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Towards a Theory to Explain the Effect of Uncertainty on Prosocial Data Disclosure

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Towards a Theory to Explain the Effect of Uncertainty on Prosocial Data Disclosure

Short Paper

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Abstract

Privacy research widely assumes that individuals are less likely to disclose their data if they are uncertain about the consequences of their disclosure decision. This negative effect has been confirmed in various contexts where individuals disclose their data primarily for their own benefit. However, recent studies in behavioral science provide evidence that uncertainty may have a different effect in prosocial contexts. Transferring this to the privacy and data disclosure context, our research study aims to better understand how uncertainty influences prosocial data disclosure, i.e., situations where individuals disclose their data to benefit others. In this short paper, we present the results of qualitative interviews conducted with 19 users of a COVID-19 contact-tracing application and develop hypotheses on how the relevant context-specific uncertainties affect prosocial data disclosure. We hypothesize that a specific type of uncertainty—other-focused impact uncertainty—is positively associated with prosocial data disclosure.

Keywords: Prosocial Data Disclosure, Uncertainty, Outcome Uncertainty, Impact Uncertainty

Introduction

Individual data disclosure behavior is often not only motivated by personal benefits and risks (e.g., Dinev and Hart 2006; Krasnova et al. 2010; Xu et al. 2009) but can also be motivated by the benefit of others. Some prominent examples are voluntary infection disclosure in COVID-19 contact-tracing applications, personal health data sharing for medical research purposes, or personal data donation to scientific research. In all these contexts, the benefits for others and society play a crucial role when disclosing personal data (e.g., Skatova and Goulding 2019; Thiebes et al. 2017; Trang et al. 2020). As these types of disclosures can be classified as a form of prosocial behavior, we define them as ‘prosocial data disclosures’,¹ which refers to data disclosures characterized by the intention to benefit others.

A fundamental characteristic and determinant of individuals’ decision-making process is the perception of uncertainty about the possible outcomes and their consequences (Acquisti and Grossklags 2007). In general, privacy research assumes that uncertainty negatively affects data disclosure if individuals are uncertain about the outcomes and the consequences (Acquisti et al. 2015; Acquisti and Grossklags 2007;

¹ In a second paper we present at ICIS 2023 with the title „Towards a Theory to Explain Prosocial Data Disclosure – An Explorative Investigation of the Antecedents of Infection Disclosure“ we introduce the context of prosocial data disclosure in more detail and elaborate on the specific antecedents of infection disclosure in the context of COVID-19 contact-tracing applications.

Al-Natour et al. 2020; Pavlou et al. 2007). Our research aims to challenge this assumption in the context of prosocial data disclosure. We do this by transferring findings from the literature on prosocial behavior (Crockett et al. 2014; Kappes et al. 2018) to the context of privacy decision-making and propose that in the context of prosocial data disclosure, the concept of uncertainty has to be investigated more fine-grained.

The literature about prosocial behavior distinguishes between two types of uncertainty in prosocial decision-making: outcome uncertainty and impact uncertainty (Kappes et al. 2018). Outcome uncertainty is understood as the uncertainty about whether or not a decision will lead to a particular outcome, while impact uncertainty refers to the uncertainty about how others' well-being will be impacted by the outcome (Kappes et al. 2018). Depending on which type of uncertainty is predominantly perceived, uncertainty has either a negative or a positive effect on the willingness to behave prosocial (Crockett et al. 2014; Dana et al. 2007; Kappes et al. 2018). The different effects of the two types of uncertainty stem mainly from whether the perceived uncertainty activates more self-focused narratives allowing the person to act selfishly, or whether it activates other-focused narratives that prioritize the well-being of others resulting in prosocial behavior (Kappes et al. 2018). We attempt to transfer this knowledge to the context of privacy and prosocial data disclosure. We argue that uncertainty, divided into outcome uncertainty and impact uncertainty, does not per se have a negative effect on the intention to disclose personal information as it is assumed in previous privacy research but rather depends on the narratives that are activated by the perceived uncertainty. Thus, our research is guided by the following three research questions:

1. Which types of uncertainty are present in the context of prosocial data disclosure?
2. Which of these uncertainties are most relevant for the prosocial data disclosure decision?
3. How do the relevant types of uncertainty affect prosocial data disclosure?

In this short paper, we aim to answer the first and second research questions. We present the results of qualitative interviews conducted with 19 users of a central European contact-tracing application. Our results suggest that in the investigated context of prosocial data disclosures, both outcome and impact uncertainty are perceived from a self-focus as well as an other-focus. Based on the interviews and existing theories on prosocial behavior, we develop hypotheses about how the most relevant uncertainties may influence prosocial data disclosure. The next step of our ongoing research project is to conduct an empirical survey to test these hypotheses to address the third research question. Our ongoing research project informs theory and practice in different ways. We contribute to privacy literature (Acquisti and Grossklags 2007; Al-Natour et al. 2020; Pavlou et al. 2007) by exploring uncertainty and its effect on prosocial data disclosure in a more fine-grained way. In particular, our research complements studies that focus on the social calculus (Wagner et al. 2018) by highlighting the relevance of uncertainty as an important predictor for individuals' disclosure decisions. Practically, our research provides relevant insights to operators of information systems that rely on prosocial data disclosures.

Theoretical Background

(Self-Focused) Data Disclosure

Data disclosure, in general, refers to the practice of individuals revealing their personal data and information to another party (Wakefield 2013). One of the most used theories in explaining individuals' data disclosure behavior is the privacy calculus which conceptualized privacy as a commodity, i.e., privacy is assigned to an economic value that is considered in a cost-benefit trade-off (Smith et al. 2011). The privacy calculus stipulates that people act rationally and accept certain information privacy risks in exchange for some perceived benefits (Dinev and Hart 2006). In different contexts such as e-commerce, online social networks, and location-based services, various privacy studies have shown that individuals typically consider benefits and risks from a self-focused perspective when deciding whether to disclose personal data (Dinev and Hart 2006; Krasnova et al. 2010; Xu et al. 2009). Thereby, benefits are perceived as personal gains from the data disclosure and mostly take the form of financial rewards, personalization, or social adjustments (Smith et al. 2011) while privacy risks are viewed as the major barrier to data disclosure (Featherman and Pavlou 2003; Krasnova et al. 2010). Thus, the self-focused data disclosure reflects an outcome of an intrapersonal trade-off in which individuals weigh personal benefits against privacy risks.

Prosocial Behavior and Prosocial Data Disclosure

Prosocial behavior refers to any behavior or action that is intended to help or benefit others (Batson et al. 2008; Piliavin and Charng 1990). Examples of prosocial behavior are blood donation, volunteering work, or helpful interventions (Batson et al. 2008; Skatova and Goulding 2019). The antecedents of prosocial behavior are well-studied: a variety of personal, motivational, emotional, contextual, and situational factors can elicit prosocial behavior (Batson et al. 2008; Piliavin and Charng 1990). One substantial determinant is altruism. In contrast to selfish-oriented people who try to maximize their own welfare, altruists are driven by the ultimate goal to benefit others (Batson et al. 2008; Piliavin and Charng 1990). A well-known theory in explaining prosocial behavior is the Norm Activation Model (Schwartz 1977). According to this model, personal norms (i.e., feeling a moral obligation to perform or refrain from specific actions), awareness of consequences (i.e., being aware of the negative consequences for others when not behaving prosocial), and ascription of responsibility (i.e., feelings of responsibility for the negative consequences of not behaving prosocial) predict prosocial behavior (De Groot and Steg 2009; Schwartz 1977).

In various data disclosure contexts such as using contact-tracing applications to help others, health data sharing to facilitate medical research, or personal data donation, individuals behave prosocial and disclose their data to benefit others (Skatova and Goulding 2019; Thiebes et al. 2017; Trang et al. 2020). We label these types of data disclosure as 'prosocial data disclosure' and define it as a form of prosocial behavior where individuals disclose their data with the intention to benefit others. We argue that it is necessary to consider prosocial data disclosures differently from previously examined self-focused data disclosures because individuals do not focus only on the benefits and risks to themselves but more importantly, they consider others' well-being when making a decision. In other words, the decision to engage in prosocial data disclosure is assessed mainly from an other-focused perspective.

Uncertainty in Data Disclosure

Uncertainty refers to the extent to which an individual cannot anticipate or accurately predict the future environment due to imperfect information (Pavlou et al. 2007). A closely related concept is risk which is associated with specific consequences (Al-Natour et al. 2020). In privacy literature, risk has been measured using the expectancy-value methodology by multiplying the a priori calculable probability of loss or exposure with the cost of that loss or exposure, e.g., an individual is able to assign objective known probabilities to possible outcomes such as the loss of control over personal information (Acquisti and Grossklags 2007; Al-Natour et al. 2020; Featherman and Pavlou 2003). Uncertainty, in contrast, relates to individuals' inability to accurately assess the outcomes and consequences as a result of imperfect information and thus is conceptually different from risk (Al-Natour et al. 2020).

Privacy research widely assumes that uncertainty negatively affects data disclosures in such a way that individuals are less likely to disclose their data when they are uncertain about the consequences for themselves (Acquisti et al. 2015; Acquisti and Grossklags 2007; Al-Natour et al. 2020; Pavlou et al. 2007). Thereby, most studies only focus on the perception of uncertain negative outcomes and treat benefits as static. However, in most contexts, data disclosures also include, to some degree, uncertainty regarding the benefits. This is of particular importance in the context of prosocial data disclosure, where benefits are not limited to the individual but primarily affect others.

The relevance of uncertainty becomes even more apparent when considering the characteristics of prosocial data disclosure. Compared to self-focused data disclosure, prosocial data disclosure is still a relatively new phenomenon that has gained considerable prominence just in recent years. In addition to possibly having less experience with such data disclosures, the benefits of prosocial data disclosure are often uncertain, both before and often even after the data disclosure. For example, when deciding whether to share personal health data to facilitate medical research, an individual might be unable to accurately assess the concrete benefits, as it is unclear if and how the donated data will be used to gain new medical research insights or who exactly will benefit from the donated data. This benefit uncertainty in prosocial data disclosure makes it for individuals, compared to self-focused data disclosure, even more difficult to anticipate or accurately predict the effects of their data-disclosure decision on the future environment due to imperfect information.

Prosocial behavior literature differs between two types of uncertainty, namely outcome uncertainty and impact uncertainty (Kappes et al. 2018). According to the authors, outcome uncertainty refers to uncertainty about whether or not a decision will lead to a particular outcome. In contrast, the impact

uncertainty relates to uncertainty about how others' well-being will be impacted by the outcome.² Although individuals often face two similar types of uncertainty in privacy-related decision-making situations, i.e., what outcome may occur in different contexts and with what consequences (Acquisti and Grossklags 2007), to date, most privacy studies have examined the effect of uncertainty at a coarse-grained level and have not distinguished explicitly between these two layers. However, such a more fine-grained differentiation is highly relevant in the context of prosocial data disclosure because recent prosocial behavior literature (Kappes et al. 2018) provides evidence that uncertainty does not always have a negative effect on prosocial behavior but can also be sometimes positive. Transferring this to the privacy context, we, therefore, call for a more fine-grained investigation of the effects of uncertainty on individuals' prosocial data disclosure.

Qualitative Interviews

Method

To answer the first research question, i.e., which types of uncertainty are present in the context of prosocial data disclosures, we conducted qualitative interviews. We consider qualitative interviews as an appropriate research method for our purpose (Myers and Newman 2007) as they allow us to create in-depth contextual, nuanced, and authentic accounts of participants' experiences and interpretations, thereby producing informative, novel accounts of the phenomenon of interest (Schultze and Avital 2011).

To make prosocial data disclosures more tangible for the participants and to compare participants' answers, we focused on one specific context: voluntary infection disclosure in COVID-19 contact-tracing applications. We explicitly chose this context for the following three reasons. First, voluntary infection disclosure is a prominent instance of prosocial data disclosure as it exhibits a high degree of prosocial benefits with almost no direct personal benefits. Second, these apps were introduced in a very short timeframe, and as such they were new to most users who had no or very less experience with contact-tracing applications at this time (Bitzer et al. 2021). The unproven effectiveness and the potential unknown consequences of using these apps at the time further increased uncertainty (Bitzer et al. 2021). And third, although the importance of COVID-19 has recently declined in many countries, contact-tracing applications are still relevant in other health contexts such as tuberculosis or Ebola and/or in other countries.

All interviews were conducted in February 2023 by one author using a semi-structured approach (Schultze and Avital 2011). The participants were recruited from this author's personal environment. Only users who downloaded the investigated central European contact-tracing application and were infected with COVID-19 at least once could participate as we were interested in how they perceived uncertainty when facing the real-life situation to disclose their infection. At the time of the interviews, the participants were between 24 and 70 years old, with an average age of 34. The total of 19 interviewees were 11 women and 8 men. Each interview was conducted either in person or online, lasts about 20 min and was transcribed.

After a brief introduction, participants were asked questions about their experience with COVID-19 and contact-tracing applications. When asked about their reasons for downloading the app, participants cited both personal motives (warning of infections, improved risk assessment) and prosocial motives (warning others of infections, reducing further infections, reciprocity). The main part of the interview addressed questions about participants' perception of uncertainty when faced with the real-life decision to disclose their infection. Specifically, we asked participants to comment on several statements and to reflect on how the perceived uncertainty at the time influenced the potential benefits and consequences for themselves and others. The interviews ended with a summary of the answers and some concluding comments, if any.

To analyze the interview data, we followed methodological guidelines for content analysis (Matthew B and A Michael 1994; Miles and Huberman 1994). Content analysis is frequently used in IS research to qualitatively categorize primary data collections described in transcribed interviews (Coners and Matthies 2014). To do so, we reviewed the transcribed interviews and derived iteratively and inductively the different types of uncertainty that are present in the investigated context. We subsequently classified them among

² The following example from Kappes et al. (2018) illustrates the difference: a person who is sick and possibly contagious can either go to work to complete a very important project for their career, or behave prosocial and stay home to avoid infecting a colleague. In this example, outcome uncertainty refers to the uncertainty about whether the person will infect another colleague. In contrast, impact uncertainty refers to the uncertainty about how badly another colleague might suffer from the infection.

the four dimensions: self-focus (i.e., uncertainty is related to one’s own well-being), other-focus (i.e., uncertainty is related to other’s well-being), outcome uncertainty (i.e., uncertainty is related to the outcome of the decision), and impact uncertainty (i.e., uncertainty is related to the impact of the associated outcome).

Results

In total, seven different types of uncertainty emerged from the interviews which are summarized in Table 1. Thereby, each listed impact uncertainty is the result of the corresponding outcome uncertainty. In the following, we will explain each uncertainty type briefly by first introducing the outcome uncertainty followed by the corresponding impact uncertainty.

	Outcome Uncertainty	Impact Uncertainty
Self-focus	Uncertainty about preserving anonymity →	Uncertainty about the consequences of not preserving anonymity
	Uncertainty about data handling practices →	<i>No uncertainty</i>
Other-focus	Uncertainty about the reliability of the app’s function →	Uncertainty about whether others will be negatively affected by the warning
	Uncertainty about whether informed users take appropriate measures →	Uncertainty about the consequences to others when not disclosing the infection
Table 1. Context-Specific Uncertainties in Infection Disclosure		

According to self-focused uncertainty, some participants indicated **uncertainty about data handling practices** as they were uncertain about how their data are collected, used, protected, stored, and controlled. The following statement exemplifies the uncertainty about the data storage period: “...that these movement patterns are simply not only recorded in the sense of Corona, but you don’t know. So that it’s there permanently, I don’t know how long it’s stored, when it’s deleted again. They [the app provider] do state that, but you don’t know whether that’s really true”. However, none of the participants was uncertain about the personal consequences in the event of a data breach or similar. Many participants were of the opinion that the donated data are rather insensitive and anonymized, offering little information value and thus only a small to no surface for the attack of further use or misuse.

Another uncertainty related to self-focused uncertainty is the **uncertainty about preserving anonymity**, as there was a risk of being identified. This includes a general uncertainty about the possible unknown outcomes of being identified, as illustrated by the following statement from a participant: “...the question is, what can you find out with this data, who gets it and how easy is it to link it to me, how anonymous is it really? And what can they find out about me?”. This uncertainty resulted in **uncertainty about the consequences of not preserving anonymity**, such as prejudice in society if the infection could be traced back to the individual. However, the participants also stated that today this uncertainty plays no more important role than at the beginning of the pandemic when social pressure was high.

Related to other-focused uncertainty, the interviews indicate that participants perceived **uncertainty about the reliability of the app’s function**, i.e., all relevant contact persons are warned at the right time, as one participant said: “...and I also wonder sometimes how some warnings come about, just recently, for example, I had five warnings at once, then again, no message at all for months. So, I’m not so sure if it’s all true.” In this regard, some participants also raised the uncertainty about whether distance measurement and contact detection are correct and technically accurate. As a result, some participants had therefore no or less trust in the reliability of the app’s function. Apart from these technical uncertainties, some participants also mentioned that they were uncertain about whether all contact persons can be warned if they do not run a contact-tracing application because they might not have downloaded the app, or they do not use an app-compatible smartphone. In the case that the app warns correctly, some participants stated that they perceived **uncertainty about whether others will be negatively affected by the warning**, e.g., plans will have to be changed or negative emotions may be evoked, as one participant said: “... I was somewhat uncertain because of course, you don’t know how the other people will react to this result” and “... sometimes you get the feeling that it then creates a lot of panic among some people, even if it was unjustified”. And another participant told “...if I share that [the test result] now, that would be then virtually associated with isolation [...] Accordingly, one did not want to destroy anyone’s “life”. So, those

were the uncertainties I had before I entered it". To better situate this last statement in its context, it is important to know what consequences individuals faced when they received a warning. In the event of an app warning, the government had strong recommendations for action (e.g., self-isolation and testing), but these protective measures as well as the app use were voluntary at all times during the pandemic and there were no automatic consequences to fear.

Finally, the second type of other-focused outcome uncertainty is **uncertainty about whether informed users take appropriate measures** when they are informed about a potential risk of infection, as one participant stated: "You have the positive intention to warn others and to give them time to test themselves and to take measures. But of course, you don't know [...] how they will implement these measures." In contrast to this outcome uncertainty, participants also perceived **uncertainty about the consequences to others when not disclosing the infection**. This uncertainty was often mentioned in connection with the uncertainty about whether others will be negatively affected by the warning, as the following statements illustrate: "As much as you may be concerned about well-being [causing negative emotions] there, but if they infect other people, then yes, that's bad and then another well-being is at risk [contagions]" or "...otherwise [when not disclosing the test result], people are not warned at all".

To answer our second research question, i.e., which of the identified uncertainties are of particular relevance, we rely on empirical evidence from our interviews. Overall, participants indicated that the decision to disclose the infection was mainly influenced by three other-focused uncertainties (uncertainty about the reliability of the app's function, uncertainty about whether informed users take appropriate measures, and uncertainty about the consequences to others when not disclosing the infection) while the remaining uncertainties did not play a large role in their decision process.³ Based on these statements, we focus below only on the three uncertainties mentioned above.

Hypotheses Development

To address our third research question, i.e., how do the relevant types of uncertainty affect prosocial data disclosure, in this chapter, we develop in the first step the corresponding hypotheses.

Uncertainty about the reliability of the app's function and uncertainty about whether informed users take appropriate measures are both examples of other-focused outcome uncertainty. Generally, outcome uncertainty represents a psychological state in which the decision maker lacks knowledge about what outcome or event will result from what choice (Platt and Huettel 2008). Thereby, outcome uncertainty bears on the decision maker's responsibility as their choice will affect the outcome. A large body of research suggests that outcome uncertainty has a negative effect on prosocial behavior (e.g., Dana et al. 2007; Exley 2016; Kappes et al. 2018) because uncertainty activates self-focused narratives which allows people to behave selfishly while maintaining a positive self-image (Bénabou et al. 2018). People optimistically underestimate the likelihood that self-focused behavior will have negative outcomes for others, making self-focused behavior seem more appropriate for themselves (Bénabou et al. 2018; Dana et al. 2007; Kappes et al. 2018). This aspect is strengthened by the perception of social norms, as selfish behavior seems appropriate in the presence of outcome uncertainty (Platt and Huettel 2008).

When we analyzed the interviews, we found additional empirical support for this line of reasoning. For example, some participants cited uncertainty about the reliability of the app's function as a reason not to disclose their infection, as one participant explained that they often received warnings that later turned out not to be positive, so they saw no benefit in disclosing their own infection. Another participant argued that the warning would not have been of any use to the contact persons due to the time delay since the infection took place at an event that subsequently turned out to be a "spreader event" and that the participants of this event were, therefore, certainly already informed or even infected. In the case of uncertainty about whether informed users take appropriate measures, one participant explained that this may be a reason not to disclose the infection because others who are warned do not care. Such explanations indicate that the participants exploited the "moral wiggle room" (Dana et al. 2007) to behave selfishly, i.e., not disclosing the

³ The lower relevance of self-focused uncertainties for the disclosure decision can be explained by the very high trust in the app provider and the expectation that personal consequences in the case of a data breach or similar are neglectable as the donated data are rather insensitive and anonymized. The uncertainty about whether others will be negatively affected by the warning also had no influence on the decision of all interviewees because the health of others was given a higher priority than causing negative emotions.

infection, when they were uncertain about the outcome of their decision. Based on the given theoretical explanations and the indications from the interviews, our first hypothesis is as follows:

Hypothesis 1: *Other-focused outcome uncertainty in the context of COVID-19 contact-tracing applications is negatively associated with prosocial data disclosure.*

Uncertainty about the consequences to others when not disclosing the infection is a form of impact uncertainty, which represents the uncertainty about how others' well-being will be impacted by the outcome of the decision not to behave prosocially (Kappes et al. 2018). In contrast to outcome uncertainty, which can help to assess responsibility, impact uncertainty relates to the welfare of others and is used to assess the magnitude of harm (Buckholtz et al. 2015; Kappes et al. 2018). The effects of impact uncertainty on prosocial behavior have been less studied than the effect of outcome uncertainty. However, first studies suggest that impact uncertainty increases rather than decreases prosocial behavior (Crockett et al. 2014; Kappes et al. 2018). Impact uncertainty may induce social precautionary preferences in which people prefer to avoid the worst-case scenario (Crockett et al. 2014). This may activate other-focused narratives which lead people to think more about protecting the welfare of potentially vulnerable others, thereby increasing their prosocial behavior (Kappes et al. 2018).

The conducted interviews provide additional empirical support for this rationale, especially when the participants faced the situation that they are uncertain about the consequences of non-prosocial behavior, i.e., not disclosing the infection. All participants explained that they would disclose their infection to not risk the well-being of others because otherwise, vulnerable individuals could not be warned, and thus further contagions would not be prevented. One participant argued that by disclosing the infection, there is at least a possibility that a few people will be warned, rather than no one being warned at all. Such a statement illustrates that individuals indeed think more about the worst-case scenario and try to avoid this when they are uncertain about the consequences to others. Based on the given theoretical explanations and the indications from the interviews, our second hypothesis is as follows:

Hypothesis 2: *Other-focused impact uncertainty in the context of COVID-19 contact-tracing applications is positively associated with prosocial data disclosure.*

Preliminary Discussion

In various important contexts, individuals disclose their data to benefit others. We define these types of data disclosures as prosocial data disclosure. Based on a literature review and 19 qualitative interviews, we argue that the effect of uncertainty on prosocial data disclosure should be analyzed in a more fine-grained way. So far, privacy research widely assumes that perceived uncertainty has a negative effect on individuals data disclosure (Acquisti et al. 2015; Al-Natour et al. 2020; Pavlou et al. 2007). However, prosocial behavior literature provides evidence that uncertainty can have positive effects on prosocial behavior if uncertainty activates other-focused narratives (Crockett et al. 2014; Kappes et al. 2018). To explore this mechanism in more detail, we conducted qualitative interviews with 19 users of a central European COVID-19 contact-tracing application. Our results suggest that the effect of uncertainty can be studied from different dimensions, e.g., self-focus vs. other-focus or outcome vs. impact uncertainty. Based on existing theories on prosocial behavior (Crockett et al. 2014; Kappes et al. 2018) and the interviews, we hypothesize that one specific type of uncertainty, namely other-focused impact uncertainty, positively affects prosocial data disclosure. In the next step, we plan to conduct an empirical online survey to test our hypotheses. Our ongoing research study aims to achieve the following expected theoretical and practical contributions:

First, we contribute to privacy literature (Acquisti et al. 2015; Al-Natour et al. 2020; Pavlou et al. 2007) by exploring the effect of uncertainty on prosocial data disclosure in a more fine-grained way. We focused our study on the context of COVID-19 contact-tracing applications. However, we believe that our findings can be transferred to other prosocial contexts, such as sharing health information for medical research purposes (e.g., Thiebes et al. 2017) or data donation (e.g., Skatova and Goulding 2019). This can be extended even further if it is considered that other types of data disclosure at least partly contain prosocial elements; for example, in online social media or knowledge-sharing platforms, individuals' motivation for disclosing their data is at least partly to benefit others (e.g., Wagner et al. 2018; Wasko and Faraj 2005). Another implication of our research is that we provide first empirical evidence calling for future studies focusing on the social calculus (Wagner et al. 2018) to examine uncertainty as an important predictor for individuals' disclosure decisions. Additionally, with our study, we respond to Skatova and Goulding's (2019) call for

research to investigate the impact of uncertainty on data donation, as we consider data donation as a form of prosocial data disclosure.

Second, this study contributes to the literature about prosocial behavior (Batson et al. 2008; Bénabou et al. 2018; Dana et al. 2007; Kappes et al. 2018) in two ways. On the one side, we introduce prosocial data disclosure as a distinct type of prosocial behavior. Although the intention to help others is present in both actions, prosocial data disclosure differs from ordinary prosocial behavior in the aspect of "costs." While traditional prosocial behavior activities like the donation to a charity or volunteering work involve the loss of personal resources such as money, time, or energy (Batson et al. 2008), prosocial data disclosure is "paid" by taking privacy risks. While the resource "data" remains in the possession of the helping individual, privacy risks might be evaluated differently and riskier than in the donation of material goods and assets in the case of traditional prosocial behavior activities. On the other side, we add to the research stream investigating the effect of uncertainty on prosocial behavior (e.g., Bénabou et al. 2018; Dana et al. 2007; Kappes et al. 2018). By examining uncertainty from multiple dimensions (self-focus vs. other-focus; outcome vs. impact uncertainty), a reasonable next step for future studies in this research stream could be to study in more depth the effects of uncertainty by, for example, using our proposed dimensions.

Our findings also inform practitioners, especially operators of information systems that rely on prosocial data disclosure. In particular, our research study provides insights into the mechanisms of how different uncertainties might elicit prosocial behavior. In line with Kappes et al. (2018), these insights can be used to communicate and highlight the effects of uncertainty to nudge users toward prosocial data disclosures.

Our study also provides avenues for future research. Related to the applicability of our findings which are highly specific to the context of COVID-19 contact-tracing apps, future research could explore in more detail the boundary conditions for other prosocial data disclosures. We assume that the developed hypotheses generally apply to all contexts of prosocial data disclosure. However, in some contexts, the effect might be stronger than in others. Furthermore, our study examined the effect of four dimensions of uncertainty (self-focus vs. other-focus; outcome vs. impact uncertainty). However, we suggest that future research could investigate the effect of uncertainty from other perspectives that lead to other dimensions of uncertainty, e.g., risk vs. benefit uncertainty. Overall, we hope that our study can be a valuable starting point for future research to further explore the effect of uncertainty on data disclosures in a more fine-grained way.

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