5.2.1. App type

Apps cited in response to the request for up to four examples were categorised into nine groups: social media, games, work-related, audio/video communications, information/search, entertainment/hobbies, health and NHS Apps, financial/banking, and others, mainly device utilities.

The more frequently reported groups were social media (23% in total reported responses 1 to 3), then games (16%), work related (16%), and other categories which varied between 7 and 8% apart from finance

Table 2
Top 15 values and other variables for IT product choice ranked by means (5-point scale). *Other variables in italics.*

Values and other variables	Mean (SD)
Functional fit	4.12 (0.78)
Equality	4.05 (1.26)
Security	4.05 (1.16)
Trust in Brand	4.03 (1.04)
Sustainability	3.97 (1.18)
Value for money	3.96 (1.00)
Knowledge	3.95 (1.08)
Responsibility	3.93 (1.17)
Honesty	3.83 (1.27)
Freedom	3.82 (1.15)
Competence	3.72 (1.07)
Helpfulness	3.70 (1.28)
Self-respect	3.62 (1.29)
Broad-minded	3.51 (1.30)
Creative	3.42 (1.22)
Other values (4)	2.12- 3.18
Other variables (6)	2.63 – 3.37

(4%). The more popular values/other variables cited for each app for all three choices were knowledge, security and utility, although there were considerable differences between app groups and the order of choice; see Table 3.

Of the fourth-ranked values only honesty for social media (9%) and security for work-related apps (10%) were frequent choices > 5%. Overall the more frequently cited values were knowledge, security, responsible, and competence, with lower frequencies of other values and non-value variables, utility/functionality, value/price and trust. Variation by app class illustrates how value judgement is context sensitive, for example games and hedonism, finance and security.

5.2.2. Other influences

Following indications in the pilot study about the general nature of influences, these were elicited as either general positive or negative influences rather than being associated with app types (see Table 4). The more frequently cited variables were external influences (including social media, word of mouth, reviews), then price and utility; whereas overall, external influences and usability were more frequent, with usability and UX tied 3=. Price was frequent for first-choice apps, less so for second and third choices, whereas usability and UX were more common for second and third choices.

The response rate declined in citation order with over 50% respondents entering 'none' for the third example. Of the responses entered, the majority were positive influences (70.8% first cited, 76% second cited and 75.6% third cited). Most price influences were negative (too expensive, subscriptions), utility influences were more evenly divided, while a minority of external influences were negative (bad reviews, word of mouth), with no negatives for usability and user experience. Twenty-four other negative influences, which did not fall into the Table 4 categories, were recorded including provenance and integrity of suppliers and distracting adverts.

5.3. Values in Covid App choice

Three other variables with two values, helpfulness and responsibility, appear to be more important for the Covid App downloading choice, as illustrated in Table 5. Three of these variables relate to privacy, arguably closely associated with the security value, while other external influences (recommendations from the NHS) reflect choice in the context of the Covid application.

All values/other variables for Covid App choice had means >3.5 on a 7-point bipolar scale, hence they all represent positive attitudes. Comparing the rank order pairs of values from the IT products and Covid App choice produced weaker correlations than those observed between life/IT product values, with only four pairs (equality/responsibility, responsibility/honesty, freedom/equality, compatibility/sustainability) being significant at $p<.01$; others correlated at $p<.05$. All the top eight-ranked pairs of values in life/Covid App values were strongly correlated

Table 3
Most popular values/other variables for each app type, cited in responses 1–3, showing only totals > 5%, i.e. of all the responses for social media, security accounted for 21%, etc.

| App types (% total) cited | Top three values/variables cited for each App class in response order | | |
	1st	2nd	3rd
Social Media (23)	Security 21%	Social Com 18%	Helpful 9%
Games (16)	Hedonism 29%	Achievement 9%	Price/value 9%
Work-related (16)	Competence 19%	Knowledge 18%	Utility 11%
Comms/CMC (8)	Security 30%	Helpfulness 8%	Utility 8%
Entertainment (7)	Knowledge 15%	Utility 9%	Hedonism 6%
Information (7)	Knowledge 27%	Utility 9%	Trust 9%
NHS/Health (8)	Knowledge 17%	Responsibility 10%	Achievement 7%
Finance (4)	Security 66%	Competence 9%	n.a.

Table 4
Frequency of other variables influencing app choice in order of entry in the free format question, illustrating the top 5 by frequency.

Response order	1st freq (%)	2nd freq (%)	3rd freq (%)	Totals freq (%)	Totals cited +ve%
External influence	37 (26.2)	27 (22)	17 (21)	81 (24%)	85.3
Price	29 (20)	9 (7)	6 (7)	44 (12.8)	29.4
Utility	25 (17)	14 (11)	10 (10.5)	49 (14.2)	57.9
Usability	13 (9)	30 (24)	27 (33)	70 (20.4)	100
UX	12 (8)	13 (11)	13 (19)	38 (11)	100
Other	25 (17.7)	21 (18.4)	15 (17.7)	61 (17.8)	60.6
Totals	141	114	88	343 (94)	
Overall response%	71.2%	60.1%	43.3%		

Table 5
Importance of values and other variables for Covid App choice, ranked by means (top 15/28). Note 7-point bipolar scale. *Other variables in italics.*

Values/Other variables	Means (SD)
Privacy-personal ID	5.86 (1.61)
Responsibility	5.77 (1.36)
Privacy-data	5.77 (1.67)
Helpfulness	5.60 (1.41)
Privacy-location track	5.59 (1.78)
NHS recommended	5.50 (1.71)
Compatibility	5.48 (2.05)
Security	5.41 (1.92)
Knowledge	5.36 (1.40)
Honesty	5.21 (1.49)
HMG recommended	5.16 (1.68)
Social Order	5.13 (1.52)
Equality	5.10 (1.39)
Covid risk	5.01 (1.41)
Sustainability	4.91 (1.46)
Self-respect	4.88 (1.33)
Other values (8)	3.82–4.80
Other variables (5)	3.57–4.69

($p<.01$) apart from equality/responsibility ($p<.05$) and sustainability/social order (ns). It appears that people's value judgements are partially consistent between values generally in life and values applied to IT products, including the Covid App. The weaker relationships between IT product and Covid App pairs probably reflects specialization in judgement when participants were focused on the Covid App.

Of the 12 other variables, three privacy measures (means 5.86, 5.77, 5.56) followed by NHS trust were the most important (mean 5.50); compatibility was sixth, while functionality, in contrast to its high rating for IT products, and Covid risk were not rated as important (eleventh, twelfth, means 3.57, 3.58). Other more important variables were all external influences (word of mouth, reviews, HMG recommended).

Regression tests were run on the Covid data with three independent variables: download Covid App, consider download, continued use, with all high-ranked values (see Table 1) and other variables as predictors in a series of models with age as the control variable in all of them. A majority of respondents had downloaded the Covid App (124/208 (59.6%), 79 males, 44 females) and of those who had downloaded the majority continued to use it (89/124 (71.7%), 59 males, 30 females). Consider download was measured on a 1..5 scale which returned a mean of 2.49 (SD 1.24). Since this question was only presented to non-downloaders ($N = 84$), it appears that considered downloading was not evaluated thoroughly (median = 2) by those who had already made a previous decision not to download.

All influence variables (predictors) were tested against the three independent variables as outcome measures: consider download, download and continued use in separate regression tests. Given the

sample size and the large number of measured variables, predictors were divided into seven models, with four predictors selected for models 1 to 4 based on the rank order in Table 5. Models 5 to 7 tested lower-ranked variables to ensure complete coverage of the survey questions.

Predictors:

Model 1. Privacy-personal ID, responsibility, privacy-data, helpfulness.

Model 2. Privacy-location, NHS recommended, compatibility, security.

Model 3. Knowledge, honesty, HMG recommended, social order.

Model 4. Equality, sustainability, self-respect, Covid risk.

The same models were then tested with consider download and continued use as independent variables. Three further models tested lower rank-order values and variables.

Model 5. External influence-family, external-influence-friends, broad-minded, competence.

Model 6. Freedom, accomplishment, creative, external-influences-social media, press.

Model 7. Hedonism, wealth, functionality.

Only significant models and predictor variables are reported, first for Models 1–4 in Table 6, followed by the lower rank-order predictors in Models 5–7.

For the lower-ranked variables in Models 5–7, Broad-minded (β 0.359, $p < .01$) was a predictor for consider download in Model 5 (r^2 0.392, $p < .000$), external influence-press in Model 6 (r^2 0.227, $p < .001$), and functionality in Model 7 (r^2 0.261, $p < .000$). Download choice was not significant in Models 5 and 6, although Model 7 (r^2 0.82,

Table 6
Regression analysis significant results: Models 1–7. β is the standardised coefficient.

Indep Variable: Consider Download				
Predictors	β	Sig	Model r^2	Sig
Helpfulness	.380	<0.01	1 0.332	<0.000
Age	.229, −0.254, −0.310, −0.288	<0.05	1, 2, 3, 4	
NHS recommend	.479	<0.000	2 0.410	<0.000
HMG recommend	.254	<0.05	3 0.380	<0.000
Equality	.366	<0.01	4 0.427	<0.000
Covid Risk	.276	<0.01	4	
Broadminded	.359	<0.01	5 0.392	<0.000
Ext Influence Press	.295	<0.01	6 0.227	<0.001
Functionality	.353	<0.01	7 0.261	<0.000

Indep Variable: Download Choice				
Predictors	β	Sig	Model r^2	Sig
Helpfulness	.355	<0.000	1 0.128	<0.000
NHS recommend	.479	<0.000	2 0.410	<0.000
Compatibility	−0.232	<0.000	2	
HMG recommend	.254	<0.05	3 0.380	<0.000
Functionality	.282	<0.01	7 0.227	<0.001

Indep Variable: Continued Use				
Predictors	β	Sig	Model r^2	Sig
Helpfulness	.355	<0.000	1 0.128	<0.01
NHS Recommend	−0.306	<0.000	2 0.232	<0.000
Compatibility	−0.232	<0.000	2	
HMG Recommend	−0.233	<0.000	3 0.172	<0.000
Age	−0.191, −0.182	<0.05	3, 4	
Equality	−253	<0.01	4 0.112	<0.05
Competence	.329	<0.01	5 0.062	<0.05
Broadminded	.251	<0.05	5	

$p < .01$) produced functionality as a significant predictor. Continued use was predicted by competence and broad-mindedness weakly ($p < .05$) in Model 5 (r^2 0.062, $p < .05$); however, Models 6 and 7 were not significant.

The results are summarised in Fig. 1a–c. In each case, arrows indicate the direction from predictors to the independent variable.

One value, helpfulness, and two other variables, NHS and HMG recommended, were consistent predictors for all three dependent variables download, consider download and continued use. Compatibility also predicted download and continued use, whereas equality and age both predicted consider download and continued use. Covid risk was only important for the consider download decision. Other influences (functionality, external influence-press, and broad-mindedness and competence values) appear to be less important, either because they were weak predictors ($p<.05$) or were in lower-importance Models 5–7.

Only two values, helpfulness and equality, appear as strong predictors or antecedent influences to continued use and consider downloading, although only helpfulness predicted the download decision. One interpretation is that these values were important for our respondents' view of the Covid Track and Trace socio-technical system; for instance, helpfulness may be related to social responsibility/altruism when respondents use the downloaded app; whereas equality may reflect the sense of a potential societal contribution as an antecedent to consider downloading and continued use. Of the other variables, clearly the recommendations from the NHS and HMG were influential, combined with the pragmatic concern about compatibility of the Covid App with the mobile phone operating systems (IOS/Android). Fear of Covid was an antecedent only in considering download, so once the decision had been taken, functionality and compatibility appear to have been more important than fear.

Age influenced considering download and continued use. ANOVAs on consider download were significant ($F = 2.339$, df 7,76 $p<.05$), with younger users showing a stronger tendency than older users; however, age was ns for continued use and download. Age-related differences reversed the order between IT products and Covid App values for security and responsibility.

Responses to 'other' non-value influences on choice to download the Covid-19 App in open-format answers were classified into:

Motivations, pull: freedom, social responsibility, altruism, self interest

Motivations, push: Covid fear, mandatory use, access to venues

Motivations, knowledge: Covid awareness, information

Privacy/security

Usability/UX including reliability, accuracy

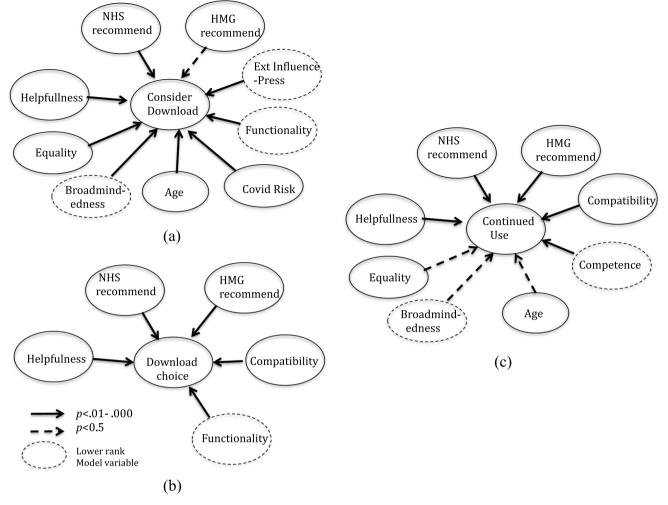Compatibility with phone version/OS

Trust in HMG

External influences: social media, reviews, friends/family, etc.

Other (two non-classified).

Totals of influences in order of entry (three items) with valences are illustrated in Table 7.

Motivations, as expected from their definitions, were almost all positive. The three categories with more negative than positive influences were poor compatibility between app and phone/OS, mistrust of HMG and app developers, and security/privacy concerns. Usability and external influences tended to be positive. Overall, positive influences (motivations) were more frequent than negative influences by approximately 3:1.

Finally, respondents who had downloaded the app were asked for their reasons for either continued use (89) or not (35) in a free-format answer. Responses for continued use were categorised as: social responsibility/helpfulness, mandatory use and conformity (including no choice, obey HMG rules), Covid risk and concerns over personal safety, functionality such as Covid information and advice, access to venues and utility in allowing visits to restaurants and pubs, and other. For respondents who had abandoned use, reasons were categorised as no/little need, which included justifications that they were self-isolating and not

Fig. 1. a Summary of regression tests on the consider download independent variable
b Summary of regression tests on Covid App download choice independent variable
c Summary of regression tests on the continued use independent variable.

Table 7
Other variables/influences on Covid App download choice: frequencies by entry order in a free format question.

Influence category	Response order: frequency			Totals freq (%)	Totals reported -ve
	1st	2nd	3rd		
Motives-pull	32	23	15	70 (34%)	0%
Motives- push	7	8	4	19 (9)	0
Motives- knowledge	6	3	4	13 (6)	7
Usability/UX	10	9	5	24 (12)	29
Security/privacy	9	8	8	25 (12)	80
Compatibility	10	3	2	15 (7)	93
Trust HMG/software	9	7	11	27 (13)	93
External influences	5	3	4	12 (6)	33
Totals	89	64	53	205	71 (35%)

Table 8
Frequency of reasons cited for continued use or abandoning the Covid19 App.

Continued Use Reasons	Freq (%)	Abandoned App Reasons	Freq (%)
Access to venues	30 (33.7)	No/little need	15 (42.8)
Covid risk and safety	16 (17.9)	Poor functionality	9 (25.7)
Social responsibility	15 (16.8)	Poor usability/performance	6 (17)
Functionality	14 (15.7)	Other	5 (14.3)
Mandatory/no choice	9 (10)		
Other	5		
Total	89	Total	35

going to public venues; usability and poor performance arguments, frequently related to Bluetooth and excessive battery use; functionality problems, ranging from poor accuracy, false contact alerts and absence of useful advice; and others. Table 8 summarises the responses.

5.4. Results: interviews

5.4.1. Values in life
The majority of interviewees had no problem in understanding and applying the values when rating their general importance within their own lives, although power was not deemed relevant to the majority (11/13) of respondents. However, R8 noted some difficulty: "had to sort of keep going back each time and really sort of thinking through it…". Wealth was ambiguous for R5: "is wealth a value?", while R4 considered wealth inappropriate, arguing that it was more "to do with (having the) sufficiency to look after yourself". Other interviewees noted that social good (R1) and inclusivity (R2) were missing from the taxonomy, although acknowledging that related concepts were present. R4 associated accomplishment primarily with the workplace and struggled to reconcile the relationship between goals in life and at work. Four respondents interpreted values from a work perspective, e.g. values guiding their occupation in software development, while three noted the difference between values as a general lifestyle attitude in contrast to

influences on a specific decision. Two respondents introduced a social/political perspective into their interpretation of some values, e.g. freedom, self-direction and power.

5.4.2. Values in relation to IT products and apps

Interpretation of values was more varied when interviewees were focused on IT products and applications. The respondents referred primarily to software apps rather than hardware such as desktop and laptop computers, tablets and mobile phones. All noted that the type of product (work/leisure, PC software) or application had a strong influence on selected values.

All found considering values in relation to IT products and apps somewhat challenging, e.g. R8: "It wasn't easy linking my values to the apps. I had to really think, think through, 'cause I hadn't really thought about apps having that effect on my values until doing this". Most interviewees assessed values by focusing on specific types of product or limiting their responses to particular apps. Three interviewees differentiated productivity applications from other software, with R6 noting that "I feel very differently about software like Photoshop that I might need to download to use to do my job to how I feel about apps like social media apps". Software applications were viewed in broadly utilitarian terms. R1 described apps as: "discreet items that help or add value to … what I feel I need to do". Functionality was also important for four respondents, e.g. R2's decisions were motivated by utility, e.g. "I'm just looking for what it can do for me. I'm not, I don't really have time or desire to discuss or research if it's alright or not. I find it. I use it."

Three respondents viewed values in products from the developer/designer perspective; for example, R2 thought that personal values are "something that should be considered when those things are designed", while R4 argued that values are tacitly designed into IT products and apps: "nothing is designed without values being embedded, and it's incredibly important how, you know, that, that we recognize that values are, are built into the technologies we use". The values which were cited more frequently included benevolence, equality and social responsibility, which reflected the role of IT products from a socio-technical system perspective, i.e. benevolent for people generally, equality being free from bias (see Table 9), accessibility; followed by security for self and friends/family, self-direction and achievement in the sense of fulfilling one's goals and empowering people, e.g. R8: "I thought no, you know I should have self respect, particularly using things like Facebook app".

For other non-value variables, three interviewees cited operating system qualities as an important influence, e.g. R9 "I prefer Android, there are more free apps, IOS is more money making"; in contrast, R11 favoured IOS: "it's better for updates, so your phone lasts longer"; while R13 liked Android because it was more configurable. Functionality was important for six respondents, e.g. battery life, screen and camera resolution, while R10 had a special requirement: "I need an LCD screen on my mobile, otherwise I get headaches". R12 linked functionality with maintainability and sustainability: "iPhones are a sealed unit, I don't like that, … I want to be able to change the Sim Card, Android is more maintainable". External influences on their decision were important for eight respondents who cited advice from family, friends, press and social media reviews; R10: "I check out reviews … on social media, anywhere, friends, family". Finally cost/value for money was cited by three

Table 9
Summary of values and other influences for selecting IT products.

Category	Interview evidence
Values	Security, social responsibility, achievement, benevolence, equality
External influences	References to reviews, social media, recommendations of family and friends
Utility/Features	References to importance of utility, fit to users' needs
Operating system qualities	References to flexibility, maintainability

respondents, illustrated by R9: "value for money's important, more features the better …".

5.4.3. Values in relation to the NHS Covid-19 App

Relating values to the NHS Covid-19 App and downloading decisions was a more straightforward process for all interviewees. All were aware of the Covid-19 App and its intended role in tracking and tracing infection. Five respondents (R1, R3, R7, R9 and R10), had downloaded the app. Four were persuaded by utility that the app facilitated access to restaurants and social venues; and four by social responsibility to help deal with the Covid epidemic.

Three (R1, R3 and R7), cited the app's useful functions although this was related to the socio-technical (whole system) utility, e.g. R1: "I don't expect anything out of it other than, other than to do the job of helping society understand where I was". These respondents were motivated by the utility of the app for gaining access to restaurants and bars, e.g. R3 explained that "… at the beginning if you didn't have the, the app, you were not allowed to enter places, to get into places, right?"; similarly, R10 used the app to conform to the University's Covid rules: "I have to go to the Uni once a week, so I have to have it". R7 echoed that sentiment saying that "I downloaded the app. Because otherwise they, they, the place wouldn't let us in".

Four who were motivated by social responsibility also noted the utility of the app for gaining access to venues and its potential to reduce the risk of infection. For example, R1 explained "I think I don't have anything to lose if I use it, and it is important that most of us use the app to have a real positive effect at controlling Covid-19″. R3 reported "it is useful for taking care of other people more than yourself", from the perspective of limiting infection. R9 noted helping others: "It's good to help others, also my family security is important since I have worked in a care home", while R10 explained " it's important everyone uses it, sort of related to benevolence".

The eight non-downloaders (R2, R4, R5, R6, R8, R11, R12, R13) cited three main justifications for their decision: privacy/security concerns (6), five of which were linked to mistrust of the Government; little or no perceived need for the app (5); and poor accuracy (4) that may lead to false alerts

Of the six non-downloaders who highlighted data privacy concerns, five mistrusted the Government (R2, R4, R5, R6, R12). R4 highlighted how lack of trust in the Government and the contact trace strategy persuaded them not to download the app in spite of a clash with their values, saying: "I feel like I've got a social responsibility to do it, so it's a bit of a source of tension for me. But I don't trust the people responsible for it, and … I think that my lack of trust is to do with the way it rolled out at the start". R5 focused on mistrust and provenance of the app: "… not having faith in the people that devise the app as well, and the fact that we were told we'd have a world beating. Um, you know? … and we didn't need a world beating track and trace. We just need one that worked". R5 cited justification for data privacy concerns: "Dido Harding[1] who is … her name is linked with some of the biggest data breaches. It is another concern for me, know my security, my, my sort of personal data". R12 noted that "despite the government saying that data is treated as anonymous, I don't believe the Government! I think how you can trust in a completely incompetent Government?".

The absence of a perceived need for the app (5) was related to respondent lockdown behavior with limited potential for exposure to the virus. For example, R6 stated that "I don't feel like I need to use it because I'm already extremely careful, incredibly limited social contact, … so … And I'm not trying to go anywhere that isn't necessary". R4 noted: "I'm barely out the house I work at home all the time", while R2 stated that: "The exposure that I have. I don't feel the need to have that application installed". Interestingly, R4 reported their need was related to perception of systems level ineffectiveness with "people switching off

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[1] Dido Harding was in charge of the UK Covid Test, Track and Trace system

the app when they got to work because they were in a situation where they were … getting notifications" and then having to self-isolate as a result, while R11 observed "everyone really has to use it, otherwise it's just not going to work, no point for me unless everyone's in".

Four interviewees felt that poor accuracy may lead to false alerts that could penalize users who had to self-isolate unnecessarily, e.g. R5: "I wasn't sure how accurate it was, and I was worried that it may decide that I've been in contact with someone that I actually hadn't". R4 reported that: "… my friends who had downloaded the app, were getting notifications all the time for doing their day-to-day stuff. … where it was inevitable, that they would get kind of, false positives". R7 felt coerced by social pressure into using the app: "So, no matter my values in this case with the community in particular, I was forced to use it to, to enter venues, right, no? My values really didn't, didn't drive me to, to download the app, or rather it was pressure from other people". R9 was not sure how the track and trace functionality worked and wanted more information.

The motivations and reasons for the interviewees downloading the Covid-19 App, or not, are summarised in Table 10.

5.4.4. Users' decision making

Both decision-making modes were observed in downloaders and non-downloader interviewees, as illustrated in Table 11.

Four/five downloaders in the interviews showed evidence of fast-path decision making driven by a clear perceived need for social conformance and pragmatics concerns; however, three downloaders weighed the trade-off between social responsibility and altruistic motivations against the downsides of privacy and security concerns over personal data. They also condoned poor usability and functional problems, such as too many false alarms being triggered in the contact tracing. The eight non-downloader respondents were split between four who had no perceived need for the app and therefore took more fast-path-oriented decisions not to consider, and trade-offs or benefits, although they did cite privacy concerns. Their decisions appeared to be determined by weak motivation and negative concerns over privacy. The other four non-downloaders followed a slow or hybrid process in which they did consider the trade-off between perceived utility and social responsibility, although these were outweighed by negative attitudes and mistrust of the HMG reinforcing privacy and security concerns.

5.5. Results: summary

5.5.1. Choice of IT products

Most of the values rated as important in respondents' lives were also important in their judgement of IT products, and most people found the values to be reasonably easy to interpret. The five more important values: responsibility, security, equality, sustainability and knowledge, appeared to be interpreted from a socio-technical systems perspective, i. e. for responsibility the product was judged to empower people to help others. Interpretation of values changed; for example, knowledge as a human attribute in values in life became, in the context of IT products, empowering human knowledge by solving problems and offering decision support. It is apparent that values alone do not provide sufficient insight into user acceptance of software products, and need to be considered with pragmatic issues, such as value for money and trust in product suppliers. Interpretation is also dependent on the product type;

Table 10
Summary of reasons for the interviewees' download/non-download decisions.

Download (5)	Non-download (8)
Utility- social access- 3	Privacy/security concerns- 6
Social responsibility- 4	Mistrust: Government/NHS- 5
	Little perceived need- 5
	Poor accuracy + social constraints- 4

Table 11
Decision process adopted by downloader and non-downloader respondents. Brackets denote a hybrid process.

	Fast path	Slow path
Downloaders (5)	4 (2)	1
Non-downloaders (8)	4 (1)	4 (2)

games were associated with hedonism, while social media was associated with a wide range of social values, such as freedom, responsibility and social order, possibly relating to the diverse content hosted on platforms.

5.5.2. Download Covid App

Regression analysis demonstrated that the decision to download the app was influenced by only one value (helpfulness) and four other variables: compatibility, HMG and NHS recommended and functionality (as a weak predictor). T-tests on these variables and interview data suggest they were all positive influences on the decision. Several values ranked as important (security, knowledge, honesty, responsibility, social order and equality) did not predict the download decision; furthermore, neither did the three high-importance privacy variables. HMG and NHS recommended were revealed as negative influences in the interviews, even though with compatibility they were rated as important and appeared as significant predictors. The same three values/variables (helpfulness, HMG, NHS recommended) also appeared as predictors of non-downloaders in the consider download decision, with two other values (equality, broad-mindedness) and four other variables (external influences-press, Covid risk, age, and functionality as a weak predictor). Recommendations for downloader individuals may have been weakly negative and overridden by the positive helpfulness values, whereas for non-downloaders their decision was probably driven by a negative assessment of NHS and HMG recommendation. The same core values/variables also appear as predictors for downloaders' continued use (helpfulness, NHS, HMG recommended, plus compatibility), with weak influences from equality, broad-mindedness and age, and stronger influence from competence.

A strong theme emerged from the interview data that the Covid App download decision was driven by a combination of social responsibility (value oriented), the pragmatic utility of access to venues, and mandatory use for work. Social responsibility may relate to the whole Covid Track and Trace system rather than more narrowly to the App. Non-downloaders cited privacy/security concerns, strongly coupled with mistrust of the Government, and a pragmatic utility judgement that they did not need the app because they were in lockdown, with no access to venues or workplaces. Qualitative data from the survey also indicated a social responsibility/altruistic motivation coupled with the utility of access to social venues. Several non-value variables were important in participants' decisions: usability/UX, security, with compatibility and HMG/NHS influences, which agrees with the regression analysis.

Our respondents were consistent in their judgements between life values/values for IT products/values for the Covid App, with some expected exceptions (e.g. broad-mindedness). Qualitative data on IT product choice and Covid download shows some similarities with quantitative data; utility is related to functionality and compatibility was a shared concern.

6. Discussion

Our headline conclusions relating to the research questions are as follows:

RQ1. Are users' generally held values in life consistent with the values they use in decisions to adopt IT products?

No: IT product choice is influenced by a sub set of the more general values in life, with a particular focus on helpfulness, which may be

related to perceived usability and utility, but also equality and broadmindedness values.

RQ2. What is the relative influence of human values and other variables in determining acceptance of IT products?

Overall our analysis on relative influences has to be tentative limited by our participants' subjective ratings; however, it is clear that values are only one influence among many other contextual variables including trust in recommendations and provenance of products.

RQ3. What are the influences of users' values and other variables on their decision to download and use the UK NHS Covid-19 Track and Trace App?

Decisions to download and continue use showed similar mix of values and other variables, however at the individual level the valency of values and other variables differed between users who accepted and rejected the T&T App, in particular trust in recommendations, provenance and perceived need (utility/functionality).

RQ4. How are the values and other influences present in general models employed in specific instances of decisions to adopt Covid Track and Trace apps?

General models such as TAM (Venkatesh et al., 2012, Williams & He 20,125, Nadal et al., 2020) tend to extend core concepts of perceived ease of use and utility with high level variables such as social norms with few specific references to values. Our results indicate many more specific, contextual influences (e.g. recommendations) as well as values (Helpfulness, Social responsibility) were involved as well as perceived utility.

H1. People will adopt slow-path decision making for Covid App adoption more frequently than fast-path decisions.

The hypothesis was rejected, no clear differences in fast or slow path decision making emerged, and although more individuals adopted a fast path with perceived utility or social responsibility being salient variables. Several users adopted a hybrid model with evidence for trade off decision making balance needs, privacy concerns and social responsibility.

In more detail, findings pertaining to RQ1 on IT product judgement suggest that while values might have some influence on users' judgement, other variables, such as functionality, trust/provenance and value for money, also play important roles. The diversity of values rated as important for product choice suggests that the core influences of technology acceptance of utility and ease of use need to be elaborated to consider users' motivations and attitudes or values in more depth thereby extending the subjective norms present in UTAUT models (Marangunić and Granić, 2015; Williams et al., 2015; Nadal et al., 2020). Although equality, security and sustainability were ranked as important, it is clear that users' judgement is context-specific, as demonstrated by their value attribution to different product/app types. While security and sustainability may be more generic concerns, agreeing with other studies (Perera et al., 2019; Penzenstadler et al., 2018), a general predictive model will have to account for many contextual variations, for example the role of trust depending on perceptions of products' association with external organisations, such as the NHS and government in our study. This contrasts with the dominance of perceived utility and usability in earlier TAM models (Venkatesh et al., 2012; Venkatesh and Bala, 2008), although it is consistent with the lack of consensus observed across more recent technology acceptance and user experience studies (Yousafzai et al., 2007; Williams et al., 2015; Bargas-Avila and Hornbæk, 2011), where contextual factors, such as subjective norms and efficacy have been elaborated with other antecedent influences on adoption decisions. Trust in organisations and inter alia the Covid App was an important influence in our findings, however, trust does not appear as a value in most taxonomies (Schwartz 1999; Cheng and Fleischmann 2010), furthermore it does not appear as an

antecedent in TAM models (Williams et al., 2015; Marangunic and Granic 2015) apart from tacitly as a subjective norm. Trust is a complex phenonomemon, vis relational trust, trustworthiness, reputational trust, etc., which may account for its omission from value taxonomies.

From the perspective of health-related adaptations of TAM (HITAM: Kim and Park, 2012), we found that health concerns and perceived susceptibility were consistent with Covid risk as an antecedent for considering download (i.e. pre-use); however, Covid risk was not an antecedent for actual use. This inconsistency may have been a consequence of the severity and pervasiveness of Covid in contrast to other health risks where personal susceptibility may be more important (e.g. diabetes: Van Rhoon et al., 2022). In contrast, external influences (subjective norms) in recommendations from NHS and HMG promotion were consistent both pre-use and in use; however, as our qualitative data demonstrated, HMG influences could be negative as well as positive. Few TAM-related studies enable pre-use and in-use contrasts (Nadal et al., 2020), where the majority of in-use reports note recommendations and satisfactions are important influences, as well as the conventional TAM antecedents (PU, PEOU, etc.). We found that recommendation was apparent in pre- and actual use, as well as the helpfulness value, probably related to perceived utility.

Our respondents found values in the context of products difficult to interpret. Attribution of values to self and a product were interpreted through a socio-political lens, e.g. responsibility (to others/society), and a developer perspective as an ethical view on the products they were creating, i.e. honest, responsible for reliable software. Sustainability may also be subject to contextual interpretation, e.g. IT product operation or development which is compatible with low carbon and climate change, or an app produced sustainably so it can be maintained over a long life or whose functionality contributes to sustainability in ecology management (Penzenstadler et al., 2018). While survey data identified a small number of values and contextual variables, e.g. recommendations as influences on adoption decision, qualitative data illustrates contextual interpretation is necessary; for example, the provenance of recommendation (NHS or HMG) changed positive or negative, while privacy and security concerns were associated with trust or mistrust. Hence, the wider socio-political context from the respondents' university to HMG is necessary to situate users' decisions in context. This contrast between unitary values and contextual interpretation has been subject to considerable debate, in approaches to value-sensitive design, being led by initial value taxonomies or depending on emergent interpretation (Le Dantec et al., 2009), and more generally between *a priori* value taxonomy-led analysis (Voida and Mynatt, 2005; Kheirandish et al., 2020) versus co-construction of values and their design dependencies via participatory and ethnographic approaches (Borning and Muller, 2012; Cockton, 2020b).

Our results relevant to RQ2 and RQ3 show a mixture of values and other more TAM-oriented variables such as functionality (perceived utility), trust and context of use (operating system compatibility, external influences) and facilitating conditions (NHS and HMG recommendations). Values appeared to be at least as important as other variables in influencing respondents' decisions in both the quantitative and qualitative analysis, notably helpfulness and equality. Responsibility did not predict downloading even though it was considered important and cited as a positive influence in the interviews. It is probable that social responsibility was important for most of our respondents, even if they did not download the Covid App. Similarly, privacy/security concerns were not predictors. The importance ranking of privacy/security, both as a data/location measure and a value, triangulates with privacy concerns revealed in the interviews, which is consistent with previous studies on Covid App acceptance (Bano et al., 2020) and other more general investigations in value-oriented software (Whittle et al., 2019). Our analysis suggests that the download decision was influenced by a trade-off between the helpfulness value, possibly interpreted as a social responsibility, and more negative influences of mistrust in the recommendations by HMG and NHS. These variables were strong predictors in

all three decisions: download, consider download and continued use. Privacy concerns agrees with Panchal et al. (2021) survey although, in contrast, we did not find usability and information content issues.

Triangulating the interview and survey data, it appears that HMG/NHS recommendations were not trusted by many respondents; furthermore, interview data indicates mistrust was associated with privacy fears. The trade-off decision between positive motivations for social responsibility and the negative fears regarding privacy is supported by the interviews and the survey question on other influences which showed the valency contrast between positive motivation and downsides of privacy, mistrust in HMG and operating system incompatibilities. This trade-off is compatible with the surveys by Tomczyk et al. (2021), Fox et al. (2021) and the experimental study of Chan & Saqib (2021), who manipulated perceived fear of Covid, which was also an influence in our analysis. Trade-offs between variables and contextual influences on users' decisions (e.g. social responsibility v. utilitarian motivations for adoption) is pertinent to the worth perspective on design (Cockton et al., 2009; Cockton, 2020a, b). Our survey results suggest a general core of values and contextual factors may have represented the worth of the T&T App; however, for many participants their perception of the App was a complex interrelationship between their work and social context, values and motivations (e.g. social responsibility, helpfulness), and technical limitations (e.g. OS compatibility). For example, the utility afforded by the App in gaining access to restaurants may be interpreted as an extrinsic motivation that society regulations enforced use of the App, while social responsibility motivations could range from adopting the Quinoline to contribute to disease control to self isolation to avoid spreading Covid.

The mix of values and other variables changed during the decision sequence from a complex mix of 3 values and six other variables, including 3 external NHS, HMG recommendations plus press influences, 2 personal variables of age and perception of Covid risk, with perceived functionality. When the actual download decision was considered participants reported only 5 influences of which 4 (helpfulness value, recommendations and functionality were consistent with consider download with the addition of OS compatibility. Continue use was influenced by the same values and 4 other variables, with the addition of Equality, Broadmindedness and Competence values. This change from pre to post use reflects differences in inherent value analysis reported by Spool (2022) in which he compares and challenges existing and new users' perceptions of the same product and scenarios of use. It is also consistent with emergent discovery of values and other constituents of worth as means ends chains change during requirements through design to evaluation in use (Cockton 2020 b).

Interviews also demonstrated the socio-technical perspective on users' decisions. Utility and the perceived need for the App clearly swayed users' judgement to download, with access to venues being a prime motivator. In contrast, non-downloaders reported little or no perceived need since they were working from home and not socializing. This indicates how predictive models of technology choice need to consider contextual factors combined with the valency of influence variables rather than simple 'perceived utility' (Venkatesh et al., 2012). Overall our findings are compatible with the richer genre of TAM models which supplement the utility/usability core with many contextual influences, as employed in several Covid studies (Fox et al., 2021; Tomczyk et al., 2021; Velicia-Martin et al., 2021). However, in contrast to these studies we have illustrated the importance of values, in particular helpfulness/social responsibility as determinants of users' decisions.

Our findings on RQ4 and H1 have to be tentative since we only have indirect evidence of our participants' decision-making process. However, it appears that both reasoning modes (slow/fast) are used in both downloaders' and non-downloaders' decisions, with fast path being more prevalent among non-downloader respondents who had little perceived need for the App and others who exhibited a hybrid process with some trade-off reasoning balancing perceived need, social responsibility, against the negative concerns over privacy and security

reinforced by mistrust of HMG. Several downloader respondents who tended towards fast-path decisions reported they needed the App for social conformance (access to venues). The hypothesis that slow-path decision making would dominate over fast-path is rejected from the interview evidence, although 6/13 respondents showed a slow-path or hybrid reasoning process with trade-off between privacy/security concerns, trust and social responsibility motivations. While regression models are a population-level summary, they do indicate that in general many variables were considered, consistent with slow-path reasoning (Payne et al., 1993; Cacioppo et al., 1986). On balance, this conclusion may favor trade-off and contextual views of value-and worth-based design (Cockton, 2020a,b; Borning and Muller, 2012) over the influence of generic value taxonomies (Nadal et al., 2020; Kheirandish et al., 2020), although comparing *post hoc* analysis of product perceptions, as in our and most TAM studies, with case studies of collaborative design processes, has to be interpreted with care.

The values we adopted in the Cheng & Fleischmann (2010) taxonomy may be broadly related to motivations, for example, helpfulness and equality are social motivations consistent with altruism and social responsibility identified in the interviews while competence may be related to social efficacy (Bandura 1982). Other variables were more heterogenous; while some could be considered as motivations, such as recommendations, other reflected judgement of perceived utility (functional and compatibility) closer to TAM concepts and influences specific to the decision context such as perceived Covid risk and age. The interviews also suggested trust (or rather mistrust in product provenance) while reinforcing perceived utility as an important influence. In the trade off perspective of worth related judgement (Cockton 2020, a,b) our results suggest a high level balance between social responsibility and perceived utility modulated by social and political context consequent on our respondents' perception of the balance between favourable views of the UK National Health Service, and less favourable views of the UK Government which probably coloured their judgments about product provenance, security and privacy.

While the quantitative data identified the mix of values and other variables which influenced our participants' decisions, qualitative data revealed the valency of values, motivations and other variables as either positive influences for downloaders with utility and social responsibility or negative for non downloaders with privacy concerns linked to mistrust of the provenance (from the UK Government) of the T&T App and little received need (negative utility).

6.1. Limitations

Survey studies always pose difficulties for construct validity since respondents' interpretation of questions may vary across individuals and not reflect the designers' intent. We conducted a pilot study to test the comprehensibility of the survey questions and as a consequence changed the value scale we used. Nevertheless, some ambiguity in interpretation is inevitable in measuring subjective attitudes even though we included explanations and examples of values in our survey. The use of a priori value taxonomies limits insight from contextual interpretation which we controlled for by including free format responses in the survey to enable participants to volunteer their own choice of influence variables; further contextual analysis was facilitated by qualitative interview data, although the number of interview inevitable restricted the range of possible contextual interpretations. Throughout most of the survey we adopted a consistent approach with importance measures, although for Covid choice values a bipolar (valency) scale was used. As the means were all above the neutral point it appears that these Covid-related value measures were generally positive. Internal validity limitations in interpreting quantitative and qualitative measures is countered by triangulation of evidence between the interviews and the survey. This was used constructively to elaborate importance measures with valency interpretations so we could illuminate the influence predictions from the regression analysis. Interviews

and open-format survey questions were also invaluable in countering the closed-set limitation of questionnaires. External validity limitations include the sample of our respondents, who were well educated generally with a university background. Our respondents also tended to be younger and the small number of interviews limits the perspective on contextual interpretation of values as well as any tentative conclusions on the fast/slow path decision-making process. The time and context of our study with the focus on Covid limits generalization to other product acceptance and value influence studies; however, since we have argued for a contextualised perspective of IT product decisions, we regard generalization of our findings to be lessons about the variety of contextually dependent variables which may influence product-related judgements in specific contexts and our conclusions on the limited utility of generic models of value influences. Our decision not to use TAM (Davis 1987, Venkatesh and Bala 2008) as the basis for our survey limits comparison with other TAM studies; however, it did allow a more open approach which demonstrated a diverse set of influences in participants' decisions. Conclusions on the decision process followed by our respondents are limited by the low number of interviews and indirect evidence; however, we included this perspective to stimulate future research on synergies between general models such as TAM and process-oriented theories of decision making (Payne et al., 1993; Kahneman, 2011).

6.2. Conclusions and future work

A previous study on acceptance of the Covid19 App, based on the available literature and a static value-based analysis (Sutcliffe et al., 2021), suggested that security and privacy would be dominant issues, although other motivations may be important. In this study, privacy was an issue; however, app utility and perceived need from a social viewpoint were probably more important. Values may play an important part in users' choice of IT products; however, values need to be considered in combination with other variables, such as utility, compatibility and external factors relating to product provenance. IT product choice is strongly context-dependent, being influenced by the product/app type, and probably by the users' task and background, although we did not study these contextual factors explicitly. In the specific context of the Covid-19 Track and Trace App, choice was primarily influenced by one value, helpfulness and external influences of trust/mistrust in App provenance from the NHS and HMG. We conjecture that the download decision was a trade-off between these variables, with downloaders discounting privacy and provenance fears in favor of social responsibility. For non-downloaders the converse was true. Interview data revealed that perceived need also played a critical role, being a positive motivation for downloaders, while non-downloaders reported little need since they were already isolating. Further research in necessary to connect quantitative models of variable influences, such as TAM, with qualitative evidence demonstrating differences in valency and role of variables (e.g. recommendations and trust) according to different groups of users, i.e. adopters and non adopters. Another avenue is to update TAM related models for the internet age where the decision to download may have different influences compared with continued use, such as perceptions of utility in contrast to actual usage experience. We also suggest an expanded role for investigating the decision making process and how people make trade off decisions by a quick fast path or more model based slow path reasoning, similar to means ends chains (Cockton, 2020b). In future work we will investigate the role of values in other IT product acceptance contexts to explore consistencies and variations in users' decisions. Further empirical studies will be necessary to examine how users' choice judgements change over time, from adoption to continued use.

IJHCS author credit statement

Andy Darby: Preparing and running the survey, Running the

interviews, interview analysis. **Luis Paucar:** Carrying out and analyzing pilot study interviews and survey. **Nelly Bencomo:** General advice on background literature and study design. **Peter Sawyer:** General advice on background literature, Ethics submission and study design. **Alistair Sutcliffe:** Analysis of the survey, Further analysis of interviews, Study design, Preparing and writing the paper.

Declaration of Competing Interest

We have no conflicts of interest to declare as a consequence of conducting this study.

Data availability

Data will be made available on request.

Appendix A. Value questions & explanations (from Cheng and Fleischmann 2010)

Values in Life:
Please inspect the following list of values.
How important is each value in guiding decisions in your life? Please rate each value listed below by selecting one option
(1–5 unipolar scale 1. Not all important… 5. Extremely important).
Values for Product Choice
Please consider each value, listed below, and rate how important they are when deciding to purchase/download software applications.
(1–5 unipolar scale 1. Not all important… 5. Extremely important).
Values for Download Covid T&T App
Please consider each value listed below and rate the influence on your decision to download (or not) the NHS COVID-19 app.
(1–7 bipolar scale 1. Very Negative… 4 Neutral/no influence…7 Very Positive)
Value prompts- same for all 3 questions.
Synonyms in ()
Wealth – It is important to be rich, to have a lot of money and expensive things.
(Money, property, financial prosperity, ownership, profits, economy)
Accomplishment – It is important to achieve your goals, both in life and at work, and to be successful.
(Achievement, success, successful, sense of accomplishment, self fulfillment, self realization).
Self Respect – It is important to have selfworth and not to compromise yourself in any way.
(Dignity, human dignity, individuality, social recognition, preserving my public image, being well respected, identity)
Security – It is important to live in secure surroundings and to avoid anything that might endanger your safety.
(Family/ national security, survival)
Broad mindedness – It is important to listen to people who are different, even when you disagree with them you should try to understand them.
(Tolerance, broad minded, adaptability, receptivity)
Helpfulness – It is important to help people and care for their wellbeing.
(Welfare of others, helpful, concern for others, human welfare, consideration, benevolence, humanism)
Creativity – Thinking up new ideas and doing things in an original way is important.
(Imaginative, a varied life, curious, experimentation)

Honesty – It is important to be honest and open with others and to be accepting of others' honesty.

(Moral integrity, integrity, informed consent, openness)

Knowledge – It is important to be able to understand things as learning and gaining knowledge is worthwhile.

(Rational, logical, intellectual, wisdom, intelligent, objective analysis, logical)

Responsibility – It is important to take ownership of your actions and to be held accountable for their consequences.

(Accountability, social responsibility)

Competence – It is important to have the appropriate abilities to undertake tasks, and the capabilities to deliver to a standard.

(High productivity, ability, skill, leadership, capable, organizational responsibility)

Social order – It is important to behave properly and conform to agreed social rules.

(organizational stability, world at peace, order, orderliness, respect for law)

Freedom – It is important to make ones' own decisions, to be free and not to be controlled by others.

(Independent, choosing own goals, autonomy)

Equality – It is important to treat people equally and that they have equal opportunities in life.

(Freedom from bias, social equality, fair treatment, fair competition)

Justice- It is important be treat others according to the law, to be fair and equitable.

(Fairness, social justice)

Hedonism – It is important to do things that are enjoyable and to seek every chance to have fun.

(Enjoyment, pleasure, fun)

Sustainability – It is important to look after the environment, to care for it and to be concerned about threats to it.

(Greenness, ecological concerns, environmentalism)

Spirituality – not used.

References

Ahmed, N., Michelin, R.A., Xue, W., et al., 2020. A survey of Covid-19 contact tracing apps. IEEE Access 8, 134577–134601.

Bano, M., Zowghi, D., Arora, C., 2020. Requirements politics or individualism: what drives the success of COVID-19 contact-tracing apps? IEEE Softw. 38, 7–12.

Bandura, A., 1982. Self-efficacy mechanism in human agency. Am. Psychol. 37 (2), 122.

Bargas-Avila, J., Hornbæk, K., 2011. Old wine in new bottles or novel challenges: a critical analysis of empirical studies of user experience. In: Proceedings of the SIGCHI conference on human factors in computing systems, pp. 2689–2698.

Bellamy, R.K.E., Dey, K., Hind, M., Hoffman, S.C., et al., 2019. Think your artificial intelligence software is fair? think again. IEEE Softw. 76–80.

Borning, A., Muller, M., 2012. Next steps for value sensitive design. In: Proceedings of the CHI'12 SIGCHI Conference on Human Factors In Computing Systems, pp. 1125–1134.

Cacioppo, J.T., Petty, R.E., Kao, C.F., Rodriguez, R., 1986. Central and peripheral routes to persuasion: an individual difference perspective. J. Pers. Soc. Psychol. 51, 1032–1043.

Chan, E.Y., Saqib, N.U., 2021. Privacy concerns can explain unwillingness to download and use contact tracing apps when COVID-19 concerns are high. Comput. Hum. Behav. 119, 106718.

Cheng, A.S., Fleischmann, K.R., 2010. Developing a meta-inventory of human values. Proc. Assoc. Inf. Sci. Technol. 47 (1), 1–10.

Cellan-Jones, R., Kleinman, Z., 2020. NHS Covid-19 App: 12m Downloads, and Lots of Questions. BBC News. https://www.bbc.co.uk/news/technology-54326267. Accessed 28.1.22.

Cockton, G., 2020a. Worth-focused Design Book 1. Balance integration and generosity. Synthesis Lecture Series in HCI. Springer.

Cockton, G., 2020b. Worth-focused design, Book 2. Approaches, context, and Case studies. Synthesis Lecture Series in HCI. Springer.

Cockton, G., Kirk, D., Sellen, A., Banks, R., 2009. Evolving and augmenting worth mapping for family archives. In: Proceedings of People and Computers XXIII Celebrating People and Technology, pp. 329–338.

Creswell J.W., Plano Clark V.L., Gutmann M.L., Hanson W.E., 2003. Advanced mixed methods research designs, in: Handbook of Mixed Methods in Social and Behavioral Research, pp 209–240.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. 1 (3), 319–339.

Diefenback, S., Hassenzahl, M., 2009. The beauty dilemma: beauty is valued but discounted in product choice. In: Proceedings of the CHI, 2009, pp. 1419–1426.

Elkhodr, M., Mubin, O., Iftikhar, Z., et al., 2021. Technology, privacy, and user opinions of COVID-19 mobile apps for contact tracing: systematic search and content analysis. J. Med. Internet Res. 23 (2), e23467.

Fox, G., Clohessy, T., van der Werff, L., Rosati, P., Lynn, T., 2021. Exploring the competing influences of privacy concerns and positive beliefs on citizen acceptance of contact tracing mobile applications. Comput. Hum. Behav. 121, 106806.

Friedman, B., Schular, D., 2008. Value sensitive design. Liberating voices: A pattern Language For Communication Revolution. MIT Press, Cambridge MA.

Friedman, B., Kahn, P.H., 2007. Human values, ethics, and design. The Human-Computer Interaction Handbook. CRC press, pp. 1267–1292.

Granić, A., Marangunić, N., 2019. Technology acceptance model in educational context: a systematic literature review. Br. J. Educ. Technol. 50 (5), 2572–2593.

Georgieva, I., Beaunoyer, E., Guitton, M.J., 2021. Ensuring social acceptability of technological tracking in the COVID-19 context. Comput. Hum. Behav. 116, 106639.

Hart, J., Sutcliffe, A., 2019. Is it all about the apps or the device? User experience and technology acceptance among iPad users. Int. J. Hum. Comput. Stud. 130, 93–112.

Hartmann, J., Sutcliffe, A., De Angeli, A., 2009. Towards a theory of user judgment of aesthetics and user interface quality. TOCHI 15, 1–30.

Hassenzahl, M., 2004. The interplay of beauty, goodness and usability in interactive product. Hum. Comput. Interact. 19, 319–349.

Hatamian, M., Wairimu, S., Momen, N., Fritsch, L., 2021. A privacy and security analysis of early-deployed COVID-19 contact tracing: android apps. Empir. Softw. Eng. 26, 1–51.

Herzberg, F., 1968. One More time: How do You Motivate Employees (Vol. 65). Harvard Business Review, Boston, MA.

Holton, J.A., 2007. The coding process and its challenges. In: The Sage Handbook of Grounded Theory, 3. Sage, pp. 265–289.

Johnson-Laird, P.N., 1983. Mental models: Towards a cognitive Science of language, Inference and Consciousness. Cambridge University Press, Cambridge.

Kahneman, D., 2011. Thinking, Fast and Slow. Penguin Books, London.

Kheirandish, S., Funk, M., Wensveen, S., Verkerk, M., Rauterberg, M., 2020. A comprehensive value framework for design. Technol. Soc. 62, 101302.

Kim, J., Park, H.A., 2012. Development of a health information technology acceptance model using consumers' health behavior intention. J. Med. Internet Res. 14 (5), e2143.

King, W.R., He, J.A., 2006. Meta-analysis of the technology acceptance model. Inf. Manag. 43, 740–755.

Kondylakis, H., Katehakis, D.G., Kouroubali, A., et al., 2020. COVID-19 mobile apps: a systematic review of the literature. J. Med. Internet Res. 22, e23170.

Krumbholz, M., Maiden, N.A.M., Wangler, B., Bergman, L., 2000. How Culture Might Impact On the Implementation of Enterprise Resource Planning packages in Advanced Information Systems Engineering. Springer, Berlin, pp. 279–293.

Lavie, T., Tractinsky, N., 2004. Assessing dimensions of perceived visual aesthetics of web sites. Int. J. Hum. Comput. Interact. 60, 269–298.

Le Dantec, C.A., Poole, E.S., Wyche, S.P., 2009. Values as lived experience: evolving value sensitive design in support of value discovery. In: Proceedings of the CHI'09, SIGCHI Conference on Human Factors in Computing Systems. ACM, pp. 1141–1150.

Magni, M., Taylor, M.S., Venkatesh, V., 2010. To play or not to play? A cross-temporal investigation using hedonic and instrumental perspectives to explain user intentions to explore a technology. Int. J. Hum. Comput. Stud. 68, 572–588.

Maslow, A.H., Frager, R., McReynolds, C., Cox, R., Fadiman, J., 1987. Motivation and Personality. Addison Wesley-Longman, New York.

Marangunić, N., Granić, A., 2015. Technology acceptance model: a literature review from 1986 to 2013. Univers. Access Inf. Soc. 14, 81–95.

Maruping, L.M., Bala, H., Venkatesh, V., Brown, S.A., 2017. Going beyond intention: integrating behavioral expectation into the Unified Theory of Acceptance and Use of Technology. J. Assoc. Inf. Sci. Technol. 68, 623–637.

Ming, L.C., Untong, N., Aliudin, N.A., et al., 2020. Mobile health apps on COVID-19 launched in the early days of the pandemic: content analysis and review. J. Med. Internet Res. mHealth uHealth 8, e19796.

Mougouei, D., Perera, H., Hussain, W., Shams, R., Whittle, J., 2018. Operationalizing human values in software: a research roadmap. In: Proceedings of 26th ACM Joint Meeting on European Software Engineering Conference, pp. 780–784.

Nadal, C., Doherty, G., Sas, C., 2019. Technology acceptability, acceptance and adoption- definitions and measurement. In: Proceedings of the CHI'19 Conference on Human Factors in Computing Systems. ACM.

Nadal, C., Sas, C., Doherty, G., 2020. Technology acceptance in mobile health: scoping review of definitions, models, and measurement. J. Med. Internet Res. 22 (7), e17256.

Paiva, A., Leite, I., Boukricha, H., Wachsmuth, I., 2017. Empathy in virtual agents and robots: a survey. Trans. Interact. Intell. Syst. 11, 40.

Panchal, M., Singh, S., Rodriguez-Villegas, E., 2021. Analysis of the factors affecting the adoption and compliance of the NHS COVID-19 mobile application: a national cross- sectional survey in England. BMJ Open 11 (8), e053395.

Payne, J.W., Bettman, J.R., Johnson, E.J., 1993. The Adaptive Decision Maker. Cambridge. Cambridge University Press.

Penzenstadler, B., Duboc, L., Venters, C.C., et al., 2018. Software engineering for sustainability: find the leverage points! IEEE Softw. 22–33.

Pereira, R., Baranauskas, M.C.C., 2015. A value-oriented and culturally informed approach to the design of interactive systems. Int. J. Hum. Comput. Stud. 80, 66–82.

Perera, H., Hussain, W., Mougouei, D., Shams, R.A., Nurwidyantoro, A., Whittle, J., 2019. Towards integrating human values into software: mapping principles and rights of GDPR to values in 2019. In: Proceedings of the IEEE 27th International Requirements Engineering Conference, pp. 404–409.

Perera, H., Hussain, W., Whittle, J., Nurwidyantoro, A., et al., 2020. A study on the prevalence of human values in software engineering publications 2015-2018. In:

Proceedings of the IEEE/ACM 42nd International Conference on Software Engineering (ICSE), pp. 409–420.

Ramos, I., Berry, D.M., 2005. Is emotion relevant to requirements engineering? Requir. Eng. 238–242.

Rokeach, M., 1973. The Nature of Human Values. Free Press, 1973.

Schwartz, S.H., 1999. A theory of cultural values and some implications for work. Appl. Psychol. 23–47.

Sheldon, K.M., Elliot, A.J., Kim, Y., Kasser, T., 2001. What is satisfying about satisfying events? Testing 10 candidate psychological needs. J. Pers. Soc. Psychol. 80, 325–339.

Shilton, K., 2018. Values and ethics in human-computer interaction. Found. Trends Hum. Comput. Interact. 12 (2), 107–171.

Spool J.M. (2022), Inherent Value Testing. https://articles.uie.com/inherent_value_testing/ [articles.uie.com], Center + Centre Inc, MA., accessed 13.7.2023.

Sutcliffe, A., Sawyer, P., Liu, W., Bencomo, N., 2021. Investigating the potential impact of values on requirements and software engineering. In: Proceedings of the IEEE/ACM 43rd International Conference on Software Engineering: Software Engineering in Society ICSE-SEIS), pp. 39–47.

Thew S., 2015. Value-based requirements engineering. PhD Thesis, University of Manchester.

Thew, S., Sutcliffe, A., 2018. Value-based requirements engineering: method and experience. Requir. Eng. 443–464. https://doi.org/10.1007/s00766-017-0273-y.

Tomczyk, S., Barth, S., Schmidt, S., Muehlan, H., 2021. Utilizing health behavior change and technology acceptance models to predict the adoption of COVID-19 contact tracing apps: cross-sectional survey study. J. Med. Internet Res. 23 (5), e25447.

Tuch, A.N., Hornbæk, K., 2015. Does herzberg's notion of hygienes and motivators apply to user experience? ACM Trans. Comput. Hum. Interact. 22 (4), 24. https://doi.org/10.1145/2724710 pages[doi.org].

Urbaczewski, A., Lee, Y.J., 2020. Information technology and the pandemic: a preliminary multinational analysis of the impact of mobile tracking technology on the COVID-19 contagion control. Eur. J. Inf. Syst. https://doi.org/10.1080/0960085X20201802358.

Van Rhoon, L., McSharry, J., Byrne, M., 2022. Development and testing of a digital health acceptability model to explain the intention to use a digital diabetes prevention programme. Br. J. Health Psychol. 27 (3), 716–740.

van der Velden, M., Abdelnour-Nocera, J., et al., 2016. Design as regulation: opportunities and limitations for sustainable mobile phone design. In: Proceedings of CaTaC 2016. IFIP- Springer, pp. 32–54. https://doi.org/10.1007/978-3-319-50109-3_3, 2016.

Velicia-Martin, F., Cabrera-Sanchez, J.P., Gil-Cordero, E., Palos-Sanchez, P.R., 2021. Researching COVID-19 tracing app acceptance: incorporating theory from the technological acceptance model. PeerJ Comput. Sci. 7, e316.

Venkatesh, V., Bala, H., 2008. Technology acceptance model 3 and a research agenda on interventions. Decis. Sci. 39, 273–315.

Venkatesh, V., Davis, F.D.A., 2000. Theoretical extension of the Technology Acceptance Model: four longitudinal field studies. Manag. Sci. 46, 186–204.

Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D., 2003. User acceptance of information technology: toward a unified view. MIS Q. 27, 425–478.

Venkatesh, V., Thong, J.Y.L., Xu, X., 2012. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS Q. 157–178.

Viega, J., Kohno, T., Potter, B., 2001. Trust (and mistrust) in secure applications. Commun. ACM 31–36.

Voida, A., Mynatt, E.D., 2005. Conveying user values between families and designers. In: Proceedings of the CHI'05 Extended Abstracts On Human Factors in Computing Systems, pp. 2013–2016.

Whittle, J., Ferrario, M.A., Simm, W., Hussain, W., 2019. A case for human values in software engineering. IEEE Softw. 38 (1), 106–113.

Williams, M.D., Rana, N.P., Dwivedi, Y.K., 2015. The Unified Theory of Acceptance and Use of Technology UTAUT: a literature review. J. Enterp. Inf. Manag. 28, 443–488.

Yousafzai, S.Y., Foxall, G.R., Pallister, J.G., 2007. Technology acceptance: a meta-analysis of the TAM (Part 1). J. Model. Manag. 2, 251–280.

Zdravkovic, J., Svee, E.O., Giannoulis, C., 2015. Capturing consumer preferences as requirements for software product lines. Requir. Eng. 71–90.