Curse or Blessing? Combining Personality Traits and Technology Acceptance to Investigate the Intention to Use of Digital Contact Tracing in Germany

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Abstract

In order to trace the transmission of COVID-19, digital contact tracing (DCT) provides an enormous value for the public health. However, the acceptance of the German contact tracing app, the Corona-Warn-App (CWA), falls short of the expected coverage in the general public. Accordingly, this study focuses on investigating the influencing factors on the CWA's acceptance to demystify the missing puzzle and to face future pandemics. To assess this objective comprehensively, we investigate personality traits (guiding perception and behavior), subjective norm (expressing social influence), and trust in technology on acceptance variables. Our empirical results emphasize that besides the personality traits conscientiousness and agreeableness, perceived usefulness, subjective norm, and trust in technology play a vital role for engagement with the CWA. Our research offers starting points for the use of mobile health solutions, particularly in early epidemic stages.

1. Introduction

COVID-19 claims millions of deaths, destroying livelihoods with enormous challenges for the public healthcare capacities and societies [1]. While time-intensive manual contract tracing is not able to reconstruct close proximity contacts, digital and mobile health solutions support understanding and monitoring the chains of transmission [2]. Particularly, digital contact tracing (DCT) provides immediate notification and predicts the risk of an infection. For our research, we follow the World Health Organization and define DCT as app-based technologies, assisting to inform unknown contacts and providing complete identifications through proximity tracing [3]. Using DCT is, therefore, an effective approach in early stages of outbreaks, e.g., Ebola and COVID-19 [3, 4]. DCT is declared as an extremely essential element in the fight against COVID-19 [3] and similar pandemics [1] that are highly likely in the future and that need to be prevented. While certain countries respond to the overwhelmed health system with fully centralized surveillance and tracking of location data, other countries search for solutions that consider individual and collective interests [5].

DCT can, however, be a double-edged sword, as it raises significant concerns, such as the collection of personal data [2, 6], the protection of privacy [6], ethical challenges, and legal challenges [7]. This kind of intervention involves data matching with public health authorities and the disclosure of information on health status [1]. Since we create a different access point, such debates are beyond the scope of our research.

In a cross-cultural study on public support for DCT, the German general public expresses restraint in using these applications [8]. DCT appears not to provide a distinct benefit to the user. For this reason, our study analyzes the influencing factors on the German DCT, the Corona-Warn-App (CWA), offering risk assessments of an infection and preventing the transmission [9]. In fact, the consideration of an intervention to minimize societal costs via effective quarantines instead of complete lockdowns [10] might turn out to fail, as the actual usage of the CWA does not meet its expectations. The following emerging and unanswered questions arise from this case: What are the influencing factors persuading users to accept DCT? Are the characteristics of a technology more deciding than the personality traits of an individual?

While the technology acceptance model (TAM) theorizes the external influences on the intention to use and explains and predicts the users' behavior [11, 12], this approach fails to consider individual characteristics leading to an engagement with the technology. Research has proven that various factors on acceptance, such as social influence, subjective norm [13–16], and trustworthiness of a technology [17, 18], are of great importance. Besides the TAM, we assess the most important factor on the acceptance, the individual's personality, as research emphasizes that personality controls individual behavior [15] and that it influences

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the individual's decision-making process [19]. For instance, in the context of DCT being beneficial to the public health and welfare and being related to other mobile health issues and their solutions (e.g. wearables) too, it is essential to widen our scope and to gain a deeper understanding of the DCT's voluntary use. In contrast, current research is limited to investigate the acceptance antecedents, especially with attention to the correlation between the theoretical constructs of the TAM involving measurable indicators, and personality [20–24]. Consequently, our study endeavors to close this research gap by using the case of the CWA.

Our research objectives are threefold: The first research question analyzes if the TAM is appropriate for predicting the CWA's acceptance. The second research objective verifies the effects of subjective norm and trust in technology. The third research objective proves the influence of personality traits. Our contribution studying the CWA is to solve the missing puzzle for DCT's acceptance: At the time of our survey, perceived usefulness, social influence, and trustworthiness have great impact, as do conscientiousness and agreeableness. In the long run, our findings offer vital options in the field of mobile health information and solutions, with attention to crisis situations. Our proposed research model puts forward the understanding of the influencing factors on DCT's acceptance.

2. Theoretical background and conceptual development

2.1. Corona-Warn-App

As the transmission of COVID-19 has not yet been fully researched, it requires timely and accurate identification of close proximity contacts. Launched in June 2020 and using Bluetooth Low Energy Standard for signal exchange [9], the proximity-sensing CWA, designed as an open source solution in Germany, is a decentralized approach of DCT. Data storage takes place exclusively on the users' smartphones with a time-limited retention [5]. Information about close proximity contacts is exchanged via encrypted identification numbers [9]. An application programming interface enables smartphones of both operating systems (iOS and Android) to deliver exposure notifications to each other [9], supporting to remember recent events or locations, the distance, and the duration of exposition [9].

If the CWA's usage rate and its coverage within the general public stays low, a high ambiguity of potential risk of undetected infections remains. In fact, the CWA's benefit increases exponentially with the number of users [25]. In order to exploit the potential and due to the protective context of DCT, it is fundamental to understand the psychological promotors as well as the inhibitors that influence the acceptance of these technologies [26].

2.2. Acceptance model enhanced by personality traits

Acceptance evolves from attitude, willingness, and is also influenced by external factors, e.g., persuasive communication; system, personality and demographic characteristics [11–14]. The TAM analyzes these effects using two main determinants: perceived usefulness (PU) and perceived ease of use (PE) [11, 12, 14]. Both variables relate to the attitude toward use (ATT) and affect the intention to use (IU) [11, 12].

However, attitude toward use and intention to use cannot be revealed solely through system attributes and characteristics [12, 14, 15]. For instance, DCT and health information are an extremely sensitive topic, particularly since they involve the exertion of social pressure in a crisis [27], the subjective norm (SN) [13–16] has to be considered too. Referring to the theory of reasoned action, the subjective norm is formed by social influences and the expectation of others [15, 16], as, for example, confirmed for the acceptance of wearables [28]. At the same time, the reliability and trustworthiness of DCT are highly relevant, as technical constraints, lack of trust, and other concerns have been intensely discussed [29]. With this in mind, an integration of the individual characteristics and personality into acceptance models appears crucial, as these promotors and inhibitors are not well understood in the field of DCT [29, 30]. Although not directly observable, personality affects the intention to use and it affects behavior [15, 16]. Personality traits are selectively included in acceptance studies [21, 22, 24, 31–33]. By addressing them, it is possible to describe further correlations of technology acceptance [22, 32]. Due to a violent pandemic crisis and following other research [26], an integration of the big five personality traits – extraversion, neuroticism, openness, conscientiousness, and agreeableness [34] – into the technology acceptance model turns out to be promising in order to develop deeper insights on DCT's acceptance. Owing to the combination of the TAM with personality traits, our research model is able to evaluate the individual and technological determinants.

2.3. Hypotheses development

Without a widespread support in the general public, the effectiveness of DCT is diminished [35, 36]. Usually, if individuals expect a benefit using the CWA,

its value increases. Since the benefits of DCT initially remain vague [29], an inference of why users install the app appears a conceivable approach. The protection of family and friends, responsibility for the public welfare, and individuals assessing their risks of an infection are the most frequently cited reasons for using DCT [35]. Furthermore, applying the CWA should be simple and involve less effort to cause a positive impact on perceived usefulness [11, 12]. In short, due to proven correlations in literature, the CWA's acceptance is based on a trade-off between effort and benefit. We thus posit the following for the CWA –

H1: PU has a positive effect on ATT.

H2: PE has a positive effect on ATT.

H3: PE has a positive effect on PU.

H4: PU has a positive effect on IU.

H5: ATT has a positive effect on IU.

The subjective norm (SN) can be expressed in two manners: Individuals are guided by influence of their relevant peer group, following the advice of experts (internalization) [37], showing conforming behavior to obtain a higher reputation (identification) [37], or avoid negative effects [14]. However, the more experience users gain, the weaker the influence of the subjective norm on perceived usefulness becomes [14, 37]. Social influence can also be perceived as social pressure [15, 38]. Even though the DCT's use is voluntary, it might be perceived as social pressure. In case individuals reject the CWA, perceived pressure may trigger not caring about the public welfare. Moreover, if the peer group relies on the CWA, perceived usefulness and attitude toward use are positively influenced, notably in times of crisis [29]. Consequently, since the subjective norm shows a significant effect on attitude toward use [38], we expect this correlation for the CWA. Since perceived usefulness is regarded more relevant in Western cultures and since it has a greater effect on intention to use than perceived ease of use [39], we do not propose any impact of subjective norm on perceived ease of use. We thus posit the following for the CWA –

H6a: SN has a positive effect on PU.

H6b: SN has a positive effect on ATT.

Trust in technology (TRU) develops out of positive expectations and the influence of others [40]. Integrity and reliability influence trust in technology [17, 41]. This trust impacts the intention to use and arises from the technology's functions, from its reliable performance, and also from its support to accomplish a task [41, 42]. Trust in the CWA is associated with the perceived usefulness and the satisfaction with the application [21, 41, 42]. Individuals being persuaded of the CWA's reliability are willing to use the DCT [12]. Likewise, subjective norm is also observed as an influencing factor on initial trust [43]. We thus posit the following for the CWA –

H7a: TRU has a positive effect on PU.

H7b: TRU has a positive effect on IU.

H7c: SN has a positive effect on TRU.

A primary goal of studying personality is to explain, structure, and anticipate the human personality shaped by experiences and influencing behavior [16, 44]. The purported big five personality traits reflect the variety of personality dimensions [34].

(1) Extraversion (EXT): Individuals with high scores of extraversion are sociable, outgoing, optimistic, active, as well as self-confident [34, 44–46]. They positively embrace new technologies and functions [47]. However, differentiated patterns emerge on extraversion in acceptance research. On the one hand, it has a positive effect on intention to use via perceived usefulness and ease of use [24]. Extraversion also influences the correlation between subjective norm and intention to use [22]. On the other hand, no significance has found of extraversion on perceived usefulness [33], and a negative impact of extraversion on actual use [21, 48]. Since the CWA does not address the needs of their optimistic, nothing will happening mentality [34], and their interests like social interaction and using mobile social apps [49], it appears reasonable to assume that they reject DCT at all. We thus posit the following for the CWA –

H8a: EXT has a negative effect on PU.

H8b: EXT has a negative effect on PE.

(2) Neuroticism (NEU): Individuals with high scores of neuroticism are unstable, anxious, sensitive, and quickly lose their mental balance in stressful situations, which results in anger, impulsiveness, and irritability [34, 44–46]. They tend to question the use and acceptance of a technology [22]. Studies reveal a negative correlation between neuroticism and perceived usefulness [22, 33, 50]. Similarly, these individuals perceive ease of use more negatively than others [20]. Consequently, unstable individuals are less likely to develop an intention to use the CWA, as they perceive it as threatening [51]. They are reluctant to engage in new experiences and have doubts about their own abilities [34]. Furthermore, they are more critical to changes in life and work situations, which affects perceived usefulness negatively [22]. We thus posit the following for the CWA –

H9a: NEU has a negative effect on PU.

H9b: NEU has a negative effect on PE.

(3) Openness (OPE): Open-minded individuals are imaginative, original, curious in looking for diverse experiences, question norms, and form their own judgements [34, 44–46]. They are often early adopters or even innovators [52]. The pattern of openness in the TAM settings is diffuse: For instance, one can observe a positive effect between openness and perceived usefulness [53] instead of not identifying any

correlations between openness and perceived usefulness [22, 33] or perceived ease of use [24, 53]. The effects of openness on intention to use range from no effect [24] to significantly positive [22]. Given these contrasting results, one can assume that open-minded people develop a positive attitude toward the CWA. They are willing to engage in new experiences [52, 54]. This new app reflects their drive for innovation [36]. By being the first users, open-minded individuals also influence others [36] and assess the perceived ease of use as simple. We thus posit the following for the CWA –

H10a: OPE has a positive effect on PU.

H10b: OPE has a positive effect on PE.

(4) Conscientiousness (CON): Conscientious individuals are determined, duty conscious, and perform their task accurately [34, 44–46, 55]. It turns out that they use selected apps because they find most apps unproductive and distracting [49]. They carefully balance the benefits of a new technology [22]. Research confirms a correlation between conscientiousness and perceived usefulness [20, 21], and an effect on perceived ease of use [20, 50]. Furthermore, conscientiousness strengthens the correlation between perceived usefulness and intention to use [22]. Based on these results, it is expected that conscientious individuals routinely use the CWA because of their organized nature [44–46]. Since they like to follow rules and guidelines [34], the app provides them a sense of reliable planning. They assess its benefit as being quickly informed about a COVID-19 infection. The CWA's functionality and the chance of a regular risk assessment are rated positively. We thus posit the following for the CWA –

H11a: CON has a positive effect on PU.

H11b: CON has a positive effect on PE.

(5) Agreeableness (AGR): Agreeableness characterizes individuals with a high degree of altruism, cooperativeness, generosity, and obligingness [34, 44–46]. They are forgiving and trust others easily [34, 44–46]. TAM studies reveal significant correlations between agreeableness and perceived usefulness [20, 23, 33, 50], while in other research agreeableness has no effect on intention to use [32] or on actual use [21]. Furthermore, agreeableness moderates the correlation between subjective norm and intention to use [22]. Agreeable individuals embrace the positive elements and perceived ease of use [20], particularly if they are able to fulfill their tasks [22, 49]. They positively welcome the benefits and ease of use of the CWA, and use DCT out of respect for the public welfare, because it supports to protect others and fulfils their altruistic needs easily [34, 44–46]. These individuals focus on the positive aspects of the CWA and look beyond slight technical hurdles, as they comply and cooperate when considering new technologies. We thus posit the following for the CWA –

H12a: AGR has a positive effect on PU.

H12b: AGR has a positive effect on PE.

A graphical overview of the combined research model is shown in Figure 1.

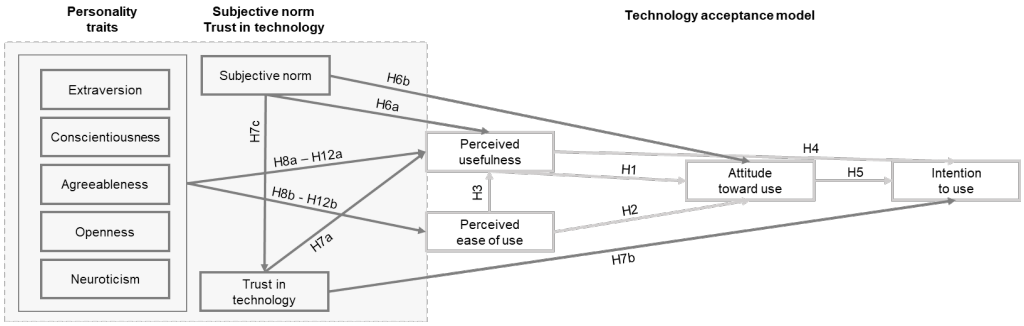

Figure 1. Research model

3. Research process and method

3.1. Study design

For the empirical evaluation of our research model, we pursue a quantitative online-based survey, and develop the questionnaire following Straub's guidelines [56]. Since a high consistency and reliability of the results is desired, proven constructs, indicators, and their items are adapted from previously validated studies [57, 58]. Our constructs include attitudes and opinions, operationalized by means of reflective measures [59]. All our variables are measured by at least two or more indicators [11]. For evaluating the personality traits, we adapt items from a German short scale [60] to consider the cultural and language divergencies. In order to make the answers comparable, we apply a five-point Likert scale [61]. During the development process, we create item pools for each construct. These are adjusted and redefined according to the following procedures: First, the number of items is reduced after a workshop with two experienced academics having assessed the

relevance of the potential target constructs [62, 63]. Second, to ensure the quality of the measurement model, a card sorting and item ranking exercise is carried out with a total of six persons. Convergence and divergence of the constructs can, thus, be assessed [64]. Within two proving rounds, the items for this paper achieve 94% agreement. Third, eight people have taken part in a pre-test of the survey.

3.2. Data collection

The data collection took place via an online survey from September 6th to 28th, 2020, at a time when the CWA had been introduced for about 2.5 months. We use convenience sampling, by posting on social media and distributing on enterprise social media platforms (telecommunication, warehousing group, education). We ensure the anonymity and strict confidentiality of data handling. As a result, a total of 833 questionnaires are evaluated. We assess a completion rate of 91%. 489 are active users of the CWA. 55% are female, 44% are male, 1% are diverse. We note an average age of 43 years. Our sample affirms a high educational level, with 53% having attained a university degree. Regarding the usage rate of the CWA, 61% uses this DCT, while almost two-thirds have used the app since its launch in June 2020. We cannot find significant differences between early and late respondents regarding their answers to the questionnaire, suggesting that the threat of nonresponse bias can be excluded.

4. Data analysis and results

4.1. Measurement model assessment

We follow the recommendations of Hair et al. [65] and rely on the partial least squares (PLS) approach, a component-based structural equation modeling technique, to test our model. The basis for assessing our hypotheses is a robust measurement model. We analyze the construct's reliability, convergent validity, and discriminant validity, and perform several measures to assure a valid measurement model [65]. All of our constructs exceed the recommended threshold for the composite reliability of 0.70 [66], and also for the threshold for Cronbach's alpha of 0.70 [67]. The only exceptions are the Cronbach's alpha for agreeableness (0.590) and subjective norm (0.636). These results are moderate and acceptable, as Schmitt [68] states that values in the range of 0.5 may be reliable for extensive constructs and their operationalization. Furthermore, the Cronbach's alpha is considered less meaningful than other quality criteria, leading to a falsification of the construct reliability [69]. In addition, we examine the factor loadings and the results demonstrate that all loadings exceed the threshold of 0.7 [67]. We assess the minimum for the average variance extracted (AVE) of 0.5. Finally, the discriminant validity, measured by the Fornell-Larcker criterion [70], is successfully approved. All in all, considering these results, it is evident that all our indicators exceed the required thresholds [65–67, 70–72].

4.2. Measurement structural assessment

To assess the structural model, we applied a bootstrap analysis (5,000 subsamples). Although not all of our hypotheses were significant, our analysis is able to provide meaningful findings. Perceived ease of use has no influence on perceived usefulness. All proposed effects of extraversion and openness are not significant. Likewise, no significant correlation between neuroticism and perceived usefulness has been measured. Table 1 presents the results of the structural model by reporting path coefficients (β), significance of each hypothesized correlation (P) [65], and effect size f^2 [73].

Table 1. Summary of the hypotheses testing

Path	β	P	f^2
H1: PU → ATT	.662	<.001***	.740
H2: PE → ATT	.111	<.01**	.024
H3: PE → PU	.083	n.s.	.009
H4: PU → IU	.248	<.001***	.049
H5: ATT → IU	.255	<.001***	.047
H6a: SN → PU	.218	<.001***	.071
H6b: SN → ATT	.063	<.05*	.007
H7a: TRU → PU	.465	<.001***	.268
H7b: TRU → IU	.249	<.001***	.063
H7c: SN → TRU	.307	<.001***	.104
H8a: EXT → PU	.021	n.s.	.001
H8b: EXT → PE	-.037	n.s.	.001
H9a: NEU → PU	.042	n.s.	.002
H9b: NEU → PE	-.076	<.05*	.005
H10a: OPE → PU	.044	n.s.	.003
H10b: OPE → PE	.029	n.s.	.001
H11a: CON → PU	.052	<.05*	.004
H11b: CON → PE	.056	<.01**	.011
H12a: AGR → PU	.063	<.05*	.006
H12b: AGR → PE	.119	<.01**	.014

Note: β = standardized coefficient, p = p-value (* p < .05; ** p < .01; *** p < .001; n.s. = not significant).

5. Core findings and discussion

We discuss our results along our developed research model. TAM (H1-H5): The impact of perceived usefulness on the CWA's acceptance is moderate. Its perceived usefulness is influenced by the expected reliability of the DCT and by social influence. Surprisingly, we have identified a weak, non-significant correlation between perceived ease of use and usefulness. A low effort to use the CWA does not implicate more usefulness. Research outlines that perceived ease of use is intrinsically motivated, whereas perceived usefulness is task-related [74]. Therefore, perceived ease of use only affects usefulness, as it is intrinsically linked to the primary task. In the case of the CWA, perceived ease of use is not an intrinsic property [74]. Cost and benefit considerations for using the DCT do not matter. Furthermore, the perceived usefulness is not being questioned and affected by a modified ease of use.

In an enhanced TAM setting including the additional variable trust, effects of perceived ease of use change [75]. Previous research proves that the correlations between perceived usefulness and ease of use are far more complex without an absolute, unambiguous measurement [76]. In our analysis, the significance between perceived ease of use and attitudes toward use is moderate. It should be considered that this correlation decreases over time [77], as users become more familiar with the app.

Subjective norm (H6a-H6b): If DCT is mandatory, social influence has stronger effects on its acceptance [13, 28]. Meanwhile, voluntary use results in the subjective norm's mitigated effect on perceived usefulness as our work has demonstrated. For instance, during a crisis like COVID-19, perceived pressure, social influence, and the idea to be bounded to a peer group appear reasonable [14–16]. Referring to the CWA, individuals are likely to follow the advice of their peer group [78], even if they are not interested in the app itself [14]. The social pressure to adopt the CWA as well as popularity of the technology [79] increase its value. In respect, supporting DCT generally promotes solidarity toward the public welfare and loyalty to the government [80].

Trust in technology (H7a-H7c): Trust in the CWA positively influences perceived usefulness and intention to use. The app works trustworthily and reliably as expected, even if users encounter minor problems [81]. Our results have proven that trust in the CWA is associated with the fulfilment of users' expectation [81] and closely related to the app's functionalities [33, 82]. As subjective norm significantly influences initial trust [43], this social influence also affects trust in the CWA.

Extraversion (H8a-H8b): We have not found any significance in studying the CWA between individuals with high scores of extraversion and perceived usefulness and ease of use like in previous research [20, 21, 33, 50]. Even though extraverts use social apps [49], the CWA does not meet any of their needs. Extraverted individuals might refrain from installing the app, as they limit the number of selected apps on their smartphones [31] or because of their optimistic traits, they do not perceive the pandemic as a threat. In this respect, it can be deduced that they have not experienced the CWA's benefits and its usefulness.

Neuroticism (H9a-H9b): It would be coherent that unstable individuals seek solutions reducing their insecurity or concerns. However, the CWA is not perceived as a problem solver. These individuals develop avoidances [83] and do not take control [53]. Furthermore, they perceive new technologies and services as ominous or less useful [50]. If unstable individuals feel a lack of control, their sense of trust in new technologies is affected [51, 76]. They doubt their own abilities [53] as well as the abilities of DCT. The negative expected correlation between neuroticism and the perceived ease of use of the CWA is confirmed. This effect is also observed in literature, but outside the range of significance [23].

Openness (H10a-H10b): In line with previous research, we have measured no significance of openness on the CWA's perceived usefulness and ease of use [21–23, 33]. Furthermore, other authors confirm no correlations between openness and the acceptance of seven categories of mobile applications [49]. Even though open-minded individuals have already been identified as early adopters [52], the influence of this personality trait fade if the app is already established [49]. Following this, openness is crucial at the time of the introduction of DCT, but the engagement decreases, for instance when it becomes mainstream [49]. Our assessment is shared by Tan and Yang observing a change of influence of personality traits as the application evolves [84]. The narrower the context and more specific the app, the less the open-minded individuals are motivated to use it [21]. In short, openness is not a simple linear relation [22] and may be much more complex than assumed, especially in the case of a sensitive topic like DCT.

Conscientiousness (H11a-H11b): Perceived usefulness and ease of use can be inferred from conscientious individuals diligently seeking solutions like the CWA enabling them to perform their tasks reliably and thoroughly [20, 22, 53]. Conscientiousness is intrinsically motivated [22]. These individuals take intensive time to learn the functions of the CWA [20, 33]. They are often guided by the opinions of other trustworthy individuals and

reconsider their attitude [22]. Duty-conscious as they are, they follow the rules. For the sake of the public welfare and to answer the governmental call, this group adopts DCT.

Agreeableness (H12a-12b): High scores of agreeableness have a significant effect on the CWA's perceived usefulness [20, 22, 33] and ease of use [20, 50]. Agreeable individuals develop a positive attitude toward new technologies like DCT [22]. They put the impact to the foreground [22, 49] and easily overlook the CWA's technical hurdles [20, 24]. Agreeable individuals are guided in their attitudes and actions by social influences [14, 85]. DCT and its usefulness are perceived positively out of consideration for others, the desire to cooperate, or to strive for conformity [24]. The idea of caring and protection of the public welfare can be a trigger for an increased acceptance, especially in the sign of a further spread of COVID-19.

6. Limitations and further research

We face several limitations and identify points of departure for future research:

First, since we only collected data online, the generalization and application of our results in another setting, and also in other contexts may be questioned [86]. Nevertheless, our study's design allows research endeavors to replicate, for example, in the domain of health information and solutions to increase the generalizability of the research results.

Second, our survey allows collected self-assessed data. Admittedly, self-assessed data base on perception and participation. Therefore, our results can be improved by collecting more objective data sources. Future research, for example, can use log file data to assess the user's actual use behavior of the CWA.

Third, the scope of our study is limited due to the study's design: Our research model, constructs, and correlation are one-dimensional and linear. Furthermore, the data collection and variables refer to a single point of time. The causal correlations therefore have to be thoroughly interpreted. Moreover, despite the accurate testing of our items by card sorting, it appears possible that by applying items in a different cultural area, the same associations are not always made. Consequently, future research could apply our model in different cultural settings to test the influences of personality.

Besides this, only people who already use the CWA are included in our results. More insights might be assessed if the personality of those who are not willing to use DCT has been disclosed.

7. Conclusion

The impact of COVID-19 continues to be challenging in public health prevention. Moreover, even now the benefits of DCT are not clearly tangible for the general public to the extent that they would support manual contact tracing and reduce the impacts of full lockdowns. By contrast, one question remains: Why is urging solidarity for the voluntary use of DCT to combat COVID-19 not fruitful, even if this pandemic does not have sufficient threatening potential? Our approach sheds new light on the acceptance of DCT and the existing literature by demystifying the promotors and inhibitors of the CWA:

Perceived usefulness plays a vital role in achieving sufficient coverage of the CWA. It remains difficult to elaborate the personal benefit of DCT as precise as possible. Nonetheless, the users already value the CWA's usefulness for public health [27]. It appears critical to include the usefulness of DCT in the focus of the nationwide strategy fighting COVID-19.

We have evaluated that perceived ease of use is of secondary importance in considering using the CWA. For instance, ease of use it is often not explicitly perceived or only in the initial use phase [76].

The influence of subjective norm is confirmed and particularly interesting in the context of DCT, considering the enormous social pressure to stop the transmission of COVID-19. Whether this influence is guided through peer groups or whether it is due to conforming behavior cannot be differentiated on the basis of our model.

Furthermore, we contribute to the intensive debate on the trustworthiness and concerns of the CWA [2, 8, 29, 35]: Our study has proven that trust building has taken place successfully. In parallel, this trust is unequivocally shaped by the subjective norm.

Finally, we conceptualized all five personality traits as factors influencing the TAM. Our results support similar findings in literature [20, 21, 24, 33], demonstrating that the effects of personality traits vary in different research contexts. Individual differences and characteristics of personality influence perceived usefulness and ease of use only partially. The lack of influence of openness as the most heterogeneous personality trait [87] is as surprising as extraversion's lack of influence. Although openness has many similarities with other personality traits, its heterogeneity leads to intercorrelations with them [88].

Eventually, from a theoretical perspective, the integration of personality traits into an acceptance model analyzing DCT widens the scope of current research, as other studies have not yet considered these

essential promotors and inhibitors [7, 8, 30, 31]. Moreover, this approach addresses the call to investigate the acceptance of DCT [29–31], even after the outbreak and when the numbers of infections fall [30]. Furthermore, this approach also analyzes the influences of personality traits on technology acceptance research in general.

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