The Impact of Dynamic Guardianship and Personality Traits on Safety Perception

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Abstract

This presently reported work sought to examine the effects of dynamic guardianship on safety perception and investigate the relationship between personality traits and safety perception in the context of dynamic guardianship. The concept of dynamic guardianship has emerged as a promising development in safety governance and burglary prevention. It seeks to create an illusion of constant surveillance and presence through the installation of smart home devices (SHDs). This study was carried out among 66 university students using a virtual reality (VR) setting that reproduced a typical Dutch neighborhood with two forms of dynamic guardianship, namely voice-enabled cameras and smart blinds. The preliminary which intended to test if dynamic guardianship manipulation was effective, indicated that participants detected voice-enabled cameras more often than smart blinds. Safety perception was not significantly affected by either voice-enabled cameras or smart blinds. Moreover, personality traits including high agreeableness and low emotionality were not associated with participants' perceived safety.

Impact of Dynamic Guardianship and Personality Traits on Safety Perception in the VR Environment

Burglary may be defined as any illegal intrusion into a property, whether forcibly or not, to commit a theft (Bankiewicz & Papadouka, 2023). Burglary is an established issue in modern society, which, may cause individuals to feel anxious or unsafe (Boyce et al., 2000). Implementing guardianship, which refers to actively monitoring and protecting a neighborhood, is now recognized as a key strategy for minimizing and managing burglary. as well as for promoting perceived safety of residents (Reynald, 2018). Research demonstrated that high levels of guardianship correlated to low levels of illicit behavior and perceived safety (Chainey & Tompson, 2012).

Guardianship in the context of crime prevention can be divided into physical and symbolic (van Sintemaartensdijk et al., 2022). Physical guardianship involves the active presence of people, such as residents or community members, who monitor their surroundings and deter criminal behavior (Zhang et al., 2019). On the other hand, symbolic guardianship is based on the idea of being watched by CCTV or neighbourhood watch signs, which can also deter offenders (Hollis et al., 2013).

In addition to traditional means of guardianship, smart house devices (SHDs), namely voice-enabled cameras and smart blinds, are now recognized as critical components for contemporary security management, capable of creating a feeling of presence and constant surveillance (Balasubramanian & Cellatoglu, 2008; Wolniak & Grebski, 2023). These devices may create a feeling of house occupancy and constant surveillance, a concept termed "dynamic guardianship" in the current study. Dynamic guardianship is a blend of physical/symbolic guardianship effects. Presently, there is very little research on dynamic guardianship, in particular, there is a marked lack of understanding regarding the effect of dynamic guardianship on safety perception. Additionally, while gender, age, and past victimization have all been

researched in connection to safety perception, the impact of personality traits which might be crucial in developing and tailoring dynamic guardianship devices for different groups of people, has received little attention.

To address the aforementioned lack of understanding, in the current study, virtual reality (VR) was implemented to experimentally evaluate the effect of dynamic guardianship and personality traits on safety perception towards crime among a sample of Dutch residents. More precisely, the presently reported work aimed to determine whether (a) voice-enabled cameras and smart blinds promote perceived safety and (b) whether there is a link between personality traits and perceived safety with the adoption of voice-enabled cameras and smart blinds.

Burglary and guardianship

Last year, law enforcement arrested 150,000 individuals as suspects in the 800,000 burglaries registered in 2023 (*Quarter of crime suspects in Netherlands younger than 23,* 2024). Burglaries have become a significant residential challenge associated with a lack of perceived safety in a majority of urban areas (Chon & Wilson, 2014). Lack of safety in one's household can adversely impact their well-being, their lifestyle, and health (Ruijsbroek et al., 2015). One consistent factor in reducing burglary rates and enhancing perceived safety is the presence of guardians within or nearby neighborhoods (Coupe & Blake, 2006).

Guardianship was initially coined as any person or object that prevents crime from happening (Cohen & Felson, 1979). One of the most comprehensive studies of defining guardianship can be found in Felson and Boba's (2010) paper, which describes it as "someone who is engaged in natural surveillance serves a gentle reminder that they are watching." While extensive research has been conducted on police intervention, Cohen & Felson's (1979) fundamental assumption is that the often-neglected aspect of ordinary citizens watching over

each other and their properties during daily routine activities may be crucial since formal guardians are not usually available when a crime occurs. In this sense, any individual engaged in their routine may contribute to some degree of safety and, thus, be considered a guardian (Hollis-Peel et al., 2011). These routine activities are coined as “recurrent and prevalent activities which provide for basic population and individual needs, whatever their biological or cultural origins” and are central to Routine Activity Theory (RAT).

Routine Activity Theory (RAT), developed by Cohen and Felson (1979), identifies three elements that create opportunities for crime: “a suitable target, a motivated offender, and a lack of capable guardianship, which converge in time and space, resulting in a crime” (Hollis-Peel et al., 2011). Hollis et al. (2013) further expanded the definition of guardianship with symbolic guardianship, as “the presence of a human element which acts—whether intentionally or not—to deter the would-be offender.” Measures such as strategically placed neighbourhood watch signs or eye images are intended to imitate the presence of people and stimulate the feeling of being watched. For example, the "Watching Eyes Effect” is the psychological phenomenon, which illustrates how the mere presence of eye cues can impact behavior. This effect suggests that burglars might be deterred due to the feeling of being watched alone even if they do not physically see someone (Bateson et al., 2006).

Aligning with “the Watching eyes effect” principle, symbolic guardianship may also take the form of closed-circuit cameras (CCTV), signaling to offenders that they are under surveillance (van Sintemaartensdijk et al., 2022). According to Welsh and Farrington (2009), CCTV fosters the probability of detecting burglars, stimulates potential victims to adopt security measures, and coordinates security personnel’s mediation to prevent burglary.

However, a research study by Reynald (2009) indicated that people often do not believe that are being actively monitored by CCTV. The author highlighted that while CCTV could

deter burglars in the past, their effectiveness waned as offenders became more accustomed to their presence and doubted their actual monitoring.

Dynamic Guardianship

Building upon the notion introduced by Hollis-Peel et al. (2011) regarding the expanded concept of guardianship, the idea of dynamic guardianship emerges as a potential evolution in security management and burglary prevention. Dynamic guardianship integrates both physical and symbolic elements. Unlike symbolic guardianship including CCTV, which might be less effective given its passive surveillance approach, dynamic guardianship might gives an impression of constant surveillance and occupancy, by implementing voice assistants and conversational AI and other human-like features, potentially increasing its deterrence. With dynamic guardianship, there is no way to check if there is or is not a person present due to the presence of a human element which enhances the feeling of continuous surveillance. Unfortunately, the effectiveness of dynamic guardianship remains uncertain due to a lack of scientific research on the subject.

A dynamic guardianship in practice usually takes the form of smart home devices (SHD). These devices serve as a strong deterrent to home invasion and unauthorized entrance. One example is voice-enabled cameras, which are one of the fastest-growing sectors of the smart home market and automation goods. They are presented as security cameras or surveillance gadgets and are intended to prevent burglary (Balasubramanian & Cellatoglu, 2008). Voice-enabled cameras also include features such as two-way audio communication and red light projection which make them noticeable, especially at night. The availability of two-way audio communication in such security cameras is more effective than traditional one-way audio systems as it can be set to automatically communicate with anyone who tries to break in

and notify them with a human-like voice that they are currently being watched, prompting them to go away without committing a crime (Tan et al., 2022).

Another example of dynamic guardianship is smart blinds. Smart blinds are programmed to open and close at different times, giving the impression of house occupancy even if no one is home (Wolniak & Grebski, 2023). This unexpected movement of smart blinds is, therefore, believed to detter burglar.. Smart blinds integrate easily with home automation systems and can be operated remotely via apps or voice commands, providing increased security with real-time adjustments (Wolniak & Grebski, 2023).

In short, voice-enabled cameras and smart blinds could facilitate higher perception of safety in residents. By focusing on residential safety, the next section seeks to bring attention to the crucial role that dynamic guardianship has in shaping perceived safety.

Citizens' perspective on safety.

Feeling safe, especially in one's own home, is crucial for their well-being (Dustmann and Fasani 2016; Lorenc et al. 2012). Perceived safety could be referred to as an individual's immediate sense of security and lack of concern about becoming a victim (Dickerson et al., 2007). Hence, it is a vital necessity in any society, and it serves a substantial role in evaluating a place of living. Scholars generally believe that evaluations of perceived safety are based on a balance between perceived crime risk in any given scenario and one's self-perceived ability to react to that risk; in other words, vulnerability (Zahnow & Corcoran, 2021).

The link between crime and perceived safety is firmly established. Two contextual factors that are likely to influence perceived safety are the geographical proximity of the crime area to an individual's residence and the temporal recency of nearby crime incidents (Arning et al., 2013). Particularly among the elderly, perceived safety in one's living environment is critical for maintaining social relationships (Dickerson et al., 2007). In addition to age, gender

has a significant impact on perceived safety. Elderly women, for example, have higher safety concerns than males, which reduces their willingness to use public transportation (Arning et al., 2013).

Recent advances in technology and smart home devices have the promise to promote both the quality of life and safety (Seven & Dirik, 2023). However, there remains uncertainty regarding whether dynamic guardianship through SHDs will significantly enhance individuals' perception of safety or it will not have any effect at all. For instance, Mann et al. (2007) discovered, in a poll of 661 elderly people, that 56.3% did not believe smart home technology would benefit them, and 59.3% did not have an interest in purchasing such a device. Numerous relevant research delved into safety perceptions and attitudes regarding symbolic guardianship in the form of video surveillance systems in transportation systems and schools. Porter and Berry (2011), questioned 880 licensed drivers in the United States and discovered that cameras were not commonly preferred. Although some of the studies suggested that people were dissatisfied with the surveillance system, Ghorayeb et al. (2021) found that symbolic guardianship improves older people's sense of safety. Also, in Gøthesen et al. (2023) study, new adopters of smart home technology expressed perceived advantages such as ease of use, security, and enhanced quality of life.

Drawing on the literature findings, there is a clear difference in opinions and attitudes toward different SHDs. Nonetheless, people overall reported a stronger perception of safety in presence of symbolic guardianship; thus, it is critical to determine whether dynamic guardianship in form of smart blinds and voice-enabled cameras will have an impact on perceived safety.

Personality and perceived safety

Residents' perceptions of safety may vary depending on their personalities (Baiocco et al., 2008). Recognizing the way various personality factors affect perceived safety is essential in tailoring dynamic guardianship to maximise their benefit for different populations.

Personality characteristics are qualities or tendencies that cause an individual to exhibit specific cognitive and behavioural patterns in different settings (Condori-Fernandez et al, 2021). Every individual's personality traits emerge from their unique experiences, which are perceived and stored as recollections and mental structures impacted by prior experiences, interactions, prejudice, and biases (Winter et al., 2021). These cognitive structures and memories are preserved in long-term mental archives for future risk assessment, judgment, and decision-making, influencing one's actions and conduct (Baiocco et al., 2008).

Addressing the psychological basis of safety perception is crucial for creating dynamic guardianship solutions that efficiently fulfill the diverse needs of individuals. Unfortunately, the relationship between the safety perception of dynamic guardianship and personality traits has been investigated to a small extent.

One study found that resilient personality qualities, particularly emotional stability, strongly predicted psychological safety (Grailey et al., 2023). According to the authors, people low in emotionality had a tendency to rely more on logical and analytical thinking rather than emotional responses. This implies that individuals with low emotionality are expected to logically assess various situations, including the presence of SHDs, and grasp their intended goal to increase safety. Further research on this personality traits by Weller and Tikir (2011), similarly revealed that those people who scored low on emotionality also reported a higher perception of safety. On the other hand, Dunkel et al. (2020) discovered that perception of neighborhood safety positively correlated with agreeableness. Individuals with high agreeableness have a tendency to trust systems and authorities, which stretches to security systems like surveillance systems. They are inclined to assume that these technologies are

effective and reliable, therefore promoting their perception of safety when such devices are present (Hough et al., 2013). Based on these literature findings, it is important to bridge the gap and look into the question of whether individuals with low levels of emotionality and high agreeableness traits experience higher perceived safety in a dynamic guardianship context.

The presently reported work

The presently reported work aimed to advance the fundamental understanding of dynamic guardianship. To this end, an investigation on the effects of dynamic guardianship devices, including voice-enabled cameras and smart blinds on residents' safety perceptions, an important yet understudied area of urban safety research. Prior studies have mostly examined the effectiveness of dynamic guardianship in reducing criminal activity, with little emphasis on how these advancements affect citizens' perception of safety. Furthermore, understanding the correlation between personality and perceived safety towards dynamic guardianship could be crucial in tailoring SHDs to different groups of people, but is mainly unknown.

To bridge this gap, this work investigated how people perceive safety in the presence of SHDs. Moreover, the influence of personality traits, such as emotionality and agreeableness, on the link between dynamic guardianship and safety perception is explored. Virtual reality (VR) technology was utilized to construct virtual environments that closely match real-world settings, particularly Dutch neighbourhoods, allowing them to experimentally manipulate environmental signals and measure people's responses under controlled conditions.

Hypotheses:

1. H1: Participants exposed to dynamic guardianship in the form of voice-enabled cameras report higher levels of perceived safety compared to those not exposed.

2. H2: Participants exposed to dynamic guardianship in the form of smart blinds report higher levels of perceived safety compared to those not exposed.

3. H3: People with lower scores on Emotionality report higher levels of perceived safety.

4. H4: People with higher scores on Agreeableness report higher levels of perceived safety.

Method

Participants and Design

The study was conducted in April 2024. In total 66 university students, took part in this study with the age range 18 to 28, M_{age} = 21.6, SD_{age} = 1.7 for the overall sample, with 21.8 years (SD = 1.34) for the "control" condition, 21.1 years (SD = 1.67) for the "blinds" condition, and 22.0 years (SD = 2.06) for the "camera" condition. The countries of origin were the Netherlands for 21.2%, Germany for 36.4%, and the remaining 42,4% comprised a variety of other nationalities, each constituting around 3.03%, among others. In exchange for participation, students were credited 1.5 Sona points. The sample consisted of (52.3%) males and (47.7%) females. Participants who signed up through Sona were granted 1.5 Sona points. Prior to the research, ethical approval was requested and granted by the Behavioural, Management and Social Sciences (BMS) ethical committee of the University of Twente. Before participation, participants received information about the general nature of the study - assessing the perceived safety of the Dutch virtual neighbourhouds.

The study used a between-subjects design allocating participants randomly to three conditions: (1) control (N=21), (2) smart blinds (N=22), (3) a voice-enabled camera (N=23). The dependent variable was perceived safety, while the independent variables were smart blinds, a voice-enabled camera system, and personality traits. Inclusion criteria was being proficient in English, being 18 years or older, and ability to be present in person.

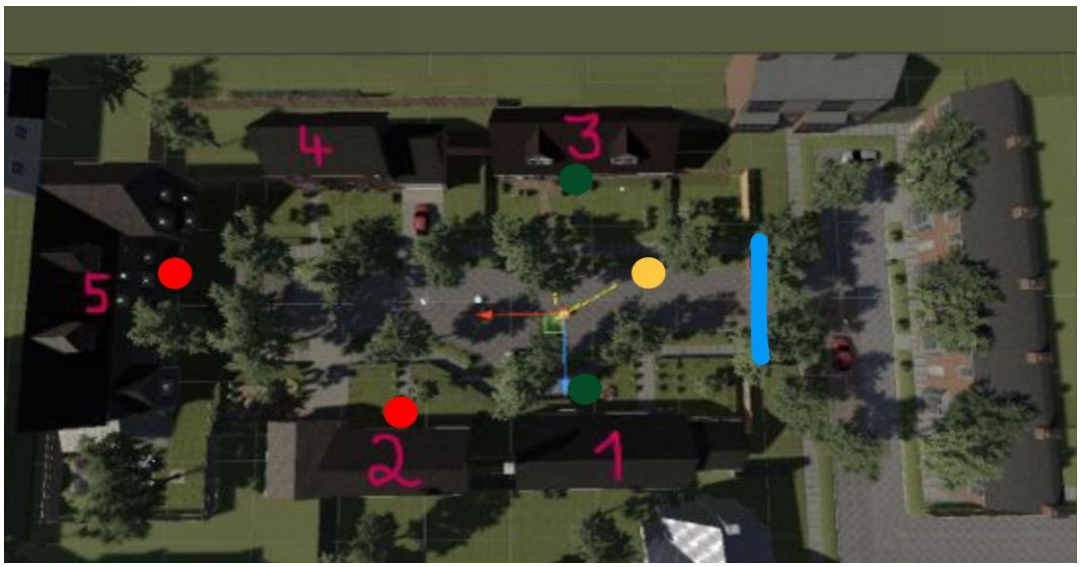
Materials

Virtual neighbourhood

The virtual environment (VE) was developed with Unity Pro programming tools (version 2021.3.4f1). The Meta Quest 2 headset featured a 360° high-quality virtual environment with moving objects. Participants explored the VE with a game controller and remained standing throughout the experiment. The VE was intended to imitate an average middle-class neighbourhood, with five houses and front and back gardens (see Figure 1). Throughout the VR experience, participants could hear the neighbourhood's background noises such as singing birds and cars.

Figure 1

Neighbourhood layout



Note. Yellow round indicates the starting point for all participants; red rounds indicate the placement of the cameras with voice; green round indicates the placement of automatic blinds and blue line indicates the exit point.

The virtual environment featured detailed and high-resolution houses, each uniquely furnished with different interiors. Additionally, minor exterior adjustments were made to resemble a real-life neighborhood setting including fountains, bushes, trees, trash cans, sprinkles, terraces, and a pool. Participants could access both the front and back gardens as

well as look through the windows. A single car was parked in the neighborhood, and one could be seen driving away at the start of the session (Figure 2).

Figure 2

Images of the virtual neighbourhood

Participants were asked to picture a scenario where they were walking around the VE and selecting a house to purchase. When participants finished exploring the surroundings and came up with the decision on the house, they could leave the neighborhood via exit, which ended the session. There were no time limits specified for scouting or choosing the target.

Dynamic guardianship manipulation

The dynamic guardianship elements (see Figure 2) included a voice-enabled camera system and smart blinds. In the first condition, smart blinds automatically silently shut when the 1st and 4th houses were approached. The second condition was a voice-enabled camera

system which was activated by emitting a red light and audibly stating “I can see you are looking for something, can I help you?” when approaching houses 2 and 5.

Questionnaires

Noticing Dynamic Guardianship Manipulations

To check if participants noticed any SHDs, they were asked an open question about what they had seen in the neighbourhood. Participants who noticed dynamic guardianship measures in “blinds” and “camera” conditions were coded as “0” while participants who did not notice them were coded as “1” and the “control” group was coded as “2”. Participants mostly remarked on the presence of cameras, gardens and pools, house sizes and styles, general aesthetics, and neighborhood cleanliness. Besides, some participants mentioned that cameras were overwhelming or terrifying, in particular the camera’s voice.

The Effect of Dynamic Guardianship on Perceived Safety

Perceived safety of the neighbourhood was measured twice. First, participants were asked about their first impression of a VR neighbourhood in terms of safety, the variable, in the present study called as “safety 1” ($\alpha = 0.78$) ($M = 3.68$, $SD = 0.68$). Later participants were provided with the definition of SHDs after which they were asked if they encountered any, if any, which specific types were observed and how safe did the neighbourhood feel then? The variable called as “safety 2” ($M = 3.68$, $SD = 0.65$) ($\alpha = 0.71$). This was done in order to see if perceived safety changed when participants were aware of the SHDs' presence.

Perceived safety was assessed with 6 items on a 5-point scale (1=strongly disagree; 5=strongly agree). Items from 1 to 4 were administered in the same way as those used by Van Sintemaartensdijk et al. (2021). Items 5 and 6 were self-created in order to evaluate personal perceived safety since there was no research on this yet. As an example, one of the questions

included in the questionnaire was “I would feel at home living in this neighbourhood”. These items were designed to elicit more information about the participant's perception of safety in this virtual neighborhood.

Considering that items 5 and 6 were self-created, the possibility that they might load on a different factor than the first four items was explored. First, the factor structure of “safety 1” was investigated. A Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) indicated adequate sampling at 0.64, and Bartlett’s test of sphericity reached statistical significance ($\chi^2(15) = 131.24$, $p < .001$), indicating that the data was suitable correlations for factor analysis. The analysis revealed one factor with an Eugenvalue of 2.34, explaining 39% of the variance. Factor loadings for safety 1 ranged from 0.50 to 0.75. Further, the factor structure of “safety 2” was explored. The KMO index was 0.71, and Bartlett’s test of sphericity was statistically significant, $\chi^2(15) = 70.65$, $p < .001$, which showed suitable correlations for factor analysis. One factor was revealed with an Eigenvalue of 1.8, explaining 30% of the variance. For safety 2, factor loadings ranged from 0.30 to 0.70. No cross-loadings above 0.4 were observed neither for “Safety 1” nor for “Safety 2”. This led to the conclusion that all items form one factor.

Personality Questionnaire

A short personality inventory of the HEXACO-60 was administered to measure 6 dimensions of personality: honesty-humility ($\alpha = 0.73$) ($M = 3.31$, $SD = 0.66$), agreeableness ($\alpha = 0.74$) ($M = 3.13$, $SD = 0.63$), emotionality ($\alpha = 0.81$) ($M = 3.12$, $SD = 0.65$), extraversion ($\alpha = 0.81$) ($M = 3.57$, $SD = 0.64$), conscientiousness ($\alpha = 0.74$) ($M = 3.54$, $SD = 0.61$), and openness to experience ($\alpha = 0.7$) ($M = 3.72$, $SD = 0.61$), answered on a 5-point scale (1=strongly disagree; 5=strongly agree) with overall ($\alpha = 0.81$), derived from Ashton and Lee’s (2007) paper. A higher score indicated a stronger propensity towards a particular personality trait. Some items had a reversed scoring scheme and hence were to be reversely coded.

Game experience

To determine whether participants' gaming proficiency influenced their responses and actions in the virtual neighborhood, they were asked about their weekly gaming habits using controllers or keyboards and virtual reality games with head-mounted displays. These questions were based on the methodology outlined by Van Sintemaartensdijk et al. (2021). Moreover, participants rated their familiarity and confidence with VR headsets on a scale of 1 to 5 (1=strongly disagree; 5=strongly agree) (M = 2.99, SD = 1.05).

Presence

In virtual reality, "presence" refers to a mental state or subjective perception in which one is aware they are in a virtual space (Weber et al., 2021). To assess the presence impact caused by the virtual environment, an updated version of the Spatial Presence Experience Scale (Hartmann et al., 2016) was used. The revised version comprises eight items and is designed to quantify the presence impact created by the virtual experience. Participants were instructed to rate their agreement with the statements on a 5-point scale (1 = strongly disagree; 5 = strongly agree) (M = 3.35, SD = 0.74) (α = 0.77).

Cyber sickness

To account for the likelihood of cybersickness during the virtual reality experience, the Simulator Sickness Questionnaire was used. It assessed the participant's potential discomfort (such as nausea, stomach pain, dizziness, lack of focus, and fuzzy vision), extracted from Van Sintemaartensdijk et al. (2021) paper. Participants were asked to rate their level of discomfort on a 5-point scale (1 = strongly disagree; 5 = strongly agree) (α = 0.77) (M = 3.87, SD = 1.02).

Procedure

Participants were recruited from the University of Twente using a combination of convenience sampling via Sona system, distribution of information flyers, engagement via Whatsapp group chats as well as through snowballing sampling facilitated by word-of-mouth referrals. Flyers were worded in general terms asking for individuals willing to participate in the research. Random assignment of conditions was assigned to recruited participants. Prior to VE engagement, participant were provided with informed consent highlighting the confidentiality of their data as well as with a brief overview of the aim and nature of the research. Any questions were addressed beforehand, and additional time was given to ensure that the VR equipment was comfortable. After providing their informed consent, participants entered VE and were instructed to walk around the neighbourhood as if they were about to scout for a potential house to buy. Upon completion of the trial, participants responded to the questionnaires including guardianship manipulation check, perceived safety, personality questionnaire, game experience, presence, cybersickness, and demographics. Participants received a full debriefing on the purpose of the study. In total, the study took around 45 minutes.

Results

Preliminary Analysis

In Table 1 means and standard deviations of responses to safety 1, safety 2, presence, cybersickness, and game experience questionnaires for all conditions can be found.

An ANOVA model was used to compare the differences in game experience, presence, and cybersickness between the experimental conditions (control, blinds, and camera). In this

model, the dependent variables were game experience, presence, and cybersickness, whereas the experimental conditions served as the independent variable.

The results obtained demonstrated no statistically significant difference in game experience across all conditions ($F(2, 63) = 1.38$, $p = .259$, $\eta^2 = .042$). Likewise, there were no significant effects on presence ($F(2, 63) = 0.93$, $p = .401$, $\eta^2 = .029$) or cybersickness ($F(2, 63) = 0.13$, $p = .878$, $\eta^2 = .004$). These findings revealed that the participants' game experience, presence, or cybersickness did not differ across three conditions, thus these variables were not added as covariates to analyses.

Whether the dynamic guardianship manipulation in the VE was successful, Chi-square tests of independence were performed. In this analysis, the independent variable was experimental conditions, while SHDs noticing served as the dependent variable. Participants observed the manipulation more frequently in the "camera" condition ($M = 0.91$, $SD = 0.28$) rather than in the "control" condition ($M = 0.52$, $SD = 0.51$). The chi-squared test displayed a significant difference between these two conditions ($\chi^2(1, N = 66) = 6.537$, $p = .011$). Respectively, in the "blinds" condition, participants reported spotting the manipulation with a mean frequency of $M = 0.67$ ($SD = 0.48$). Yet, there was no statistically noteworthy difference in SHD recognition between the "control" and "blinds" conditions, $\chi^2(1, N = 66) = 0.395$, $p = .530$.

Table 1

Means and standard deviations of responses to the safety 1, safety 2, presence, cybersickness and game experience questionnaires for all conditions.

Variables	Condition	Mean	SD
Presence			
	Control	3.4	0.7

	Blinds	3.5	0.7
	Camera	3.2	0.8
Cybersickness			
	Control	4.0	0.9
	Blinds	3.8	1.0
	Camera	3.9	1.2
Gaming experience			
	Control	3.0	1.1
	Blinds	2.9	1.0
	Camera	3.2	1.1
Safety 1			
	Control	3.9	0.5
	Blinds	3.6	0.7
	Camera	3.6	0.8
Safety 2			
	Control	3.9	0.5
	Blinds	3.7	0.8
	Camera	3.6	0.5

Main Analyses

To test the first and second hypotheses, linear analyses were used to investigate the relationship between the effect of dynamic guardianship on safety 1 and safety 2. Then, to test third and fourth hypotheses, high agreeableness and low emotionality served as independent variables to investigate their effect on perceived safety using two separate linear regression analyses.

The Effect of Dynamic Guardianship on Perceived Safety

To answer the first hypothesis, the effects of the experimental conditions on safety 1 and safety 2 were analyzed using two separate linear models. In these analyses experimental conditions were used as independent variables, while safety 1 and safety 2 served the dependent one. The linear analyses were not statistically significant, for safety 1 $F(2, 63) = 1.144$, $p = .325$, with an R^2 of .035, as well as $F(2, 63) = 0.654$, $p = .523$, with an R^2 value of .020 for safety 2 suggesting that the conditions did not explain a significant portion of the variance in safety 1 and safety 2 scores.

The Effect of Personality Traits on Perceived Safety

To address the third hypothesis, which investigated if high agreeableness was associated with higher levels of perceived safety, two separate linear regression analyses were conducted with agreeableness as the independent variable while safety 1 and safety 2 served as dependent variables. The finding of both models were not statistically significant, $F(1, 43) = 0.33$, $p = .565$, with an R^2 value of .01 for safety 1 and $F(1, 43) = 0.57$, $p = .455$, with an R^2 value of .013 for safety 2.

Then, the effect of emotionality on safety 1 and safety 2 was tested to answer the fourth hypothesis. No significant effect was found between emotionality and safety 1, $F(1, 43) = 0.33$, $p = .566$, with an R^2 value of .007. Likewise, there were no significant effects on safety 2, $F(1, 43) = 0.53$, $p = .470$, with an R^2 value of .012.

Discussion

The presently reported work was one of the pioneering studies to look at the way dynamic guardianship affected perceived safety and investigate the relationship between

personality traits and perception of safety. The preliminary analyses showed that participants successfully detected the voice-enabled cameras; however, it was not the case for smart since they were less frequently detected. The findings also revealed that voice-enabled cameras and smart blinds had no significant impact on safety perception. Unexpectedly, high agreeableness and low emotionality traits were not significantly associated with perceived safety either.

In the following subsections, the findings of the present work including the effect of dynamic guardianship on perceived safety, differences between noticing investigated guardianship manipulation, and the impact of agreeableness and emotionality on perceived safety in the context of dynamic guardianship are discussed.

The Effect of Dynamic Guardianship on Perceived Safety

Dynamic guardianship in the form of voice-enabled camera systems and smart blinds was predicted to be associated with participants' higher levels of perceived safety, however, no evidence for such a relationship was found. A number of factors including an adverse psychological impact and perceived privacy concerns about voice-enabled cameras and one's unfamiliarity with smart blinds may explain the obtained findings.

Firstly, voice-enabled cameras are usually implemented to create a sense of well-being, safety, and protection for residents (Balasubramanian & Cellatoglu, 2008). However, as stated by Malik and Humane (2024), these cameras seem to create a pervasive impression of being always watched, making them feel as if their privacy is always threatened. According to the authors, a perceived violation of one's privacy may trigger emotions of vulnerability, anxiety, and discomfort, especially in places like one's house where people usually expect some level of autonomy and discretion. An interview study by Abdi et al. (2021) revealed that despite the fact that voice-enabled cameras have certain benefits including offering an opportunity to set automatic human-like voice responses to deter burglars, some people reported that their

primary fear is being listened to through the voice-enabled camera monitoring app on the phone. In their study, participants' privacy concerns about the app connected to the cameras made them switch their phones when sleeping or having intimate conversations.

Secondly, smart blinds might not result in higher perceived safety due to the fact that they are usually not recognized as a security or crime deterrent feature, but rather as a convenient utility or energy-saving appliance (Valencia-Arias et al., 2023). A study proposed that technological devices that are less common or lack immediate visual cues are frequently ignored in complex environments (Treviño, 2015). In particular, this applies to VR settings in which the complexity of the visual environment may precipitate subtler objects overlooked (Gajjar et al., 2017)

Following this, unlike common security measures, including alarms or smart CCTV, smart blinds which are rarely perceived as safety devices due to their novelty may fail to provide direct deterrence, surveillance, or occupancy impression which might minimise their effect on the perception of safety (Piza et al., 2019).

Differences in Noticing Investigated Dynamic Guardianship Manipulation

The preliminary analyses intended to test whether participants detected SHDs in dynamic guardianship conditions, and if yes, which ones? The outcomes revealed that participants readily detected the presence of voice-enabled cameras, contrary to smart blinds which were rarely noticed. Choi et al. (2019) believe that visual salience plays a critical role in the way certain objects are noticed and stand out among others. Along with this statement, cameras might be considered to be naturally visible. Besides being more visible, voice-enabled cameras projected red light in the virtual environment. As suggested by (Abaya et al., 2014),

the projection of red light might potentially indicate the active status of a camera, which leads to an increase noticeability. Not only the light, but a human-like voice which warned participants in a VE that they are being watched, might be the reason for the difference between detecting SHDs. Human-like voice feature taps into the innate human tendency to devote close attention to spoken language (Kühne et al., 2020); thus it may express urgency and importance significantly better than visual or nonverbal audio cues, which offers insight as to why smart blinds (which had no sound) were not noticed by participants.

Moreover, the notion of inattentional blindness, when one fails to spot an unforeseen stimulus in plain sight, could possibly account for why smart blinds were omitted (Hyman et al., 2010). Simons and Charbis (1999) suggested that even when one is looking directly at something if it is not foreseen, there is a high chance that it may be overlooked. This occurrence is remarkably prominent in settings with high cognitive load, such as VR environments (Hyman et al., 2010).

The Effect of Personality Traits on Perceived Safety

High agreeableness and low emotionality traits were predicted to be associated with a higher perception of safety of smart blinds and voice-enabled cameras, however, there were no relationships found.

Individuals with high agreeableness who are more trusting and cooperative are assumed to be more inclined to have a higher safety perception (Ashton & Lee, 2007). However, unexpectedly, agreeableness was not related to higher perceived safety towards dynamic guardianship. Before entering the VE, participants were instructed to select a house they

wanted to buy without a specific emphasis on assessing safety based on dynamic guardianship measures. Highly agreeable individuals, due to their natural inclination towards social harmony and positive interactions (Peeters et al., 2006), might have focused more on how welcoming and aesthetically pleasing the environment was rather than on the safety features provided by smart home devices.

On the other hand, according to Peeters et al. (2006) research, high agreeableness was strongly linked with less confrontational and noncompetitive individuals nature. Similarly, in Wong and Carducci's (2005) study, authors highlighted that people with high agreeableness preferred to avoid conflicts and unpleasant situations, which might result in fewer opportunities for acquiring risk assessment skills. According to Nicholson et al. (2005), a lack of experience in risk assessment indicates that highly agreeable individuals may have a limited ability to objectively analyze the safety aspects in VE.

People with low emotionality were expected to report higher perceived safety, however, that was not the case. Even though people with low emotionality were assumed to be less emotionally reactive and to use a more analytical approach (Grailey et al., 2023), more specifically to grasp the genuine intent of SHDs, could have individual factors including past experiences and adverse attitudes towards SHDs which altered their perceptions of safety. As an example, research shows that individuals are likely to be skeptical of SHDs benefits and safety effects if they were exposed to surveillance abuse, which stands for "the use of surveillance methods or technology to monitor the activity of an individual or group of individuals in a way which violates the social norms or laws of a society (Robertson, 1999).

On top of this, individuals who are high in emotional stability usually require a much longer adaptation period to novel or unfamiliar settings. The limited timeframe during the VR session might have prevented these individuals from fully appreciating or reacting to the dynamic guardianship devices (Xu et al., 2022). Sutherland (2020) proposes that it is also

possible that during the VR simulation, participants experienced a high cognitive load while they were navigating the virtual environment. This cognitive load could have hindered their ability to effectively evaluate safety features, considering the fact that emotionally stable individuals are typically methodical and thorough in their evaluations (Peeters et al., 2006). As a consequence, they might have been more sensitive to such cognitive load, resulting in underestimating the safety provided by dynamic guardianship.

Strengths and Limitations

The present paper demonstrated a number of notable strengths. The ability to recruit 66 participants within a short timeframe proved the feasibility of VR-based research for efficient data collection. Conducting the research in a VR setting promoted the ecological validity of the outcomes by providing a highly controlled and immersive environment. Besides, self-created items for perceived safety questionnaires were implemented in the current research in order to ensure that the measures were tailored to the study objective lens, potentially increasing the significance of the data obtained.

Nonetheless, several limitations must be admitted. First of all, the sample primarily consisted of students, which may not be a suitable sample for study which includes a scenario where participants select a house to buy. In the same manner, the sample may contribute to a representative cross-section of the larger population. As a consequence, the generalisability of the findings is limited by this homogeneity. Not to mention, some participants were acquainted with the researchers which could potentially lead to altered motivation and attentiveness to the VR setting as well as to the questionnaire responses.

Future directions

Several further directions could be pursued in light of the current paper's conclusions. According to Zhang et al. (2019), the presence of symbolic guardianship increases people's psychological stress. In accordance with this, Smith et al. (2020) discovered that surveillance can have significant psychological consequences, such as increased anxiety and altered behavior. Unfortunately, studying these implications in the context of dynamic guardianship was outside the scope of this study. Thus, future research might look into whether dynamic guardianship, such as the presence of SHDs, causes psychological strain on people. This line of inquiry may reveal whether dynamic guardianship has similar effects on perceived safety and behavior.

More research may be conducted on public perception and acceptability of dynamic guardianship devices, addressing issues about privacy and information leaks. Researchers could look into how these concerns affect the safety and uptake of such devices. Recognizing these difficulties helps guide the development of smart home devices, easing social concerns. As smart home devices gain recognition, it is vital to strike a balance between apparent safety benefits and privacy concerns. This is consistent with previous research, which revealed that privacy concerns significantly influenced surveillance technology adoption (Vasalou et al., 2014). Examining this balance can help to develop dynamic guardianship strategies that are both effective and acceptable in society.

Finally, including gender as a variable could help researchers gain an understanding of how men and women perceive safety differently towards dynamic guardianship devices. Previous research has discovered significant gender variations in perceptions of safety, with women experiencing greater dread and lower emotions of security than men (Pain, 2001). This demonstrates that gender has a major impact on the perception and application of smart home devices. As an example, addressing the question of whether women feel more reassured by SHDs or whether they find them intrusive could potentially give rise to new insights from a

research perspective. Finding answers to these questions can help develop tailored dynamic guardianship features considering gender differences.

Conclusion

Feeling safe at home is essential for one's well-being and quality of life. Previous studies have primarily focused on symbolic guardianship with a goal to increase safety perception. The purpose of the present work was to bridge the gap between the effectiveness of dynamic guardianship in the form of smart home devices, and the perception of safety in the residential environment, as well as to investigate the potential relationship between low emotionality and high agreeableness and perceived safety. The findings revealed that participants detected voice-enabled cameras more frequently than smart blinds. However, the investigated SHDs did not have any impact on perceived safety. On top of this, high agreeableness and low emotionality traits did not indicate a significant association with perceived safety. Based on the suggested future outlook of the presently reported work, the psychological effects and privacy concerns about SHDs as well as and potential gender differences might provide insight into how different demographic groups perceive and respond to these technologies, thereby tailoring the development of more effective and socially acceptable dynamic guardianship systems.

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