MASTER THESIS – Final Version

Environment and Fear: Their Effect on Drone Acceptance, Information Needs, and Privacy Concern.

What do people think about the use of drones to enhance the general safety of citizens in public places?

Myrthe Sophie Anne von den Benken

Supervisors:

- Dr. ir. P. W. de Vries
- Dr. M. S. D. Oostinga

Faculty of Behavioural, Management and Social Sciences

Psychology of Conflict, Risk and Safety

Enschede, The Netherlands

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Abstract

Drones are used increasingly in different domains of daily life. Positive and negative aspects are known about drones, but there is a gap between what people think about the use of drones to enhance the safety of citizens in public places and the literature. The current study investigated how environment and fear influence privacy concerns, information needs and drone acceptance. Participants' fear about drones was manipulated: they read a negative or a positive article about drones and privacy concerns. Participants (N = 136) put on VR glasses and saw a festival or a park where a drone flew over. As expected, results showed that drones were accepted more at the festival than in the park. Against expectations, many important variables were not significantly affected by fear. Against expectations, information needs were similar for all conditions, and a clear pattern was observed. Participants were mostly interested in (1) why is the drone here, (2) who is flying with it, and (3) privacy protection. The main recommendation is to provide people with this specific information about drones when they see a drone flying over to enhance the safety in public places, as people were to a great extent willing to obtain extra information. Future research could investigate how this information should be provided and what the effect is of meeting people's information needs in this context.

Word count: 224

Keywords: drone acceptance, information needs, privacy concern, fear appeal, Virtual Reality (VR), communication.

Samenvatting

Drones worden in toenemende mate gebruikt in het dagelijks leven. Over de positieve en negatieve aspecten van drones is veel bekend, maar er is weinig literatuur over wat men ervan vindt als drones worden ingezet om de algemene publieke veiligheid te vergroten. Deze studie onderzocht hoe omgeving en angst invloed hebben op privacy concern, informatie behoefte en drone acceptatie. Het angstgevoel van deelnemers werd gemanipuleerd alvorens het experiment werd gestart: een negatief of een positief artikel gelezen werd gelezen over drones en privacy concern. Met behulp van VR werden deelnemers (N = 136) in een park of een festival geplaatst waar een drone overvloog. Zoals verwacht, werden drones meer geaccepteerd op het festival dan in het park. Tegen verwachtingen in, werden veel belangrijke variabelen niet significant beïnvloed door angst. Onverwachts hadden deelnemers in elke conditie dezelfde informatie behoefte en een duidelijk patroon was zichtbaar. Deelnemers waren vooral geïnteresseerd in (1) waarom is de drone hier, (2) wie vliegt ermee, en (3) privacy bescherming. De belangrijkste aanbeveling is om mensen te voorzien van deze specifieke informatie omtrent drones wanneer zij een drone zien overvliegen om de algemene publieke veiligheid te vergroten, aangezien mensen erg graag extra informatie wilden verkrijgen. Daarnaast zou er in toekomstig onderzoek

gekeken kunnen worden naar wat de beste manier is om deze informatie te verstrekken en wat voor effect het heeft als mensen worden voorzien in hun informatie behoefte in deze context.

Woorden: 235

Trefwoorden: drone acceptatie, informatie behoeftes, privacy concern, angst beoordeling, Virtual Reality (VR), communicatie.

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Introduction

Seeing a drone flying over or spotting one floating in the sky nowadays is not a new phenomenon, as the Federal Aviation Administration predicted there would be around seven million drones (or Unmanned Aerial Vehicles) flying around in 2020 (Farber, 2017). There are several positive and negative aspects regarding drone usage. One of the positive aspects is that drones have been used for over a decade for obtaining military intelligence (West & Bowman, 2016). Unmanned Aerial Vehicles are also known for other beneficial purposes like commercial use, aerial photography, and law enforcement (Mehta et al., 2020). Safety organisations use drones to enhance detection and prevention of crime, and to improve how potentially dangerous situations are assessed and managed (e.g., crowd control, carried out by drones) (Rahman, 2016). A clear example is the increased use of drones as part of the security system at festivals and events, as they give invaluable information about what happens on the ground while keeping officers out of harm's way (Robakowska et al., 2017; Margaritoff, 2018). In addition, more research is carried out worldwide, investigating the medical use of drones, and successful operations are accomplished where drones had autonomous navigation while delivering blood or medical supplies (Jain & Luthra, 2021). This medical use is on the rise (Medical Drone Service, 2021), and the goal of the organisation Medical Drone Service is to deliver the right care at the right time and place with the help of drones at places with harsh conditions or environments. Lastly, on December 31st 2020, harsher regulations got into effect regarding drones and their usage (RIVM, 2020), which take into account the potential risk of an accident during a flight. These regulations can help to accomplish that drones are used safely and according to the rules by citizens.

However, there are negative aspects as well. For example, drones can cause problems at airports. In 2018, Gatwick Airport London was shut down for a whole day, because unfamiliar drones could not be detected properly by radars (Kaspersky, 2020). Second, military drone strikes go wrong sometimes, killing people which were not the target (Roma, 2017). Because of these stories, citizens can have negative associations with (military) drones (Khan et al., 2018). Moreover, a big concern for citizens is that drones can collide with objects or persons because there are many stories online and in newspapers about accidents where a drone collision caused serious bodily harm or damage to properties (Wild et al., 2016; Chang et al., 2017).

In addition, concerns regarding drone usage are rising, and privacy concern is an often addressed topic (Custers, 2016; Finn & Wright, 2016). Privacy concern is about the need of keeping personal information away from others or third parties (Westin, 1967; Mcknight et al., 2011). Custers (2016) found that people feel their privacy is violated by a drone flying over and that people can experience feelings of fear and anger. A camera is often applied to drones to film the environment, which makes people feel spied upon and that their privacy is violated as well (Vattapparamban et al., 2016). As stated before, there are new, harsher regulations nowadays for flying with drones (RIVM, 2020). However, people could still feel their privacy is violated when a drone flies over since these regulations might not be basic knowledge for everyone. Therefore, it is interesting to investigate which

information about drones people deem important, to find out which information they would want to obtain if they had the possibility.

Although drones and their applicability to different domains in everyday life are increasingly researched nowadays, the amount of systematic research of drones in civilian contexts, especially with psychological aspects, is limited (Clarke, 2014; Chamata & Winterton, 2018). Studies about drone acceptance were found, but it becomes clear there is a gap between the currently available literature and what people think about the use of drones to enhance the general safety of citizens in public places. Also, what influences their drone acceptance and privacy concern has not been investigated yet. As stated before, drones are used increasingly nowadays, not only for leisure activities but also to improve or monitor public safety. However, citizens' concerns about drone usage are rising as wel. Therefore, bridging the gap between the current literature and how people feel about the use of drones and what influences their feelings, could have important implications. This could mean that information needs are addressed adequately in the future and that people because of this, feel less spied upon or feel less like their privacy is violated when a drone flies over. This might accomplish that citizens feel more at ease when they see a drone flying over, which would be beneficial for the society.

A recent study by Oltvoort et al. (2019), investigated public acceptance of drones and underlying psychological mechanisms. This study was the inspiration for the current study. Results showed that drones were accepted most at an event or festival environment, and accepted least in a park environment. In addition, they found that participants were mostly interested in information options about why drones were used and least interested in the feedback option, indicating that people can have different *information needs* in regards to drone acceptance. Unfortunately, providing transparent information about drones alone did not have a significant effect on drone acceptance (Oltvoort et al., 2019) as drone acceptance was not higher for participants who could obtain transparent information about drones, compared to participants who could not obtain transparent information.

The current study builds on the findings of Oltvoort et al. (2019), to confirm the finding that drones are accepted more at a festival than in a park. In addition, the current study extends the research of Oltvoort et al. (2019) by investigating whether manipulating fear and different environments influence privacy concern, drone acceptance, and information needs. Another goal of this research is finding out which information people want to obtain regarding drones, in other words, what their information needs are, as providing transparent information alone did not have the desired effect in the previous study. Therefore, the research question of this study is:

> *How do environment and fear influence privacy concern, information needs and drone acceptance?*

Theoretical framework

As stated before, more systematic research is needed about the psychological mechanisms underlying drone acceptance. An important assumption in the current study, based on literature and previous studies, is that different environments and circumstances can influence how uncertain people feel, which in turn might influence privacy concern. Moreover, providing transparent information is assumed to decrease uncertainty and increase trust. The following paragraphs will address variables that are related to the current study. First, privacy concern is addressed, as it is thought that privacy concern plays an important role in drone acceptance and that privacy concern can vary with environments. Second, information needs are described, followed by fear and emotional state, addressing how these could influence the current study. Then, the conceptual model and accompanying hypotheses are presented, followed by two explorative variables, namely uncertainty and trust.

Privacy Concern and Environment. Privacy concern is a prevalent factor that affects people's drone acceptance (Ljungholm, 2019). The reason why many people are concerned about their privacy is that they think drones spy on or follow them and obtain personal data from them (Custers, 2016). Fisk et al. (2018) argue, based on appraisal theories, that angry individuals are likely to act aggressively. In 2017, a news article in 'de Volkskrant' stated that a 19-year-old boy shot a drone out of the sky with an airgun because he felt the drone spied on him, which made him angry (Witteman, 2017). It could be the case that more people act aggressively towards drones if they are upset with their presence because they are angry and are concerned for their privacy. Besides concerns for (bad) privacy protection or espionage, other issues appear as well, such as dehumanization, voyeurism, and chilling effects (Finn et al., 2014). These issues go further than privacy violation alone since it can occur that people adjust their behaviour because they are watched or filmed by a drone (van der Linden, 2011; Clarke, 2014). Some authors go even further, stating that drones are currently disturbing fundamental privacy rights (Ahmad et al., 2021). Lastly, victimization occurs more often, especially with recreational private drones, since these drones can peek through the windows of homes, invading people's privacy (Graham et al., 2019).

It follows from the previous paragraph that the presence of drones can enhance privacy concern and thus, can affect how people feel. It is argued that privacy concern should be measured as a state variable instead of a trait variable (Khan et al., 2018; Usmanova, 2018; Ahrendt, 2020). In previous studies, it was measured as a universal concern for privacy (i.e., trait variable) instead of a concept that depended on the situation people were in at that moment (i.e., state variable). As a park can be seen more as a private and a festival more as a public place (Taylor, 2010), it can be argued that the level of privacy concern might be different for these two environments. In addition, Gill and Spriggs (2005) stated that when a drone flies over in a park environment, this can be seen as a privacy threat. Moreover, research by Oltvoort et al. (2019) showed that people in a park environment wanted to read information about privacy, whereas this was not the case for people in a festival environment.

This might indicate that people were more concerned about their privacy when they were in a park because they wanted to read about how their privacy was protected while the drone flew by. Especially in the current study, it is insightful to investigate what influences privacy concern and whether it varies within situations.

Building on this, two hypotheses are formed. First, the research of Oltvoort et al. (2019) showed that drones were accepted more at festivals than in parks, and Usmanova (2018) showed drone acceptance to be environment-dependent as well. This indicates that drone acceptance could vary within environments. The current study aims to confirm the finding that drones are accepted more at festivals than in parks (H1). Second, it is hypothesized that privacy concern can vary within different environments, the effect of Environment on Drone Acceptance is mediated by Privacy Concern; being in a park causes higher Privacy Concern than being at a festival, and this, in turn, causes lower Drone Acceptance (H2).

Information Needs. The study of Oltvoort et al. (2019) unexpectedly showed that people can have different information needs, based on the environment they were in. In a park, people were most interested in the reason *why* a drone was there. At a festival, people were most interested in *how* the drone was operating. These information needs are further investigated and analysed in the current study.

The definition of information needs is difficult to capture in one concise description, due to the different domains it is applied to (Naumer & Fisher, 2010). Also, the concept is often taken as a given (Savolainen, 2012), and as Savolainen (2017) stated "… even though information needs is probably the most widely used construct explaining why people engage in information seeking, this concept is still vague" (p. 3). However, a few definitions are found that ought to capture the definition of information needs together in the context of the current study. First, the definition as used by Dervin (1992), explains information needs as a gap of knowledge that requests information to overcome that gap, known as Dervin's sense-making approach. The focus lies on making sense of the whole and doing so by needing information and bridging the gap. Second, Ingwersen (2000) described three different types of information needs a person can have: the verificative information need, the conscious topical information need, and the muddled topical information need. Shortly, verificative information need is about wanting to verify pieces of information; conscious topical information need refers to wanting to clarify or pursue information, and lastly, muddled topical information need is about engaging in the exploration of unfamiliar situations or contexts (Borlund & Pharo, 2019). The latter two have in common that explorative search is carried out by people because they want to satisfy their information needs.

Linking this knowledge to the current study, it can be argued that conscious topical and muddled topical information need might be important determinants of information needs and drone acceptance. Therefore, information needs will be described and used in this research as: the need for obtaining information to be able to make sense of a situation and to explore unfamiliar situations to a

satisfactory level. Overcoming risk perceptions and uncertainties enhances trust in and acceptance of new technologies (Gefen et al., 2003; Pavlou & Gefen, 2004; Li et al., 2008; Davis et al., 1989; Davis, 1993), therefore, it seems important to contribute to this by meeting people's specific information needs.

Another aspect of information needs could be the degree of perceived transparency of the provided information. According to Apvrille et al. (2015), transparent information about drones could establish drone acceptance. However, the research of Oltvoort et al. (2019) showed that providing transparent information alone did not have a significant effect on drone acceptance. Therefore, linking transparency and information needs, the current study investigates people's information needs when they are given transparent information about drones. Research shows that, when potential outcomes of a specific situation are clearly and transparently described, people are less afraid or distressed by the situation they are facing (Bennis et al., 2010). Therefore, it is assumed that transparent information is important regarding drones as well, especially information about the origin of the drone and why that drone is there. The way information about a drone is given and communicated to the public seems a trivial aspect of how transparent people think information is. If people perceive information as transparent, this could lead to acceptance of a source, because it is believed that transparency can create trust and diminish uncertainty (Bennis et al., 2010; Walumbwa et al., 2008). As Oltvoort et al. (2019) found by chance that people were interested in different information categories, based on the environment they were in, it is hypothesized that information needs depend on the environment. Specifically, in a park, people's information needs are mostly about why the drone is present, while at a festival, people's information needs are mostly about how the drone is operating (H3).

Fear and Emotional State. As an extension of the research of Oltvoort et al. (2019), the current study investigates the effect of fear on drone acceptance, privacy concern, and information needs. The following paragraph explains why it is expected that fear influences these three variables.

Many researchers investigated the relationship between affect and cognition, and they found that different mood states can affect judgments and memories (Clark & Fiske, 1982; Kaiho, 1997; Martin & Clore, 2001). Specifically, participants in a positive mood condition showed enhanced memories of positive words and their judgments were typically more positive as well (Kitamura, 2005). In addition, Morris (1990) described moods as the "frame of the mind", because moods influence behaviour as they affect the way humans think (Bless, 1997) and how people generally judge their environment (Mayer et al., 1992). Next, risk perception decreased significantly when people were put in a positive emotional state (Jin & Atkinson, 2021). These examples show how positive emotional states can affect human behaviour and judgement.

On the other hand, negative emotions can have an influence as well. Tannenbaum et al. (2018) found that fear appeal influences human behaviour and judgement. In short, fear appeals are specific messages with a motivational character that highlight the negative consequences of a certain action (Maloney et al., 2011; Peters et al., 2012; Witte & Allen, 2000). Specifically, it is a persuasive

communication technique that tries to arouse fear in a human being (Ruiter et al., 2014). Based on a broad range of risk communication studies, fear appeal can be classified as a specific type of risk communication (Reser & Bradley, 2017). A well-known classical example of fear appeal is found in the cigarette industry. Disturbing pictures and texts on cigarette packages, used to scare smokers about the negative consequences of smoking, are displayed to get people to quit smoking (Ruiter et al., 2014). This example shows that by using fear appeal (i.e., showing the negative consequences of smoking), people judge certain actions or situations (i.e., smoking) as bad or undesirable with the ultimate goal to adjust their behaviour and to stop smoking.

Based on these ideas, the researcher of this study argues that people will judge the presence of drones as bad when they are made aware of the negative consequences of drone (usage) by using fear appeals because fear is enhanced. On the other hand, when people are made aware of the positive aspects of drone (usage), it is assumed that people will judge the presence of drones positively, because fear is not enhanced. In addition, based on Bless (1997) and Mayer et al. (1992), it is assumed that using fear appeals influences privacy concern. It is argued that privacy concern is higher when fear appeals are used than when fear appeals are not used. Therefore, taking all these ideas and inputs together, it is hypothesized that the effect of Fear on Drone Acceptance is mediated by Privacy Concern; high Fear causes higher Privacy Concern than low Fear, and this, in turn, causes lower Drone Acceptance (H4).

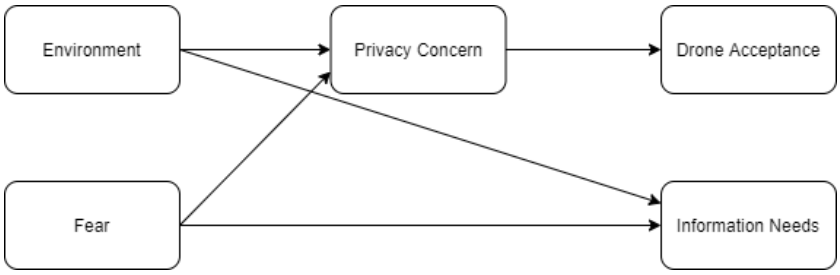
Lastly, the protection motivation theory (PMT) (Rogers 1975, 1983) is thought to be the link between fear and information needs in the current study. Rogers (1975) described that PMT predicts the behavioural intention of people. Also, it is about how people are triggered to respond in a self-protective way when a (health) threat is perceived (Westcott et al., 2017). Campaigns that focus on the danger of getting skin cancer from the sun and that stimulate people to use sunscreen to protect themselves is a clear example of the practical use of PMT. A basic principle is that the fearful part of a message stimulates people to come up with ways to protect themselves (Roser & Thompson, 1995). Williams (2011) described that generally, using fear appeals enhances interest, involvement, recall, and persuasiveness because people's distress is aroused. Based on these ideas and the knowledge about fear appeal, it is hypothesized that fear influences which information people want to obtain regarding drones. In other words, when fear is high, people will seek mostly information that protects them from the drone, whereas when fear is low, people will seek more neutral information about the drone (H5).

Taking all the above-mentioned information together, the current study investigated factors that influence drone acceptance, information needs, and privacy concern, when people see a drone flying over to enhance the general safety of citizens in public places. Regarding information needs, two information categories were used; namely neutral information (How and Flying Route) and protective information (Who, Why, Privacy Protection, and Rules and Regulations). The following conceptual model is proposed in Figure 1 with Environment (IV), Fear (IV), Privacy Concern

(mediator), Drone Acceptance (DV), Information Needs (DV) with accompanying hypotheses:

Figure 1

Conceptual Model with 'Drone Acceptance' and 'Information Needs' as dependent variables, 'Environment' and 'Fear' as independent variables, and 'Privacy Concern' as mediator



H1: Drones are accepted more in a festival environment than in a park environment.

H2: The effect of Environment on Drone Acceptance is mediated by Privacy Concern; being in a park causes higher Privacy Concern than being at a festival, and this, in turn, causes lower Drone Acceptance.

H3: In a park, people's Information Needs are mostly about why the drone is present, while at a festival, people's Information Needs are mostly about how the drone is operating.

H4: The effect of Fear on Drone Acceptance is mediated by Privacy Concern; high Fear causes higher Privacy Concern than low Fear, and this, in turn, causes lower Drone Acceptance.

H5: When Fear is high, people will seek mostly information that protects them from the drone (Who, Why, Privacy Protection, and Rules and Regulations), whereas when Fear is low, people will seek more neutral information about the drone (How and Flying Route).

Explorative

In the current study, the concepts Uncertainty and Trust are investigated in an exploratory manner, and thus, no hypotheses were made. These two concepts are thought to be linked to privacy concern and drone acceptance, and are, therefore, interesting to research as well.

Uncertainty. According to Apvrille et al. (2015), people judge drones as quite new and uncertain technologies. Therefore, it is assumed that if a drone flies over somebody, this person might judge this situation as uncertain. According to Trepte et al. (2017), uncertainty avoidance and privacy are intrinsically connected. How much a person stands by or follows the *rules* describes uncertainty avoidance, while privacy can be seen as a set of *rules* (i.e., how much private information is agreed to share amongst people) as stated by Petronio (2002). In addition, Hofstede (1991) argued that some people might try to avoid uncertain situations, for example by avoiding potential privacy risks. Therefore, people scoring high on uncertainty avoidance try to avoid uncertain or contradictory situations to keep their privacy concern low. Herewith, privacy concern can be seen as a source of

uncertainty.

People can differ in their level of uncertainty avoidance (Blodgett et al., 2008). Looking at the bigger picture, uncertainty avoidance can be linked to one of the big five personality traits: openness to new experiences (Hofstede, 2011). Generally, it describes to what extent people feel comfortable in unstructured or ambiguous situations. If a person has a low score on openness to new experiences, this person will probably score high on the trait uncertainty avoidance (Hofstede, 1980). Concretely, this means the person prefers familiar situations and known risks, and thus avoids uncertain situations as well (Ellsberg, 1961). Blodgett et al. (2008) stated that people with a high level of uncertainty avoidance value security and written rules to a large extend, and do not like to deviate from norms. On the contrary, people with low levels of uncertainty avoidance commit less to written rules and tolerate risks more. With the help of this insight, Lidynia et al. (2017) found that the level of uncertainty avoidance might be related to drone acceptance in diverse contexts (c.f. Engle-Warnick et al. (2007)). Research by Usmanova (2018) showed that uncertainty avoidance was positively associated with perceived control (i.e., to be able to obtain information about the drone). Moreover, uncertainty avoidance was negatively associated with drone acceptance, however, only for a park environment. However, how it further affects drone acceptance and under which circumstances, stays unclear. Therefore, the current study investigates in an exploratory manner what influence uncertainty avoidance has on for example drone acceptance and privacy concern.

Trust. Trust is described as a way to deal with uncertainty and risk and it is perceived to lower uncertainty (Frederiksen, 2014). Fjaeran and Aven (2021) argue that in an uncertain situation, trust can be improved by understanding the potential risk of that uncertain situation and by making clear why that situation is uncertain. Therefore, in the current research, trust is seen as a mechanism to deal with uncertainty (and therefore, also with privacy concern, see Trepte et al. (2017) and Petronio (2002)). According to Apvrille et al. (2015), people judge drones as a quite new technology. To increase acceptance of a new technology, trust should be enhanced (Gefen et al., 2003) because trust is found to help diminish risk perceptions and uncertainty about the use of a new technology (Pavlou & Gefen, 2004). Moreover, whether a new technology will be adopted by the public, can be positively influenced by indirect information about the organizational structure, social influence, and perception of the organisational sponsor of the technology (Gallivan, 2001). These factors play a role in initial trust of a new technology as well (Li et al., 2008). Researchers are stretching the importance of investigating trust as people have to overcome risk perceptions and uncertainty before they will choose to use or accept a new technology (Wang & Benbasat, 2005). In the current study, it is investigated in an exploratory manner what influence the level of trust has on for example drone acceptance and privacy concern and whether trust differed for people in different conditions.

Method

Design

This study had a 2 (Environment: park vs. festival) x 2 (Fear: high vs. low) between-participants factorial experimental design. The dependent variables (DV) were Drone Acceptance and Information Needs, the independent variables (IV) were Environment and Fear. Privacy concern was the mediator variable. Exploratory, Uncertainty Avoidance and Trust were investigated.

Participants

A priori, a power analysis was conducted with the G*Power tool (Faul et al., 2007) with a medium expected effect size (f = 0.25), $\alpha = .05$ and a power of 0.8, for 'fixed effects, special, main effects and interactions'. The analysis showed that the total sample size should consist of 128 participants.

Before the official data collection started, approval of the BMS Ethics Committee of the University of Twente was obtained, and seven people participated in a pilot test. Based on these pilot tests, a few minor adjustments were made to the experiment and procedure, for example, the talking pace and certain instructions.

A convenience sample of 137 participants from the researcher's social network and the general population was taken. Everybody who could fill out a questionnaire, who could wear VR glasses, and who was 16-years or older was allowed to participate. Participants could choose the language of the questionnaire (English or Dutch) to maximize the chance that people could fill in the questionnaire. One participant was deleted from the dataset, as this person was not willing to fill out the questionnaire. Furthermore, the data was checked for very unusual answers (such as filling in the same answers to each question), but this was not detected. Two participants failed the manipulation check for environment. However, they were included in the dataset, as these participants had the same questions regarding drone acceptance and for the results, no differences were found if these were included or excluded.

The final data set consisted of 136 participants ($N = 136$) between 17 and 77 years old ($M = 41.39$; $SD = 19.14$). Amongst the participants, by chance 68 were male (50%) and 68 were female (50%). Participants differed in the highest obtained education (20.6% completed high school, 11.8% intermediate (MBO) degree, 59.5% had a college or university degree, and 6.6% had another degree (e.g., PhD)) as well as in their nationality (97.8% Dutch, 1.5% German, 0.7% Greek). Participants were evenly and randomly assigned to one of the four conditions (*Park, low fear* =37; *Park, high fear* = 32; *Festival, low fear* = 35; *Festival, high fear* = 32).

To see how acquainted participants were with drones, they had to indicate whether they had seen a drone flying over before, and 81.6% ($n = 111$) answered positively. It was also checked if

people had used VR before, and 47.1% (*n* = 64) answered yes, whereas 52.9% (*n* = 72) stated that they had not used VR before.

Materials

The Oculus Rift S was used. These VR glasses have a refresh rate of 80 Hz, the resolution per eye is 1280 x 1440. This Oculus is suitable for people who wear glasses in daily life as well. The Oculus Rift S was connected with the ZOTAC VR Backpack that has a 2.8 GHz Intel Core i7-6700T Quad-Core. With the Leap Motion tracker (140 x 120° typical field of view), participants could see their own 'virtual hands' (see Appendix 1). This enabled them to touch the tablet within – and thereby interact with – the Virtual Environment.

Procedure

The English and Dutch versions of the experiment only differed in language, for both the VR environments and the questionnaire. All participants carried out the experiment in a mobile lab in a van (the Experivan of the BMS lab, see Appendix 2), which stood multiple days at different places at Enschede and Oldenzaal. Especially these cities were chosen because the researcher knew many people there and promoted the research on forehand in these cities (see Appendix 10). Before the experiment started, participants read an introductory text which partly explained the purpose and outline of the experiment. This included a cover story: the study was about the use of drones to enhance public safety. Participants were told they would enter a VR environment and a drone from the Dutch Drone Company would fly over at a certain point. In addition, they were told that they could obtain information about this drone on a virtual tablet and that they should look at the information categories they thought were interesting to read concerning the drone. They were informed that they could close the application after they read about the categories they found interesting. They were informed about their rights, and participants had to agree to the informed consent (Appendix 3). After that, the experiment started.

Participants filled out the first part of the questionnaire (Appendix 4). After this, participants read either a negative or a positive article. The negative article shed a light on the negative aspects of drones and privacy issues to manipulate their ideas about drones and to induce fear. The positive article shed a light on the positive aspects of drones and how they can be beneficial for society, so that fear was not induced (Appendix 5).

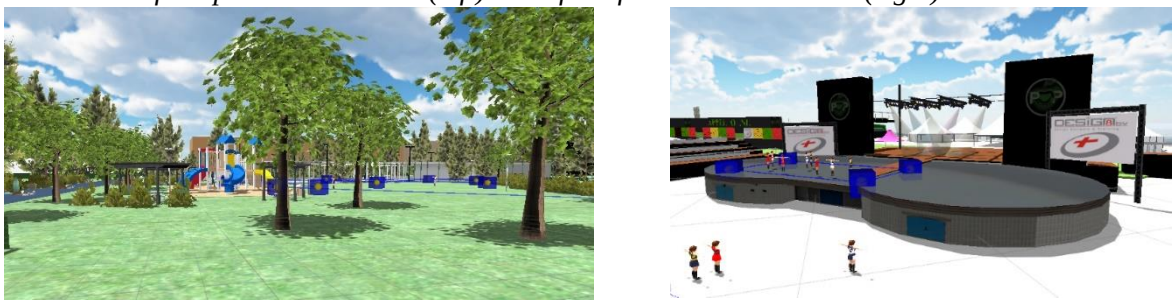
It was explained to the participants how the VR glasses worked, and what was expected of them during the experiment. They were told that the researcher would be close to them at any time[1], so they could ask for help, if necessary. Participants were asked to put on the VR glasses, and they were randomly assigned to either the park or the festival environment. The park environment consisted of trees and other plants, a playground, picnic tables, and virtual people walking by (see Figure 2). Also,

[1] Keeping the 1.5 meters for social distancing, as the experiment was carried out during the COVID-19 outbreak.

a nature sound was added to make the experience even more realistic, and birds, wind, and water flowing in a brook were audible. The festival environment consisted of a stage, a DJ booth, bleachers, virtual people walked by or danced, and a layback jazz track was audible to set the scene (see Figure 2). They had 60 seconds to adjust to the VR environment, to tackle the 'Novelty factor' or the 'Wow-effect'. They could look around 360°, and they could also look at their 'virtual hands' because of the Leap Motion tracker. After these 60 seconds, they could unlock the virtual tablet with a single click.

Figure 2

Screenshot of the park environment (left) and of the festival environment (right)



Now, they saw the menu with six categories they could click on (Who, Why, How, Privacy Protection, Flying Route, and Rules and Regulations (see Appendix 9)). As previously explained to them, they had one minute to read the categories they found interesting. One minute was too short to read everything, however, this was chosen on purpose. With only one minute, participants had to prioritize which categories they deemed important to read. After this minute, a buzzing sound was audible and a drone appeared. Participants had to close the tablet, put their hands down, and they could observe the drone. The drone flew around for one minute and disappeared, which marked the end of the VR experience. Participants were asked to take off the glasses and to fill out the remaining part of the questionnaire (Appendix 7).

Lastly, the participants were thanked for their participation. They were told they could contact the researcher if they wanted more information about the research and they were debriefed about the real aim of the study. The experiment generally took 25 minutes per participant.

Measures

At specific points during the experiment, participants had to answer items that measured several constructs. Most items (except for General Drone Acceptance) had a 5-point Likert Scale (1 = strongly disagree; 5 = strongly agree), with a score of 3 indicating they were neutral about the item. All items had forced responses, so no item could be skipped. See Appendix 7 for all constructs and all corresponding items.

General Drone Acceptance. Based on nine items of the Acceptance Scale (Van der Laan et al., 1997), General Drone Acceptance was measured. The standard question was: *"What do you think about the use of drones to enhance the general safety of citizens? I find it:…"*. Participants could

answer with different categories each time on a 5-point Likert Scale (see Appendix 7, p. 49), for example, *"I find it extremely useful – not at all useful."* or *"I find it extremely effective – not effective at all."*. The answers were recoded, as scoring 1 on these items indicated a positive score (I find it extremely useful), while the other constructs work the other way around (so scoring low on items, the more negative they were). After recoding, the higher people scored on this construct, the higher they scored on drone acceptance and this construct had a very high internal consistency ($\alpha = .91$).

However, it turned out this construct did not measure what it was supposed to measure due to the kind of items that was used. Namely, in retrospect, these items measured whether participants accepted the *technology* of drones, instead of the intended *presence* of drones to enhance the general safety of citizens. Therefore, General DA has not been further taken into account in this study.

Drone acceptance. This construct was measured with three self-designed items such as: *"It is logical that drones are dedicated to helping enhance public safety."*, based on items of Oltvoort et al. (2019). The higher participants scored on this construct, the more they accepted the presence of a drone in their VR environment (so either park or festival) and this construct had a very high internal consistency ($\alpha = .90$).

Privacy concern. This construct was measured with nine items such as: *"I felt I was being watched when the drone flew over."* and *"This drone violates my basic human rights."*, by adjusting items from Usmanova (2019). This way, privacy concern was measured as a *state* variable instead of a *trait* variable. The higher participants scored on this construct, the more concerned they were about their privacy in their specific environment. This scale had a high internal consistency ($\alpha = .81$).

Information Needs. This construct was measured with four self-designed items such as: *"It is important to be able to obtain information about the drone."*. This construct measured whether people would want to obtain information about the drone after they saw a drone flying over in their VR environment. The higher people scored on this construct, the more there were willing to obtain information about the drone. This scale had an acceptable internal consistency ($\alpha = .76$).

Besides that, people had to rank their top three of information categories, choosing from six information categories: Who, Why, How, Privacy Protection, Flying Route, and Rules and Regulations. A distinction was made between protective information categories and neutral information categories. The protective categories (Who, Why, Privacy Protection, and Rules and Regulations) are deemed as protective because people can get to know who is flying with the drone, and how their privacy is protected as well. This kind of information could make people feel safer when a drone flies over. The neutral categories (How and Flying Route) were judged as neutral because these categories do not give specific information that can make people feel safe(r) when a drone flies over. On the tablet in VR, participants could click on and read the categories they found interesting. Log data was collected from this clicking behaviour, showing which categories participants deemed important (i.e., what their information needs were).

Fear Appraisal. This construct was measured with three self-designed items such as: *"Drone technology is safe."* and *"I think I will feel safe when a drone flies over."*, based on items of Oltvoort et al. (2019). This measured whether people were afraid of drones, after reading the positive or the negative article regarding drones and privacy concern to check whether the fear manipulation, in the beginning, worked (Appendix 6). The items were recoded. The higher people scored on this item, the more negative they were about drones and vice versa. So, for people with a higher score, fear might be enhanced, while for people with a lower score, fear might not be enhanced. The internal consistency of this construct was not very high ($\alpha = .64$). It was expected that people who read the positive article, scored lower on this construct than people who read the negative article. By performing an independent samples t-test, it was checked whether the manipulation worked. Fear appraisal was higher for people who read the negative article ($M = 2.56$; $SD = 0.73$) than for people who read the positive article ($M = 2.17$; $SD = 0.68$), and this difference is statistically significant ($t\ (133) = 3.24$; $p < .01$; $CI_{95\%}\,[0.15; 0.63]$). This indicates that the fear manipulation worked.

Uncertainty Avoidance. This construct was measured with seven items such as: *"I prefer structured situations over unstructured situations."* and *"I prefer specific instructions over broad guidelines."*, based on the scale of Jung and Kellaris (2004). The higher the score of the participants, the more they would avoid uncertainties or uncertain situations. This scale had an acceptable internal consistency ($\alpha = .77$).

Trust in the Dutch Drone Company. The items of this construct are based on the items from Rawlings (2008), that measured Trust in Organizations. This construct was measured with nine items such as: *"I expect that the Dutch Drone Company treats people like me fairly and justly."* and *"I expect that the DDC can be relied on to keep its promises."*. The higher participants scored on this construct, the more they trusted the Dutch Drone Company. This scale had a high internal consistency ($\alpha = .84$).

Transparency Dutch Drone Company. This construct was measured with five items such as: *"The DDC provides information that is useful to people like me for making informed decisions."*, adjusting items from Rawlings (2008). The higher participants scored on this construct, the more transparent they perceived the imaginative Dutch Drone Company to be. This scale had an acceptable internal consistency ($\alpha = .77$).

Coding process open question. The answers to the open question: *"Did you have any other thoughts or concerns when you saw the drone?"*, were coded. Overlapping answers were coded under the same name/category. The researcher checked with a peer whether this person would divide the answers the same way, and also whether the chosen names of the categories were fitting, to make the divisions more reliable. After discussions, it was concluded that answers could be placed under seven categories (Noise, Collision possibility, Data protection, Why, Flying route, Who, and Positive). For example, the answer *"Who would control this drone?"* was placed under the category *"Who",* or

"Falling down! Gives me an unsafe feeling and I think it is an unsafe situation." was placed under *"Collision possibility"*.

Results

Analyses were conducted to test the five hypotheses and to answer the research question. First, descriptive statistics are reported to provide a general description of the findings. Second, all relevant analyses involving Drone Acceptance are reported, followed by Privacy Concern. Next, all relevant analyses for Information Needs are described. Exploratory and additional analyses can be found at the end of this section, consisting of Uncertainty Avoidance, Trust, Log data, an open question, and comparing more means for environment. If applicable, results are linked with the hypotheses.

Descriptive statistics

Table 1 provides a general overview of the data obtained in the current study, including means, standard deviations, Pearson correlations, and demographics. The two dependent variables Drone Acceptance VR and Information Needs scored above the mid-point of the scales. For drone acceptance, this indicates that generally, people accepted to some extent the presence of the drone to enhance the general safety of the citizens. For information needs, this indicates that people thought it was very important to be able to obtain additional information about the drone. Besides that, people were generally not so concerned about their privacy, as the mean score was below the mid-point of the scale. Moreover, even though participants did not know the Dutch Drone Company (as this was an imagined company), they trusted the Dutch Drone Company to some extent.

Correlations. First, Privacy Concern and Drone Acceptance were moderately negatively correlated. This indicates that if people scored lower on Privacy Concern, they generally reported higher Drone Acceptance. Second, Fear Appraisal and Privacy Concern were highly positively correlated which indicates that the more people were afraid of drones and drone technology, the higher their privacy concern was. These correlations are in the expected directions.

Drone Acceptance

The Effect of Environment and Fear on Drone Acceptance. A factorial between-participants analysis of variance (ANOVA) was used to compare the average level of Drone Acceptance (DV) for differences in Environment and Fear (IVs). Shapiro-Wilk's assumption for normality was violated, however, as each condition contained more than 30 participants, normality can be assumed, based on the Central Limit Theorem (McLeod, 2019). Also, an ANOVA is robust against these kinds of violations if the sample is large enough (Allen & Bennett, 2010). The assumption of homogeneity of variance was not violated. All Skewness and Kurtosis values were not outside the range of normality, so this distribution can be considered normal.

The main effect of Environment on Drone Acceptance was statistically significant, F (3, 129) = 31.61, $p < .001$, with participants placed in the park accepting the presence of drones less

Table 1

Mean scores, Standard Deviations and Pearson Correlation Matrix for variables of the current study

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Drone Acceptance	3.55	1.13	-														
2. Privacy Concern	2.56	0.74	**-.38**	-													
3. Information Needs	4.21	0.75	-.05	**.30**	-												
4. Fear Appraisal	2.36	0.73	**-.25**	**.56**	**.27**	-											
5. Uncertainty Avoidance	3.09	0.69	*.18**	.07	.06	-.10	-										
6. Trust in DDC	3.94	0.66	**.38**	**-.24**	-.04	**-.28**	.05	-									
7. Transparency	3.66	0.75	**.26**	-.03	.15	-.10	.05	**.32**	-								
8. Age	41.39	19.14	.16	-.03	-.06	.23	-.17	.12	**.22**	-							
9. Education	-	-	-.16	**.27**	.15	*.19**	-.07	**-.30**	-.09	.15	-						
10. Who	13.64	13.15	-.01	.00	.11	-.03	-.02	-.03	-.10	-.16	.01	-					
11. Why	8.77	7.56	-.02	.05	-.07	.03	.04	-.07	.03	-.04	.05	-.01	-				
12. How	7.73	10.67	.10	-.07	-.07	.04	.05	-.06	.10	.01	.09	**-.28**	-.11	-			
13. Privacy Protection	9.98	9.78	-.00	-.01	-.03	-.12	.05	.12	.03	-.02	-.12	*-.22**	-.12	*-.22**	-		
14. Flying Route	5.78	7.37	-.02	.12	-.01	-.01	.01	-.13	-.05	.08	.02	**-.27**	**-.26**	-.10	-.16	-	
15. Rules and Regulations	3.34	8.34	-.05	.01	-.02	.14	-.15	.09	-.04	.03	-.03	*-.20**	*-.20**	*-.20**	-.01	-.14	-

Note. $*p < .05$, $\mathbf{p < .01}$ (2-tailed). Scale categories: (1 strongly disagree – 5 strongly agree). Categories 10 – 15 contain 'Looking times' in seconds.

(M = 3.07; SD = 1.08; $CI_{95\%}$ [2.82; 3.31]) than participants placed at the festival (M = 4.06; SD = .94; $CI_{95\%}$ [3.81; 4.32]). Partial η^2 for this effect was .197. Herewith, Hypothesis 1 can be accepted.

The main effect of Fear on Drone Acceptance was not statistically significant, F (3, 129) = 0.05, p = .82, partial η^2 for this effect was .004. No difference was found regarding Drone Acceptance when fear was high as compared to when fear was low.

There was no significant interaction between Environment and Fear, F (3, 129) = 0.51, p = .48, partial η^2 = .004.

The Effect of Environment and Fear on Privacy Concern. Another ANOVA was carried out to compare the average level of Privacy Concern for differences in Environment and Fear. All assumptions were met.

The main effect of Environment on Privacy Concern was statistically significant, F (3, 132) = 4.25, p = .04, with participants placed in the park having higher privacy concern (M = 2.68; SD = 0.73; $CI_{95\%}$ [2.52; 2.86] than participants placed at the festival (M = 2.43; SD = 0.74; $CI_{95\%}$ [2.26; 2.61]). Partial η^2 for this effect was .031.

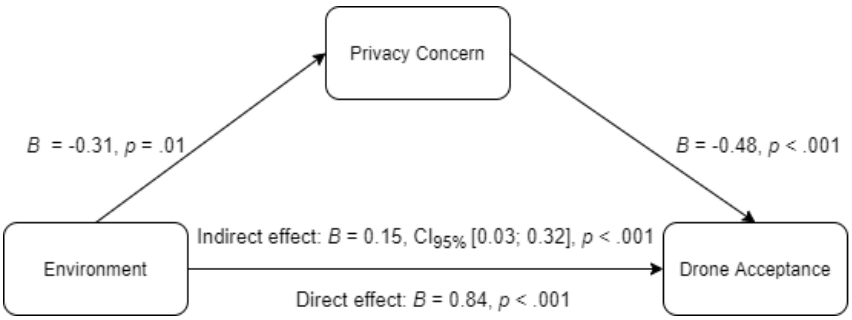
The main effect of Fear on Privacy Concern was not statistically significant F (3, 132) = 2.21, p = .14, partial η^2 for this effect was .016.

Privacy Concern as mediator. Using the PROCESS macro of Andrew Hayes, mediation analyses were performed, with Drone Acceptance as DV, Environment as IV, Privacy Concern as mediator, and Fear as covariate. Privacy Concern and Fear were also switched (i.e., Privacy Concern as covariate and Fear as mediator), but this did not influence or change the outcomes.

First, Hypothesis 2 was tested. There was a significant indirect effect of Environment on Drone Acceptance through Privacy Concern, B = 0.15, BCa $CI_{95\%}$ [0.03; 0.32], p < .001. Figure 3 shows a visual example of all effects. The confidence interval does not include zero, which indicates that there is likely to be a genuine indirect effect. There was a partial mediation effect of Environment on Drone Acceptance by Privacy Concern. The negative relationship between Privacy Concern and Drone Acceptance indicates that as privacy concerns go down, drone acceptance goes up and vice versa. In other words, if people are not worried much about their privacy, their drone acceptance is generally higher and vice versa. These relationships are in the predicted direction and Hypothesis 2 can be accepted.

Figure 3

Model of Environment as predictor of Drone Acceptance, mediated by Privacy Concern. The CI for the indirect effect is a BCa bootstrapped CI based on 5000 samples



Second, Hypothesis 4 was tested. The indirect effect of Fear on Drone Acceptance through Privacy Concern was not statistically significant $B = 0.09$, BCa $CI_{95\%}$ [-0.03; 0.22]. This is not unexpected, as the ANOVA showed that fear did also not have a significant main effect on privacy concern. The range includes zero, so there is not likely a genuine indirect effect. Therefore, the variable Privacy Concern could not be shown to act as mediator between Fear and Drone Acceptance. Hypothesis 4 had to be rejected.

To conclude, the variable Privacy Concern acted as partial mediator for the relationship between Environment and Drone Acceptance. However, no mediation effect could be shown for the relationship between Fear and Drone Acceptance in the current study.

Information Needs

The dependent variable Information Needs is investigated using descriptive statistics. First, Table 2 shows how many times each information category is ranked in the top three most important information categories during the questionnaire. The top three consisted of 'Why' ($n = 125$), 'Privacy Protection' ($n = 88$), and 'Who' ($n = 87$).

Table 2

Total times each category is chosen as first (1#), second (2#), and third (3#) most important information category, and the total amount each category was chosen in the top three

Category	#1 *n* (%)	#2 *n* (%)	#3 *n* (%)	Total times in top three
Why	91 (66.4)	26 (19.0)	8 (5.8)	125
Privacy protection	8 (5.8)	40 (29.2)	40 (29.2)	88
Who	24 (17.5)	36 (26.3)	27 (19.7)	87
Rules and Regulations	6 (4.4)	12 (8.8)	38 (27.7)	56
Flying Route	2 (1.5)	12 (8.8)	16 (11.7)	30
How	5 (3.6)	10 (7.3)	7 (5.1)	22
Total *N*	136	136	136	408

To investigate Hypothesis 3, descriptive statistics were used. Table 3 shows how many times each category is ranked in the top three, separately for the park and the festival environment. This table gives insight into information needs, depending on the environment. Looking at the columns under 'Total', a certain pattern can be recognized (i.e., independently of the environment, participants ranked categories almost with similar amounts in the top three). In total, 91.3% of the people at the park environment (n = 63) ranked the category 'Why' in their top three. Against expectations, 92.5% of the people at the festival environment ranked 'Why' in their top three as well, instead of the hypothesized category 'How' (which only 17.9% of the participants chose). Therefore, Hypothesis 3 can only be partially accepted. It is striking that for both environments, the category 'Why' is ranked most often in the top three, and that, against expectations, the category 'How' is ranked least of the time in both environments. Moreover, Table 3 shows that the top three for the park and the festival environments is similar. Namely, for both environments, the highest-ranked categories were 'Why', 'Who', and 'Privacy Protection'.

In addition, a Chi-squared test was used to investigate if there were significant associations between Environment and whether an information category was ranked in the top three. Unfortunately, there were no statistically significant associations between Environment and any information category: Who [χ^2 (1, N = 136) = 3.02, *ns.*]; Why [χ^2 (1, N = 136) = 0.07, *ns.*]; How [χ^2 (1, N = 136) = 0.29, *ns.*]; Privacy Protection [χ^2 (1, N = 136) = 0.02, *ns.*]; Flying Route [χ^2 (1, N = 136) = 0.08, *ns.*]; and Rules and Regulations [χ^2 (1, N = 136) = 2.36, *ns.*]. This indicates that in both environments, there was no difference in ranking a certain information category in the top three.

Table 3

Total amount each category is ranked in the top three (number #1, number #2, and number #3), for the park and festival environment separately

Category	#1 Park	#2 Park	#3 Park	Total	#1 Festival	#2 Festival	#3 Festival	Total
	n	*n*	*n*	*n* (%)	*n*	*n*	*n*	*n* (%)
Who	17	19	13	49 (71.0)	7	17	14	38 (56.7)
Why	45	12	6	63 (91.3)	46	14	2	62 (92.5)
How	2	4	4	10 (14.5)	3	6	3	12 (17.9)
Privacy protection	1	22	22	45 (65.2)	7	18	18	43 (64.2)
Flying Route	0	8	8	16 (23.2)	2	4	8	14 (20.9)
Rules and Regulations	4	4	16	24 (34.8)	2	8	22	32 (47.8)
Total *N*	69	69	69	207	67	67	67	201

Note. In total, 65 participants read the negative article (high fear), and 71 participants read the positive article (low fear).

To investigate Hypothesis 5, descriptive statistics were used again. Table 4 shows how many times each category is ranked in the top three, separately for the high fear and low fear condition. As described in the method section, there were neutral information categories (How and Flying Route)

and protective information categories (Who, Why, Privacy Protection, and Rules and Regulations). Table 4 shows that protective categories were indeed ranked in the top three when fear was high (e.g., 90.8% of the participants ranked 'Why' and 70.8% ranked 'Who' in the top three). Against expectations, almost the same pattern is observed for people whose fear was low (e.g., also 'Why' (93.0%) and 'Who' (57.7%)). This is not in line with Hypothesis 5 which stated that for people whose fear was low, the neutral categories ('How' and 'Flying Route') would be ranked in the top three. In the low fear condition, 'How' was ranked in the top three by only 16.9% of the participants, and 'Flying Route' by 19.7% of the participants. Therefore, Hypothesis 5 can only be partially accepted; when fear was high, people wanted information that protects them from the drone by seeking protective information. However, when fear was low, people wanted to read similar categories. Moreover, Table 4 shows that the top three for high fear and low fear is similar. Namely, for both conditions of fear, the highest-ranked categories were 'Why', 'Who', and 'Privacy Protection'.

In addition, a Chi-squared test was used to investigate if there were significant associations between Fear and whether an information category was ranked in the top three. No statistically significant associations between Fear and any information category were found: Who [χ^2 (1, N = 136) = 2.50, *ns.*]; Why [χ^2 (1, N = 136) = 0.22, *ns.*]; How [χ^2 (1, N = 136) = 0.06, *ns.*]; Privacy Protection [χ^2 (1, N = 136) = 0.55, *ns.*]; Flying Route [χ^2 (1, N = 136) = 0.42, *ns.*]; and Rules and Regulations [χ^2 (1, N = 136) = 0.93, *ns.*]. This indicates that for both conditions of fear, there was no difference in ranking a certain information category in the top three.

Table 4

Total amount each category is ranked in the top three (number #1, number #2, and number #3), for high and low fear separately

Category	#1 high *n*	#2 high *n*	#3 high *n*	Total *n* (%)	1# low *n*	#2 low *n*	#3 low *n*	Total *n* (%)
Who	12	23	11	46 (70.8)	12	13	16	41 (57.7)
Why	42	14	3	59 (90.8)	49	12	5	66 (93.0)
How	2	4	4	10 (15.4)	3	6	3	12 (16.9)
Privacy protection	4	14	22	40 (61.5)	4	26	18	48(67.6)
Flying Route	2	6	8	16 (24.6)	0	6	8	14 (19.7)
Rules and Regulations	3	4	17	24 (36.9)	3	8	21	32 (45.1)
Total *N*	65	65	65	195	71	71	71	213

Note. The high fear condition had 65 participants, the low fear condition had 71 participants.

Exploratory analyses

As stated in the introduction, the variables Uncertainty Avoidance and Trust were investigated in an exploratory manner.

Uncertainty Avoidance. First, based on the obtained knowledge about uncertainty avoidance,

privacy concern could be a source of uncertainty, trust could be a mechanism to deal with uncertainty, and transparency could lead to acceptance of a source and diminish uncertainty. Therefore, it is interesting to investigate whether this variable could operate as moderator. To investigate this, simple moderator analyses were performed using the PROCESS macro of Andrew Hayes. Three analyses investigated three different relationships.

First, the relationship between Privacy Concern – Drone Acceptance was investigated. The outcome variable was Drone Acceptance with Privacy Concern as the predictor variable. The moderator variable was Uncertainty Avoidance. The interaction between Privacy Concern and Uncertainty Avoidance turned out not to be statistically significant: B = -0.10, t = -0.48, p = .63. Second, the relationship between Environment – Privacy Concern was researched, with Privacy Concern as dependent variable, Environment as independent variable, and Uncertainty Avoidance as moderator variable. There was no significant interaction between Environment and Uncertainty Avoidance: B = 0 .15, t = 0.84, p = .40. Lastly, the relationship between Fear (IV) and Privacy Concern (DV) was investigated, with Uncertainty Avoidance as moderator variable. Unfortunately, there was no significant interaction between Fear and Uncertainty Avoidance: B = -0.23, t = -1.17, p = .24. Therefore, the variable Uncertainty Avoidance could not be shown to operate as moderator between the described relationships in the current study.

Secondly, it was investigated whether uncertainty avoidance could predict drone acceptance, privacy concern, and information needs, by performing simple linear regression analyses. According to a simple linear regression model, the level of uncertainty avoidance significantly predicted drone acceptance, F (1, 131) = 4.14, p = .04, adj. R^2 = .023. Counterintuitive, the level of uncertainty avoidance had a significant positive effect on drone acceptance, B = 0.30, SE = 0.15, p = .04. Second, uncertainty avoidance did not significantly predict privacy concern, F (1, 134) = 0.61, p = .44, and also not information needs, F (1, 134) = 0.53, p = .47.

In addition, by performing six separate simple linear regression analyses, it was investigated if the level of uncertainty avoidance could predict whether participants ranked certain information categories in their top three. Only for the information category ‘Why’, the level of uncertainty avoidance significantly predicted ranking ‘Why’ in the top three, F (1, 134) = 5.51, p = .02, adj. R^2 = .032. The level of uncertainty avoidance had a significantly positive effect on ranking ‘Why’ in the top three, B = 0.08, SE = 0.03, p = .02. This indicates that an increase in the score on uncertainty avoidance is associated with an increase for including the information category ‘Why’ in the top three. For the other five information categories, uncertainty avoidance could not be shown to be a significant predictor (F (1, 134) = [0.29; 1.75], *ns*.).

Trust in the Dutch Drone Company. As trust can lead to acceptance of a source (Bennis et al., 2010; Walumbwa et al., 2008), trust in the Dutch Drone Company was investigated in an exploratory manner, to gain more insight into this variable. Generally, participants trusted the DDC to a certain extent (M = 3.95; SD = 0.66). Moreover, trust in the DDC and drone acceptance were

moderately positively correlated (r = .38, p < .01). This indicates that the more participants trusted the DDC, the higher their drone acceptance was.

Second, by performing independent samples t-tests, no difference was found in the level of trust for people in the high fear and the low fear condition (t (134) = -0.20; p = .84), indicating that manipulating fear did not affect how much participants trusted the DDC. In addition, no difference was found in the level of trust for people in the park and festival environment (t (134) = -1.04; p = .44).

Lastly, it was investigated whether trust in the DDC could predict variables such as drone acceptance, information needs, privacy concern, fear appraisal, and transparency by performing separate simple linear regression analyses. First, the level of trust significantly predicted drone acceptance, F (1, 131) = 21.90, p < .001, adj. R^2 = .137. Trust had a significant positive effect on drone acceptance, B = 0.64, SE = 0.14, p < .001. Second, trust did not significantly predict information needs, F (1, 134) = 0.25, p = .62, adj. R^2 = -.006. Third, trust significantly predicted privacy concern, F (1, 134) = 8.13, p < .01, adj. R^2 = .050, and had a significant negative effect on privacy concern, B = -0.27, SE = 0.09, p < .01. Moreover, trust significantly predicted fear appraisal, F (1, 133) = 11,34, p < .001, adj. R^2 = .072. Trust had a significant negative effect on fear appraisal, B = -0.31, SE = 0.09, p < .001. Lastly, trust significantly predicted perceived transparency of the DDC, F (1, 134) = 15.75, p < .001, adj. R^2 = .099, and had a significant positive effect on transparency, B = 0.37, SE = 0.09, p < .001.

Additional analyses

Log data from Unity. As stated in the Methods section, all participants were able to obtain extra information about the drone while wearing the VR glasses. They could click on six different information categories on a tablet to read information (Appendix 9). Unity logged the actions of all participants, meaning that the time spent in each category was logged and saved. The order in which participants chose to read the categories was saved as well. Table 5 contains the log data of participants' clicking behaviour for the park and festival condition separately. This data is compared to the data in Table 3, to investigate whether the reported data from the questionnaire (Table 3) matches the data from participants' clicking behaviour (Table 5). In other words, these tables were compared to find out whether participants intuitively were interested in the same categories (i.e., clicking on the categories on the tablet in VR) as when they had to rank their top three in the questionnaire.

Table 5

Log data about the clicking behaviour of participants, for the park and festival environment separately

Category	#1 Park *n*	#2 Park *n*	#3 Park *n*	Total (%)	#1 Festival *n*	#2 Festival *n*	#3 Festival *n*	Total (%)
Who	21	12	9	42 (64.6)	25	9	7	41 (66.1)
Why	17	18	1	36 (55.4)	18	15	6	39 (62.9)
How	3	12	8	23 (35.4)	4	8	9	21 (33.9)
Privacy Protection	5	8	5	18 (27.7)	4	14	3	21 (33.9)
Flying Route	14	7	6	27 (41.5)	9	10	7	26 (41.9)
Rules and Regulations	5	6	1	12 (18.5)	2	2	6	10 (16.1)
Total *N*	65	63	30	158	62	58	38	158

Note. As participants had one minute to read the categories on the VR tablet they deemed important, not all participants read a similar amount of categories. Therefore, the total amount of clicks is not the same. In addition, not all log data was saved due to an error. Therefore, the total amount of first clicks (n = (65 + 62 = 127)) is not similar to the total sample size (N = 136).

Table 3 and 5 show that in the park environment, 'Who' and 'Why' were ranked and clicked on the most. These tables show that for the festival environment, 'Who' and 'Why' were ranked in the top three and clicked on the most as well. It is notable that there is overlap in categories for both environments, and that the intuitive clicking behaviour and the ranking behaviour are very similar. It stands out that the category 'Flying Route' is clicked on by more than 40% of the participants for both environments, but that only around 20% of the participants ranked this category in their top three (see Table 3). Also, around 65% of the participants in both environments ranked 'Privacy Protection' in their top three, while only around 30% clicked on this category for both environments.

To conclude, on the one hand, 'Who' and 'Why' were ranked and clicked on the most for both environments, indicating that these were of main importance and interest for the participants. On the other hand, some categories were not ranked and clicked on in similar amounts.

In addition, a multivariate analysis of variance (MANOVA) was performed to investigate whether the looking times (see Table 1) of different categories depended on which condition participants were placed in. The assumptions of homogeneity of covariance were not violated. There was no evidence of a significant effect, as there was no statistically significant difference in looking times at all six categories based on the condition participants were placed in, F (18, 137) = .60, p = .90, partial η^2 = .030. Therefore, it could not be shown that the time spent looking at/reading the categories at the VR tablet differed significantly for all four conditions.

Open question Privacy Concern. One open question was asked regarding Privacy Concern: *"Did you have any other thoughts or concerns when you saw the drone?"*. In total 87 participants (63.5% of the total number of participants) left the space blank, indicating that they did not want to write down any other thoughts or concerns. The other 36.5% (n = 49) gave a variety of answers. The following paragraph shows an oversight of the coded answers. In addition, percentages are displayed

to obtain a clear oversight of the prevalence of codes/answers. Lastly, Figure 4 gives insight into the prevalence of each category for all four conditions separately.

Noise. In total, 14 participants (28.6%) stated that they found the noise of the drone very distracting and very loud, even though the volume of the noise of the drone was the same for all participants. A participant stated: *"I felt very rushed when I heard the drone because the noise was very profound and loud."*. Another stated: *"The presence of the drone is distracting me and my focus. Besides that, I wanna live by trust, not by fear."*.

Collision possibility. In total, 14.2% of the participants (n = 7) stated they were afraid of their physical safety, especially regarding potential collisions or drones falling out of the sky. Someone said: *"I am afraid for my physical safety, the danger of being hit by a drone."*.

Data protection. Five people (10.2%) stated as an extra concern they were afraid about the data protection, and they were questioning whether that would be done properly. In addition, they stated that they obtained a 'big brother is watching you' feeling, as this participant clearly described: *"I felt really watched, that was confronting, felt like the situation in China where they are tracking your every moves."*.

Why is the drone there. Six people (12.2%) indicated that they wanted to know why that drone was flying there and that they were concerned because they did not know why the drone was there. *"Because I don't know why this drone is flying over, I get a somewhat uncomfortable feeling."* is what most participants stated.

Flying route. In total, 10.2% (n = 5) described that they felt uncomfortable because the drone was flying quite low in the VR environments. One person suggested: *"Can't the drone fly a bit higher? Then it will be less visible and also less present."*.

Who flies with the drone. Only four people (8.2%) indicated that they were concerned about who was flying with the drone. One participant captured the overall opinions very well with his/her answer: *"As long as the police or other governmental institutions are flying with the drone, I do not have a problem with it. If it would be a private company, I would feel more watched and followed."*.

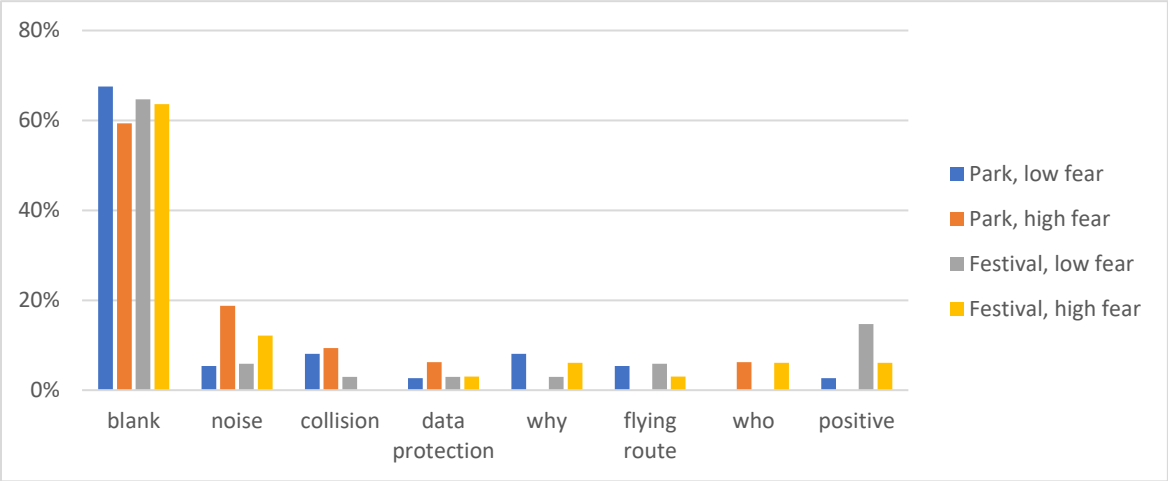
Positive. It was expected that people would only fill out (negative) concerns or thoughts. However, eight people (16.3%) elaborated on the fact why they thought it is a good thing to use drones to enhance the general safety of citizens: *"If the drone can prevent that people in front [of a festival] are crushed or pressed, it's a benefit."*. People also stated that it made them curious (*"I became very curious when I saw the drone!"*). One participant elaborated: *"After I read about the rules and regulations, all the concerns I had before, were instantly gone."*.

Figure 4 shows the prevalence of each open question category in percentages for all conditions. For all conditions, most participants left the space blank, indicating that they did not have anything else to state about their privacy concern, and a few other things stand out. First, especially for people in the high fear condition, the noise was more an issue than for people in the low fear condition. Second, especially people who were placed in the park environment were concerned about a

drone collision. Moreover, only people in the high fear condition wanted to know more about who controlled the drone. Lastly, people who were at the festival low fear condition especially stated positive things.

Figure 4

Prevalence of the seven categories in percentages for all four conditions



Comparing drone acceptance within environment conditions. By performing an ANOVA, the effect of environment on drone acceptance was investigated, noted at the beginning of the results section. However, these differences can be studied in more detail, comparing the levels of drone acceptance within the two environment conditions. As people who were in VR at the festival had to indicate how they thought about the presence of the drone and afterwards, had to *imagine* they were in a park and indicate how they would think about it, it can be investigated whether they judged the presence of a drone differently in these two environments. People who were in VR in the park had to do the same, and afterwards, they had to *imagine* they were at a festival and indicate how they thought about the presence of the drone to enhance the general safety of citizens.

First, people who were in VR at the festival were positive about the presence of the drone (M = 4.06; SD = 0.94). However, when they had to *imagine* they were at a park, and a drone would fly over, they were much less positive about this (M = 2.89; SD = 1.02) and this difference is statistically significant, obtained by performing a paired-samples t-test (t (63) = 8.61; p < .001; $CI_{95\%}$ [0.90; 1.45]).

Second, people who were in VR in the park were neutral about the presence of a drone (M = 3.03; SD = 1.09). However, when they had to *imagine* they were at a festival, and a drone would fly over, they became more positive about this (M = 3.98; SD = 1.06). This difference is also statistically significant, obtained by performing a paired-samples t-test (t (71) = -6.48; p < .001; $CI_{95\%}$ [-1.24; -0.66]). See Appendix 8 for more compared means.

Discussion

The current study explored the effects of environment and fear on drone acceptance, information needs, and privacy concern. In line with the hypothesis, drones were accepted more at a festival than in a park. As hypothesized, being in a park caused higher privacy concern than being at a festival, which in turn caused lower drone acceptance in a park than at a festival (partial mediation). Against expectations, privacy concern could not be shown to act as mediator for the relationship between fear and drone acceptance. Not in line with the hypotheses, participants' information needs did not differ for each condition; for all conditions, people were especially interested in the reason why the drone was present, who was controlling the drone, and how their privacy would be protected when a drone flies over.

The finding of Oltvoort et al. (2019) that drones were accepted more at festivals than in parks is replicated by the current study. Therefore, the reliability of both studies is strengthened, which might imply that an actual pattern or trend is discovered, in which drones are accepted more at festivals than in parks. The fact that the age of the participants had a wide range (between 17 and 77 years old), makes the finding even stronger because one might expect that younger people have a more positive attitude towards (new) technologies than older people, as there remains an eminent digital divide between these two groups (Kim & Choudhury, 2020). However, in the current study, a lot of youngsters and elderly people participated who generally scored positive on drone acceptance, indicating that youngsters, as well as elderly people, accepted the presence of the drone. This finding goes against the assumption of Kim and Choudhury (2020) but strengthens the outcome of the current study even more: there is still a significant difference between drone acceptance in a park and at a festival, even though a broad range of people of different ages participated in this research.

Fear was successfully manipulated, however, against expectations, this did not result in different information needs. Independently of whether fear was high (i.e., fear appeal was used) or low (i.e., fear appeal was not used), information needs were similar (which was the case for people who were at the festival or in the park environment as well). People were mostly interested in why the drone was present, who was controlling the drone, and how their privacy would be protected. This could imply there might be a discrepancy between the currently available literature and the outcomes of this study. Literature shows that when fear appeals are used, people engage more in protective behaviour (Ruiter et al., 2014). This was indeed the case for people in the high fear condition as they ranked the 'protective' information categories (e.g., Why and How) most often in their top three. However, in the low fear condition, people ranked similar categories in their top three, which fell under the 'protective' categories as well. Therefore, against expectations, using fear appeal or not, resulted in people wanting to read or obtain similar information about drones. Based on this finding, two main recommendations are proposed. The first one is to provide people with information about drones or to give them the possibility to obtain information about the drone when they see one flying over (that is there to enhance the general safety of citizens). This is recommended because the current

research showed that people were willing to a great extent to obtain additional information about the drone and a clear pattern of information needs was observed. Second, future academic research could investigate how to provide this information about drones to the public and whether meeting people's information needs (based on the findings of this research) diminishes privacy concern and enhances drone acceptance, with the ultimate goal to make people feel safe(r) and more at ease when a drone flies over.

Moreover, against expectations, fear did not significantly predict privacy concern. Taking into account that high or low fear did also not result in different information needs, one might conclude that manipulating fear did not have the desired effects. De Hoog et al. (2007) observed similar findings, and they stated that highly fear arousing texts did not make people feel more fearful than texts just stating negative consequences or situations. They argued that communications using fear appeal can be effective if the information about the negative consequences is just plainly written; the message does not have to be as appalling as possible. In addition, Peters et al. (2012) found that too much arousing fear appeal might have the opposite effect, as they found negative effects. It could be the case that the articles in the current study were too one-sided and that they, therefore, did not have the desired effect. Another explanation of the absence of the expected effect might be traced down to how fearful participants felt in this study. Even though a significant difference was found in mean scores for the high and low fear condition, both groups scored below the centre of the 5-point Likert Scale. This indicates that participants, in general, were not afraid of drones and drone technology and might explain as well why manipulating fear did not have the desired effects in this study. It could also be the case that in general, fear does not have an effect as big as expected or hypothesized at the beginning of this research. To conclude the two previous paragraphs, little can be said about fear in this study.

Privacy concern was found to be a partial mediator for the relationship between environment and drone acceptance. This indicates that other variables play a role as well, which were not investigated in the current research. Against expectations, no mediator effect could be shown for the relationship between fear and drone acceptance, indicating that privacy concern was not crucial in affecting drone acceptance (MacKinnon & Dwyer, 1993; MacKinnon, 2008).

Uncertainty avoidance was investigated in an exploratory manner. However, it did not influence, predict, or affect many variables in the current study. First, it was researched whether uncertainty avoidance could act as moderator, but this could not be shown. Other analyses were performed to further investigate the role of uncertainty avoidance. Two significant outcomes were obtained. First, the level of uncertainty avoidance positively predicted people ranking the information category 'Why' (i.e., reasons why the drone is there) in their top three. Second, uncertainty avoidance positively predicted drone acceptance, indicating that the higher people scored on uncertainty avoidance, the higher their drone acceptance was as well. Noticing a drone flying over is seen as a potential privacy threat (Gill and Spriggs, 2005) and as an uncertain situation (Apvrille et al., 2015).

Therefore, one might expect that the higher people score on uncertainty avoidance, the lower their drone acceptance will be. However, the opposite result was found. Aurigemma and Mattson (2018) also found opposing effects regarding uncertainty avoidance[2], and they believed this was because two components of uncertainty avoidance played a role in this situation. DeWees and Lerner (2020) argued as well that there are two important components regarding uncertainty avoidance. First, people can deviate in what they classify as uncertain (Hirsch et al., 2016). Second, when a person judged a situation as uncertain, it can differ from person to person to what extent they believe this uncertainty should be avoided (Matsumoto et al., 2008). It might be important to look at these two components as well in the context of the current study. However, no distinction was made between these two components (i.e., uncertainty avoidance was investigated as a whole using items of Jung and Kellaris, 2004). This might explain why uncertainty avoidance did not influence, affect, or predict many variables in the current study. Therefore, it is interesting to investigate these two components further to be able to make a distinction between them in future research (about drones) and to apply this to future research about uncertainty avoidance.

Trust in the Dutch Drone Company was investigated in an exploratory manner as well. It turned out that, even though the DDC was an imaginative company, participants trusted the company quite much. Moreover, trust had a significant positive effect on drone acceptance, indicating that the more participants trusted the DDC, the higher their drone acceptance was, which is in line with findings of Oltvoort et al. (2019). In addition, trust had a significant negative effect privacy concern. Harborth and Pape (2020) found a similar effect in their research, where trust beliefs had a negative effect on risk beliefs/privacy concern. Other studies show a negative correlation between trust and privacy concern as well (Wirtz & Lwin, 2009; Lin & Liu, 2012; Wu et al., 2012; Kumar et al., 2018). Furthermore, the current study showed a significant negative association between trust and fear appraisal, as was found by De Cremer (1999) as well. Findings of the current study are in line with newly obtained literature, even though trust was investigated in an exploratory manner. Future research could take these findings into account to draw hypotheses about trust, as it seems that trust plays a (significant) role for many other constructs or variables.

The current study could not show that the looking times at different information categories at the tablet in VR depended on the condition people were placed in. This is not unexpected, as the Log data from Unity was used for this analysis. During the experiment, it was visible that not all participants only read the categories they found interesting, even though this was mentioned explicitly before they put on the VR glasses. Some participants were intrigued by how the VR glasses worked and how they could see and use their own hands without controllers, and thus they sometimes clicked on random categories to play and to interact with the VR environment. Therefore, the obtained data

[2] They expected a positive effect of uncertainty avoidance on adopting a voluntary information security control, but they found a negative effect (i.e., people scoring high on uncertainty avoidance were less motivated to adopt this control instead of more motivated).

from Unity (representing participants' clicking behaviour) does not only contain information categories people deemed important but random categories as well. This 'random clicking behaviour' was visible by many participants and at all conditions. Therefore, it was not unexpected that the MANOVA could not show that looking at/reading different information categories depended on the condition participants were placed in.

Limitations and future research

The first limitation concerns the fear manipulation. Even though the manipulation was successful, fear did not have the expected effects, and almost all hypotheses concerning fear had to be rejected. A reason why the manipulation did not have the desired effects, could be traced back to the manipulation itself. First, the negative article consisted of only very negative points and the positive article consisted of only very positive points. Some participants in this study stated that the article, whether positive or negative, had the opposite effect for them. They did not believe that the article could be true and legit, because no paper would write only positive or negative things about a topic. A good newspaper would shed a light on both sides, even if the author had a preference for one side. One participant stated: *"This article makes me angry, is it real!? That cannot be, I don't believe it! Please explain to me what is happening here.".* Logically, this could not be explained during the experiment. Afterwards, a dialogue took place in which the participant told the researcher the article had the opposite effect, as the participant was trying to come up with positive things about drones because he/she read the negative article. Based on these experiences and new findings in the literature (e.g., De Hoog et al., 2007; Peters et al., 2012), a reason why the fear manipulation did not cause the hypothesized effects, might be that especially the negative article (i.e., fear arousing) was too negative. It might be the case that it, therefore, did not have an effect or even the opposite effect. Future research could set up the fear manipulation in a different way, not making the fear appeals too extreme. Therefore, future research could take into account that the manipulation should not be too one-sided, meaning that there should be a balance between positive and negative information. It is expected that more balanced fear manipulations can result in the desired or hypothesized effects. However, it should be noted again that it could be the case that fear is not as important in this context as expected.

The second limitation concerns the fact almost only Dutch people participated in the current research, even though the research was made available to a lot of people since the whole experiment could be completed in either Dutch or English. In addition, the Experivan was used in different cities to bring the research to the people, but still, almost only Dutch people participated. Therefore, the results are generalizable to the Dutch population, but not much can be stated about the generalizability to other countries. In the current study, not many results were obtained regarding Uncertainty Avoidance but it is interesting to maximize the possibility to find more (differences) about this construct. This might be achieved by carrying out the current study in Germany for example, as research by Steenkamp (2001) showed that German citizens scored higher on the dimension of

uncertainty avoidance of Hofstede (2001) than Dutch citizens. Therefore, it is interesting to investigate whether this results in different outcomes for different countries because then, outcomes might become generalizable to other countries as well.

In line with the previous paragraph (describing potential differences due to nationality), a limitation is found regarding differences in language, concerning the translations of the information categories on the tablet in VR. Especially regarding the category 'How', something might got lost in translation. The English version explained how the drone operated. After closer inspection of the information categories of Oltvoort et al. (2019), it became clear this was their intention as well. However, inspecting the Dutch version of 'How' closer after partially rejecting Hypothesis 4, it became clear that here, the meaning got somewhat lost in translation. Plainly translated, the Dutch version explained how the drone *worked* instead of how the drone *operated*. Dutch participants told the researcher they thought this was about how the drone worked technically. They did not find this interesting, so they did not click on this option much. However, in Dutch as well, the option 'How' was meant to explain how the drone operated instead of how it worked technically. In hindsight, the meaning of the Dutch version was different from the English version. Therefore, it was also different from how it was meant in the research of Oltvoort et al. (2019). Unfortunately, only three participants filled in the English version, so it could not be checked whether the different languages really had an effect. However, based on the fact that almost everyone chose to fill in the Dutch questionnaire (97.8%), this might be explaining why the option 'How' was not ranked as high as hypothesized.

Lastly, even though there are many beneficial aspects of using Virtual Reality (ecological validity, experimental control, and reproducibility), participants are still aware of the fact that there is no real danger or real consequences when they are wearing VR glasses (Pan & Hamilton, 2018). This could have affected how intensely participants reacted to the presence of the drone, and maybe different as well than they would have done in real life. Therefore, the results and the extendibility to real-life situations should be interpreted with some caution. However, VR is often used to simulate situations that are hard to find, dangerous in real life or which do not occur similarly all the time (Pan & Hamilton, 2018), so it is a good and safe alternative and VR is used more and more nowadays. Linking this with the outcome that the fear manipulation did not have the desired effects, future research should ensure that participants actually feel vulnerable to the threat (i.e., the presence of drones) to obtain the desired effects. Based on the extended parallel process model (Witte, 1992), only if people feel vulnerable, they might become motivated to take on protective behaviour (i.e., reading 'protective information categories' in the current study). Making people feel more vulnerable could be achieved by engaging participants even more in the situation, with the help of VR. One could think of creating one frightful VR environment in which an accident happens with the drone. The other VR environment could be a calm and serene environment in which the positive aspects of drone usage come to light. In combination with using improved fear manipulating articles, it is expected that this way, participants will feel actually vulnerable to drones (in the frightful condition) and that the fear

manipulation might have the desired effect this way.

Besides these limitations, the current study has also strong points. First, to the knowledge of the researcher and the supervisors, this was the first time that Privacy Concern was measured as a *state* variable instead of a *trait* variable. Research by Usmanova (2018) and Ahrendt (2020) already suggested using adjusted items to measure privacy concern as a state variable. Measuring it this way would allow this variable to potentially operate as mediator instead of an independent variable. In the current study, it had to be accounted for that answers to these items should be able to vary within a person, based on the (emotional) state or situation they were in. Therefore, the items were adjusted with this in mind. The created items (see Appendix 7, p. 47), intended to measure privacy concern as a state variable, obtained a high internal consistency. This means that the construct is highly reliable, measuring what it is supposed to measure (i.e., privacy concern as a state variable). These newly created items should be validated by more researchers in more studies. Future researchers are therefore encouraged to use these items as well if privacy concern is to be measured as state variable instead of trait variable. Hopefully, this can contribute to the validation of a new construct, measuring privacy concern as state variable.

Second, even though some people were distracted while participating as quite some noise from outside the Experivan was audible, the data collection was a success and travelling around with the Experivan captured people's interest. Talking with people about the study's purpose and showing the VR glasses made people enthusiastic about participating in scientific research. Carrying out research this way is, for potential participants, an interesting approach. Apparently, this attracts them quickly, possibly due to the imposing Experivan and the VR gadgets. Therefore, this is a great way of carrying out social and scientific research. It is advised to future researchers to make use of novel equipment and research tools (e.g., VR glasses, AR glasses, eye-tracking) to make participating in research more accessible to a large group of people.

Conclusion

Taking everything into account, it can be concluded that the current study successfully showed again that drones are accepted more at festivals than in parks. It also showed, against expectations, that information needs were similar, independently of whether people were at the festival or the park and whether fear was high or low. Privacy concern was shown to operate as partial mediator for the relationship between environment and drone acceptance, in which, as hypothesized, people in the park environment scored higher on privacy concern and lower on drone acceptance. As expected, this was the other way around for people in the festival environment. The current study successfully investigated privacy concern as a state variable instead of a trait variable.

Based on this study, the main recommendation is to provide people with specific information about drones at the moment they see a drone flying over (that is present to enhance the general safety of citizens). Furthermore, the main recommendation proposed for future academic research is to

investigate how to communicate information about drones in the best way, and what the effect is of meeting the specific information needs that followed from this research.

Inspired by the current study, a few implications are found for practice. If future research shows that providing transparent and adequate information about drones in the right way results in people feeling less scared, afraid, or angry when a drone flies over, this would be a positive and useful outcome for society as a whole. Second, when governments or organisations want to implement drones in daily life to enhance the general safety of citizens in public places, they can take the following into account: people are more acceptant towards the presence of drones at festivals than in parks. Lastly, the finding that information needs were similar for all four conditions, is beneficial for practice, especially at the moment when drones will be more implemented in daily life. Organisations or governments could focus on providing specific information topics, (probably) addressing the majority of the people in public places. They could specifically focus on topics such as: (1) why is the drone here, (2) who is flying with the drone, and (3) how will citizens' privacy be protected when a drone flies over.

All in all, the current study showed a clear pattern regarding information needs, independently of where participants were and that drone acceptance depended on the environment.

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Appendix 1 – Measures, seeing own virtual hands with the Leap Motion tracker

Appendix 2 – Pictures of the Experivan

Note. Van Heekplein, Enschede.

Note. Sint Plechelmusplein, Oldenzaal.

Appendix 3 – Informed consent and disclaimer information about the VR glasses

Dear Participant,

You are being invited to participate in a research study titled “The use of drones in order to enhance public safety.” This study is carried out by Myrthe von den Benken from the Faculty of Behavioural, Management and Social Sciences at the University of Twente, master track Psychology of Conflict, Risk, and Safety.

The purpose of this research study is to find out what you think about the use of drones in order to enhance public safety, and will take you approximately 25 minutes to complete. The data will be used for analyses in my Master’s thesis.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any question.

We believe there are no known risks associated with this research study; however, as with any online related activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by not asking your name or other

information that could lead back to you. All information and responses from you will be anonymized. Data will be saved on a protected server of the University of Twente.

Lastly, you have to be at least 16 years in order to be allowed to participate.

If you have any questions regarding your rights as a research participant, or other questions, please feel free to contact me (Myrthe von den Benken) through this email: m.s.a.vondenbenken@student.utwente.nl

If you have any complaints about this research, please feel free to contact Lyan Kamphuis from the Ethics Committee of the University of Twente: l.j.m.blikman@utwente.nl

This study makes use of Virtual Reality (VR), so you will have to put on VR glasses and you will enter a VR environment for around 3 minutes. It is **not** recommended to use VR if you are tired, dizzy, feel woozy (light in the head), nauseous, ill, under influence of alcohol or drugs, or if you suffer from balance disorders, as you could become dizzy by using the VR glasses. If this happens, please tell me, I will help you and you can stop participating. If you suffer from a severe medical condition, consult your doctor first, before using VR. Please focus well during the experiment, because a question will be asked to test whether you were paying attention well enough.

Appendix 4 – Uncertainty Avoidance items

Firstly, I would like to get some information about your personal characteristics.
Please indicate how strongly you disagree or agree with the following statements:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I prefer structured situations to unstructured situations	○	○	○	○	○
I prefer specific instructions to broad guidelines	○	○	○	○	○
I tend to get anxious easily when I do not know an outcome	○	○	○	○	○
I feel stressed when I cannot predict consequences	○	○	○	○	○
I would not take risks when an outcome cannot be predicted	○	○	○	○	○
Rules should not be broken only because of practical reasons	○	○	○	○	○
I do not like unstructured situations	○	○	○	○	○

Appendix 5 – Manipulation stories NRC Checks; negative article (using fear appeal, high fear condition) and positive article (not using fear appeal, low fear condition)

NRC.CHECKS

'Drones have a negative impact on society'

As is recently stated by Sander Pakker in the newspaper *"Trouw"*.

Introduction
Columnist Sander Pakker recently wrote about the negative aspects of drones. "Despite the new Europewide regulations regarding flying with drones that went into effect on December 31st, 2020, many things still often go wrong. These new rules should enhance safety in the air and on the ground: First, people flying with a drone should always have a legal flying license with them; Second, they should check before flying where they can and cannot fly, and they are not allowed to record film or audio during the flight without an official purpose." The rules are clear, but these rules do not prevent all the accidents that happen on a yearly basis. Therefore, Pakker thinks that drones have a negative impact on society.

Analysis of the NRC
Hanna Kip of the NRC: "Despite these new regulations, military drones are used for drone- and airstrikes. This is a cheap way to carry out airstrikes from a distance, but these strikes sometimes go wrong, killing people that were not the target. This unfortunately happens quite frequently, at least 36 times a year, and that's a real shame! Currently, there are hundreds of commercial drones that film specific places or objects, but these drones collide with objects and damage property 200 times a year. What is even worse, is that drones also collide with people! Last week, a propeller of a malfunctioning drone sliced the eyeball of a toddler into two pieces. The mother of the toddler: "My child was directly taken to the hospital, but there the doctors said that my kid will never see with that eye again."
Hanna thinks this is very upsetting, and she needs a minute. Afterwards, she says: "What bothers me so much personally, is that I cannot easily get to know who is flying the drone, who owns the drone, or what the goal is of the presence of the drone. Because of this, I always have the feeling that my privacy is violated when I see a drone flying over my head. I am scared that an individual will use the videos of the drone with my presence on it for their own purposes. I really feel that they are spying on me!"

Conclusion
The conclusion of the newspaper NRC is that the use of drones brings many disadvantages, that people should be wary and that people should look out when a drone flies over.
The abovementioned comments by Sander Pakker are judged as **true.**

- ✓ **true**
- ○ **somewhat true**
- ○ **somewhat false**
- ○ **false**

NRC.CHECKS

'Drones have a positive impact on society'

As is recently stated by Sander Pakker in the newspaper *"Trouw"*.

Introduction
Columnist Sander Pakker recently wrote loving words about the use of drones. "Despite the new Europewide regulations regarding flying with drones that went into effect on December 31st, 2020, many things still often go wrong. These new rules should enhance safety in the air and on the ground: First, people flying with a drone should always have a legal flying license with them; Second, they should check before flying where they can and cannot fly, and they are not allowed to record film or audio during the flight without an official purpose." Pakker thinks that these extra safety measures are a good addition to enhance the safe use of drones and that because of this, people do not have to worry about their privacy or safety when a drone flies over. Therefore, Pakker thinks that drones have a positive impact on society.

Analysis of the NRC
Hanna Kip of the NRC: "Beside recreational use, drones are used for other purposes, and until now this has had a very positive impact! The ministry of Defence wrote on the 28th of May, 2021 that military drones have been used to safe the lives of refugees that were lost on the Mediterranean Sea when the weather got really bad. Because of the drones, the refugees could be localized and saved. Also, the police are using drones to improve crime prevention and fighting, because drones can keep a clear oversight of the area."
Head Commissioner of the Police: "Around 65% of all criminal actions have been prevented because of the presence of drones."
Moreover, Hanna tells: "The government is also using drones more and more often to enhance the general safety of citizens. For example, drones are used to carry out crowd control in parks, at a festival, in city centres, or at the beach."
Minister of Justice and Safety van Vliet: "These drones can only film from above, and these drones cannot record any audio. So, the privacy of citizens is ensured, because the drones cannot recognize faces since they only film from above and the drones cannot tap into conversations, as these drones don't contain a microphone."

Conclusion
The conclusion is that that the use of drones brings many advantages, and people do not have to be afraid for their privacy. Privacy is well guarded due to the new European rules and the enhanced supervision of the government.
The abovementioned comments by Sander Pakker are judged as **true.**

- ✓ **true**
- ○ **somewhat true**
- ○ **somewhat false**
- ○ **false**

Appendix 6 – Fear Appraisal items

Please indicate how you feel about drones **after reading the article.**

	Totally disagree	Somewhat disagree	Not disagree, not agree (neutral)	Somewhat agree	Totally agree
I am afraid of drones	○	○	○	○	○
I think drone technology is safe	○	○	○	○	○
I think I will feel safe when a drone flies over	○	○	○	○	○

Note. Fear manipulation check

Appendix 7 – Remaining items

The following questions are about your feelings when the drone flew by in the VR environment. I am interested in how you would have felt if a drone would fly over in real life.
Therefore, please imagine that you were in this environment in real life, so you would be outside and a drone would fly over. What would your feelings have been?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I felt I was being watched when the drone flew over	○	○	○	○	○
I felt I was being recorded when the drone flew over	○	○	○	○	○
It was upsetting to see this drone fly overhead	○	○	○	○	○
I was worried about my conversations being heard or recorded by this drone	○	○	○	○	○
This drone violates my basic human rights	○	○	○	○	○
This drone, being used as surveillance equipment, is an invasion of personal privacy	○	○	○	○	○
The owners of the drone might misuse the data they obtained with the drone	○	○	○	○	○
This drone enhances public safety due to the fact that it can monitor groups and situations (reversed)	○	○	○	○	○
The obtained footage could be used against me somehow if it fell into the wrong hands	○	○	○	○	○

Were there any other thoughts or concerns when you saw the drone? If yes, please describe shortly. If not, please fill in an X and continue to the next questions.

Note. Privacy Concern items.

The company flying with the drone, the Dutch Drone Company (DDC), is chosen by the government to enhance public safety and to monitor what is going on outside at public places. As you could read at the tablet during the VR experiment, the DDC meets all the requirements from the government to fly with the drone, and it makes sure that all rules and regulations are followed. Please indicate how you feel about the DDC.

Dutch Drone Company

DUTCH DRONE COMPANY

"I expect that:"

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The Dutch Drone Company treats people like me fairly and justly	○	○	○	○	○
Whenever the DDC makes an important decision, I know it will be concerned about citizens like me	○	○	○	○	○
The DDC can be relied on to keep its promises	○	○	○	○	○
The Dutch Drone Company takes the opinions of people like me into account when making decisions	○	○	○	○	○
I can be confident about the skills of this company	○	○	○	○	○
DDC has the ability to accomplish what it says it will do	○	○	○	○	○
Sound principles guide this organisation's behaviour	○	○	○	○	○
The DDC is not harmful for people like me	○	○	○	○	○
It is important to watch this organisation closely so that it does not take advantage of people like me	○	○	○	○	○

Note. Trust in Dutch Drone Company items.

The following question will come back 9 times. Each time with other answer options. What do you think about the use of drones to enhance the general safety of citizens? I find it:

- ○ Extremely useful
- ○ Very useful
- ○ Moderately useful
- ○ Slightly useful
- ○ Not at all useful

Please tick a box on every line.

I find such a system...

1.	Useful	Useless
2.	Pleasant	Unpleasant
3.	Bad	Good
4.	Nice	Annoying
5.	Effective	Superfluous
6.	Irritating	Likeable
7.	Assisting	Worthless
8.	Undesirable	Desirable
9.	Raising Alertness	Sleep-inducing

Van der Laan, J.D., Heino, A., & De Waard, D. (1997). A simple procedure for the assessment of acceptance of advanced transport telematics. Transportation Research - Part C: Emerging Technologies, 5, 1-10.

The following question is meant as the aforementioned attention check.

"During the experiment, I was at a":

- ○ Festival
- ○ Park

Note. General Drone Acceptance items and environment manipulation check.

In your situation in VR, you were at a festival, and in here:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It is logical that drones are dedicated to helping enhance public safety during festivals	○	○	○	○	○
I understand why drones are being dedicated to helping enhance public safety during festivals	○	○	○	○	○
I think it is a good thing that drones are used to help to enhance public safety during festivals	○	○	○	○	○

Page Break

Q24

Now, please imagine that you were at a **park**, and a drone flew over, what would you think of the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It is logical that drones are dedicated to help enhance public safety in a **park**	○	○	○	○	○
I understand why drones are being dedicated to help enhance public safety in a **park**	○	○	○	○	○
I think it is a good thing that drones are used to help to enhance public safety in a **park**	○	○	○	○	○

Note. Drone Acceptance, VR festival condition items. First, state to what extent you accept the presence of the drone to enhance the safety at a festival in VR. Second, imagine you were in a park, how would you feel?

In your situation in VR, you were at a park, and in here:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It is logical that drones are dedicated to helping enhance public safety	○	○	○	○	○
I understand why drones are being dedicated to helping enhance public safety	○	○	○	○	○
I think it is a good thing that drones are used to help to enhance public safety	○	○	○	○	○

Page Break

Q26

Now, please imagine that you were at a **festival**, and a drone flew over, what would you think of the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It is logical that drones are dedicated to helping enhance public safety during **events/festivals**	○	○	○	○	○
I understand why drones are being dedicated to helping enhance public safety during **events/festivals**	○	○	○	○	○
I think it is a good thing that drones are used to help to enhance public safety during **events/festivals**	○	○	○	○	○

Note. Drone Acceptance, VR park condition items. First, state to what extent you accept the presence of the drone to enhance the safety in a park in VR. Second, imagine you were at a festival, how would you feel?

In the Virtual Reality environment I was in during the experiment, I think:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It is important to be able to obtain information about the drone	○	○	○	○	○
I am willing to obtain extra information about the drone	○	○	○	○	○
It is useless to obtain extra information about the drone	○	○	○	○	○
I will feel more at ease when I know what the purpose is of the presence of the drone	○	○	○	○	○

Note. Information Needs items.

For the following question, there are 6 options to choose from. If you think back to the VR experiment, you might recall that these 6 options are identical to the options you could look at during the VR experiment on the tablet.

Now, please indicate, in order of importance, your top 3 of topics that you would want to read about in order to obtain more information about the drone that flew over your head in the experiment. Please note that the order of importance does not have to match with the order of options you clicked during the VR experiment! So just indicate which option you think is most important/interesting to read, then the second most important/interesting option, and then the third option. Please drag the 3 options of your choice to the right box. Do **not** select more than 3 options in total, and just 1 option per box!

Items	Most interesting/important to read
Who flew with the drone	
Why did they fly with the drone	
How does this drone operate	
Privacy	
Map - Flying route	
Rules and Regulations regarding Drone usage	

Second most interesting/important to read

Third most interesting/important to read

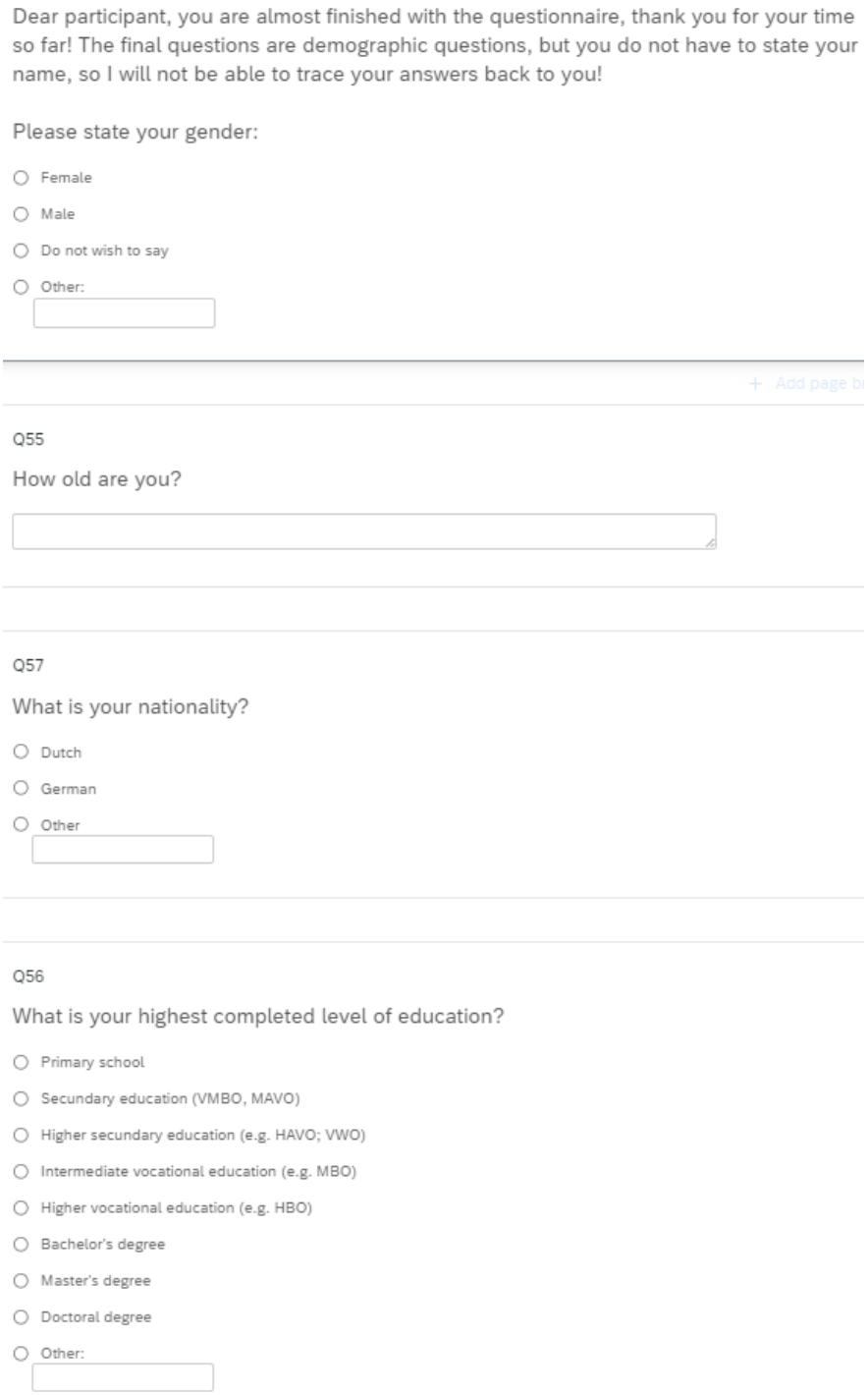
Note. Ranking the top three of most interesting/important information categories.

The following questions are about the Dutch Drone Company.
You probably do not know this company, so the idea is that you answer from the gut feeling you got during the experiment regarding DDC.

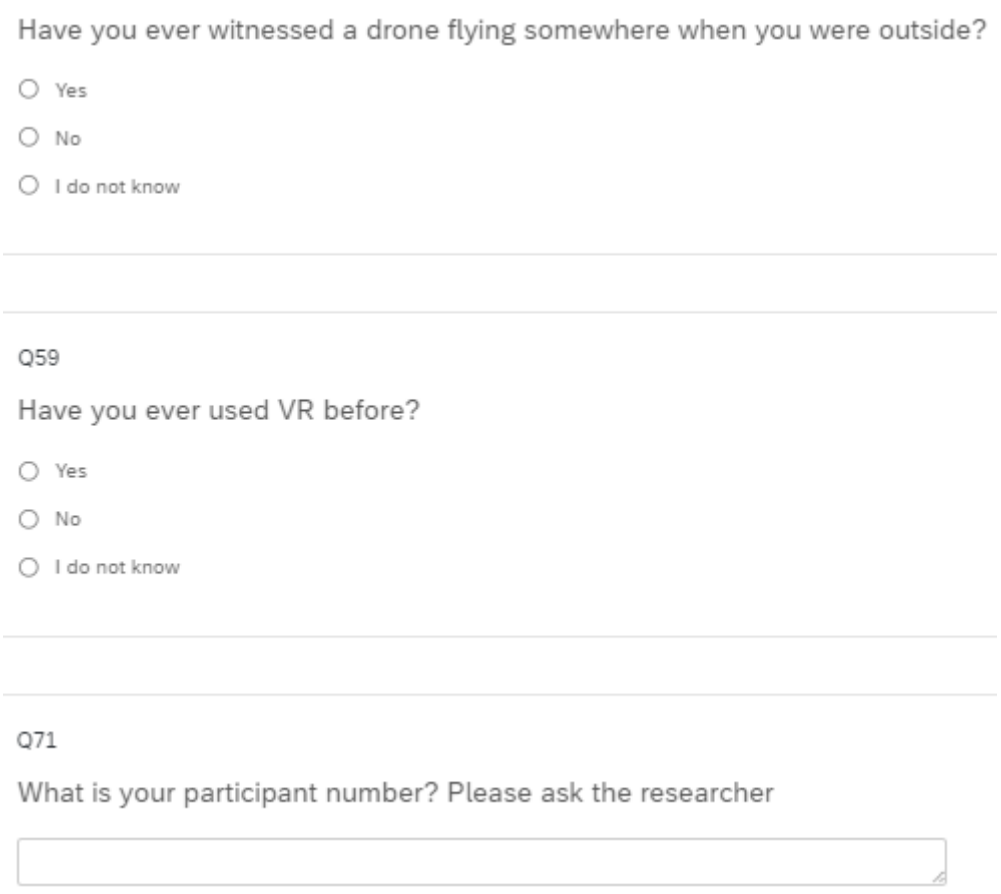
The organisation flying with the drone (Dutch Drone Company):

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Wants to understand how its decisions affect people like me	○	○	○	○	○
Provides information that is useful to people like me for making informed decisions	○	○	○	○	○
Wants to be accountable to people like me for its actions	○	○	○	○	○
Wants people like me to know what it is doing and why it is doing it	○	○	○	○	○
Provides detailed information to people like me	○	○	○	○	○

Note. Transparency items.



Note. Demographics items, part 1.



Note. Demographic items, part 2.

Dear participant,
Thank you very much for your participation in my research, your contribution is very much appreciated!

Next follows a short debriefing over the actual purpose of the study. This and set-up was not discussed with you in the beginning, as this could have influenced your ideas and opinion. Therefore, the actual purpose and set-up will be explained to you.

The actual purpose of the study was finding out whether different environments have an influence on drone acceptance and information needs.
It was hypothesized that drones are less accepted in parks than at festivals, and that different information topics would be of interest, depending on which environments participants were placed in (you were either in a park, or at a festival).

In addition, I am interested in whether enhanced fear appraisal has an effect on privacy concerns, drone acceptance and information needs. You had to read either a news article about positive aspects that drones can bring, or a negative news article about the risks around drones. The article you had to read is completely fictional, I wrote it myself in order to manipulate your ideas/feelings towards drones.

If it turns out that the manipulation worked, and people who read the positive news article are less concerned about their privacy and accept drones earlier, different implementations might become possible. For example, an implementation might be that the government is going to use campaigns to raise awareness for the positive and important things drones can do, in order to give people a better feeling when a drone flies over and that they do not only have the feeling that their privacy is violated when a drone flies over.

If you want to know more about my research or the results, please feel free to contact me via: m.s.a.vondenbenken@student.utwente.nl

Note. Debriefing.

Appendix 8 – More Comparing Means for Environment

When comparing Drone Acceptance of people who were placed at a park (DA VR park (*M* = 3.03; *SD* = 1.09)) and people who were placed at a festival (DA VR festival (*M* = 4.06; *SD* = 0.94)), an independent-samples t-test showed that people accepted the presence of a drone more when they were placed at a festival than in a park. There was a significant difference between drone acceptance in a park and drone acceptance at a festival (t (131) = -5.64; $p < .001$; $CI_{95\%}$ [-1.34; -0.65]).

To explore even more regarding the different categories of Drone Acceptance, two new variables were created for additional analyses, (1) Drone Acceptance VR park + imagined park, named DA_Park_TOTAL, and (2) Drone Acceptance VR festival + imagined festival, named DA_Festival_TOTAL. This is done to compare the total drone acceptance at a festival with the total drone acceptance in a park. By means of a paired-samples t-test, a significant difference in the scores

for Drone Acceptance in a park (M = 3.55; SD = 1.13) and Drone Acceptance at a festival (M = 4.05; SD = .99) is found (t (132) = -5.70; p < .001; $CI_{95\%}$ [-0.67; -0.32]). This suggests from another angle, that again, people accepted the presence of a drone to enhance the general safety of citizens more at a festival than in a park.

Appendix 9 – Text of the six information categories at the VR tablet

Who

The Dutch government has decided to start using drones in order to improve the general safety of citizens and of our beautiful environments. For this operation, they have chosen the Dutch Drone Company (DDC) to carry out the task. This company is the most experienced company in the Netherlands to monitor the general safety with the help of drones. The staff (operators of this drone) are people who followed a special training program from the government in order to fly safely with the drone. In addition, the team of operators follows special courses in order to keep up to date with the rules and regulations regarding drone usage!

Why

This drone is used to make the environment a pleasant and safe place for everyone. The drone helps the staff, enabling them to monitor the crowd and its dynamics. Moreover, this drone films the environment in order to carry out crowd control, making the environment a safe and nice place for everyone.

How

This drone can recognize risky situations and risky behaviours. However, important to notice, the drone can only monitor the surroundings. If a situation or specific behaviour of people seems risky, the drone gives a warning to the staff and they can take fitting action if required. The drone can also assist for safe evacuations if that would be necessary. It can monitor where people are and how they are moving, and the staff can give proper instructions in order to keep the evacuation as safe as possible. Lastly, the drone does not contain a microphone, so it cannot record conversations of people.

Privacy Protection

Protecting the privacy of the citizens and visitors is of very high importance! Your data will never be shared with other parties, because our main goal is to enhance safety and to make the environment a safe place for everyone. This drone is not able to identify individuals, especially because the drone films from above. Your privacy is therefore well guarded. In addition, the drone does not contain a microphone, so your conversations cannot be recorded or shared with other parties. The drone only has a camera in order to monitor the surroundings and to give signals to the staff. The staff in turn, could take proper actions if that is required in order to keep the public space safe.

Flying Route

You can check out the flying route of the drone; where did it fly before and what is the next destination. This map shows the route that is created before the flight takes off, which shows that the flight and its preparation are handled with care on forehand.

Rules and Regulations

In this menu, you can read about the rules and regulations regarding drone usage for this specific purpose. Important to note is that this drone and the flight meet all the necessary requirements, and that all the rules are followed by the staff!

This drone and accompanying flight is assessed by the RIVM (National Institute for Public Health and the Environment) as a flight with 'Moderate Risk (Specific Category)' because the drone is allowed to:

- -Fly above people
- -Fly in the area of air traffic territory
- -Weigh more than 25 kilograms
- -Fly in residing areas
- -Fly higher than 120 meters
- -Fly beyond visual line of sight (BVLOS)

The following rules are applicable, before the pilot is officially allowed to fly with the drone:

- -The owner of the drone (exploiter) must register by asking for an exploiter number at the RDW (Traffic Service)
- -The pilot must have at least an official proficiency flight certificate
- -The exploiter must carry out a risk analysis on forehand
- -The exploiter must have an official flight permit from the Inspection Living Environment and Transportation (ILT)

Appendix 10 – Promotion Flyer, Banner and Instagram (Dutch)

Note. Flyer.


EEN GAVE VIRTUAL REALITY EXPERIENCE BELEVEN?
DOE DAN MEE MET DIT ONDERZOEK!
MASTER SCRIPTIE UNIVERSITEIT TWENTE
SLECHTS 25 MINUTEN
CORONA PROOF
DIRECT OF LATER MEEDOEN
MEER WETEN? VRAAG GERUST!
Onderzoekster: Myrthe von den Benken
Psychology of Conflict, Risk and Safety

Note. Banner.

Note. Promoting the research on the Instagram of D.R.V. ‘Euros’.