

ARTICLE

Personality pathways to aggression: Testing a trait-state model using immersive technology

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Abstract

Trait-state models aim to provide an encompassing view of offender decision-making processes by linking individual dispositions to proximal factors. In an experiment using an immersive virtual reality bar fight scenario, we propose and test a trait-state model that identifies the pathways through which robust personality correlates of aggressive behavior, that is, agreeableness, emotionality, and honesty-humility, result in intentions to aggress. Using structural equation modeling, we show how these personality traits relate to intentions to aggress via anger, fear, perceived risk, and anticipated guilt/shame. Additionally, we demonstrate superior validity of our virtual scenario over a written version of the same scenario by virtue of its ability to provide more contextual realism, to establish a stronger sense of presence, and to trigger more intense emotional states relevant to the decision situation. Implications for future decision-making research and theory are discussed.

KEYWORDS

aggression, decision-making, personality, trait-state models, virtual reality

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1 | INTRODUCTION

The claim that both individual dispositions and proximal factors are relevant for the explanation of crime is unlikely to spark much controversy among criminologists. It is now widely accepted that both play fundamental roles in decisions to commit crime and engage in antisocial conduct. How dispositions affect the way proximal factors are evaluated, however, and how this, in turn, results in decisions to commit crime, has thus far not been the subject of extensive empirical research (for exceptions, see Longshore, 1998; Nagin & Paternoster, 1993, 1994; Pickett et al., 2018; Van Gelder & De Vries, 2012, 2016). Yet, an encompassing understanding of the propensity–crime nexus requires an examination of the intervening mechanisms. In this article, we address this gap in the literature by employing a trait-state approach.

Trait-state models connect the distal and proximal levels by identifying the pathways through which individual dispositions, “traits,” influence decision-making via proximal factors, “states,” that operate at the moment of decision-making, such as perceived risk of sanction and anticipated shame (see, e.g., Van Gelder & De Vries, 2012). We take the trait-state hypothesis as a point of departure for developing a framework explaining how robust personality correlates of aggressive behavior—agreeableness, emotionality, and honesty-humility—are related to intention to aggress.

We aim to advance the research literature in terms of both theory and method. First, on the trait side, our framework draws from structural models of personality, which are based on a consensus that the human personality can be described by a handful of traits that are relatively enduring styles of thinking, feeling, and acting (McCrae & Costa, 1997). Prior criminological research addressing the relation between propensity and crime has typically relied on singular traits or trait-like concepts, such as self-control, morality, or self-esteem. By definition, a focus on singular concepts negates the possibility that people may engage in crime for different reasons, and that certain traits may be more strongly related to one type of behavior than others. For instance, personality traits expressed particularly in social contexts, such as agreeableness, have been found to be strongly predictive of violent crime but not of property crime. Conversely, a trait like conscientiousness, which is strongly related to self-control and manifests itself in the way an individual plans, manages tasks, and achieves goals, may be a stronger predictor of crimes that lack an interpersonal aspect. In contrast, a unitary construct like self-control, which has been found to be predictive of both violent and property crime, and which contains content related to both agreeableness and conscientiousness (e.g., De Vries & Van Gelder, 2013; Marcus, 2004), lacks this ability. Furthermore, measurement instruments based on structural models of personality allow for the identification not only of individual traits but also of constellations of traits linked to criminal involvement (Caspi et al., 1994; Herzberg & Hoyer, 2009). In short, structural models of personality allow for predicting outcomes with greater accuracy and make it easier to conceptually understand and interpret the relations between a trait and an outcome (De Vries et al., 2011; De Vries & Van Gelder, 2013).

Second, research into criminal propensities, similar to personality research in psychology, has typically prioritized explaining the content of behavior, that is, the behavioral outcome, over the processes underlying it (Buss, 1989). Disregarding such processes, however, also limits our understanding of why aggression or antisocial behavior occurs. Identifying the processes, or pathways, through which dispositions result in crime is critical for understanding choice as different propensities may be equally related to antisocial conduct but there may be different mechanisms accounting for these relations (Miller & Lynam, 2001). For example, an individual may engage in aggressive behavior after being provoked because they are angry but also because the provoca-

tion is interpreted as a challenge to their status that needs to be redressed. This suggests not only that different individual propensities are related to aggression but that these propensities may be activated for different reasons and in different contexts.

Third, whereas previous research linking dispositions and proximal factors has mainly focused on property crime, our focus is on aggression. Although existing aggression theories acknowledge that certain personality traits predispose individuals to aggressive behavior, these theories do not provide a framework for explaining why and how particular variables predict it (Bettencourt et al., 2006, p. 753). Providing and testing such a framework, therefore, is one of the main goals of this study.

Our focus on aggression also ties in with our methodological argument. The study of aggression and interpersonal violence is typically beyond the purview of traditional experimental methods. Aside from the physical danger and the many ethical obstacles involved, simulating a credible violent event and reliably reproducing it across trials is challenging and costly (Levine, 2003; Rovira et al., 2009). As an alternative to behavioral experiments, researchers have often resorted to written vignettes (e.g., Armstrong & Boutwell, 2012; Exum, 2002; Mazerolle et al., 2003; Schoepfer & Piquero, 2006). Yet, as will be explained in more detail below, a short narrative is at best a faint reflection of the often chaotic, heat-of-the-moment circumstances that tend to characterize situations of interpersonal conflict and criminal conduct (e.g., Collins, 2009, 2013; Hochstetler et al., 2017; Lofland, 1969; Shover, 1996; Topalli & Wright, 2013).

We argue that for the study of aggression, and antisocial behavior more broadly, virtual reality (VR) integrates the relevant properties of both methodologies while compensating for some of their limitations as it can safely “immerse” participants in the situation of interest without sacrificing experimental control. Furthermore, by more realistically approaching the decision situation in its contextual detail, VR scenarios approximate the real-life event in a more veracious manner compared with vignettes. This renders VR scenarios more likely to elicit the relevant emotions and cognitions that characterize an equivalent real-life situation. In this article, aside from testing our trait-state model, we compare participant responses to a virtual scenario (experienced through VR goggles) and a written version of the same scenario. We use a context familiar to most criminologists: a conflict between two patrons in a bar (e.g., Armstrong & Boutwell, 2012; Barnum & Solomon, 2019; Copes et al., 2013; Schoepfer & Piquero, 2006; Van Gelder et al., 2019).

Below, we first elaborate on our choice of personality traits before detailing our trait-state perspective and discussing the hypothesized personality pathways to aggression. We then discuss the potential of VR for the study of decision-making prior to outlining our research method and presenting the results of the analyses.

1.1 | Traits: Structural models of personality and crime

In the 1990s, a time during which the self-control concept (Gottfredson & Hirschi, 1990) established itself as the dominant dispositional perspective in criminology (Pratt & Cullen, 2000), a consensus emerged among personality psychologists that the human personality is best described by a handful of orthogonal traits that are “dimensions of individual differences in tendencies to show consistent patterns of thoughts, feelings and actions” (McCrae & Costa, 1990, p. 29). These traits, commonly subsumed under the term “Big Five” or “Five-Factor Model” (FFM), are known as openness to experience, conscientiousness, extraversion, agreeableness, and emotional stability (vs. neuroticism). A substantial body of research since then has unveiled robust relations between personality and criminal and antisocial behavior more generally (e.g., Jones et al., 2011; Miller &

Lynam, 2001; Wilcox et al., 2014), and aggressive behavior more specifically (e.g., Hyatt et al., 2019; Klimstra et al., 2010; Tremblay & Ewart, 2005).

Two Big Five/FFM personality traits have emerged in research as consistent correlates of aggression in particular, namely agreeableness, which regards individuals' interpersonal relationships and their tendency to be trusting, straightforward, and empathic, and emotional stability (vs. neuroticism), which refers to people's emotional adjustment and stability (Miller & Lynam, 2001).

Reanalyses of the original data that were used to uncover the original Big Five dimensions, and data that have become available since, suggested the existence of a sixth cross-culturally corresponding personality dimension, termed "honesty-humility" (Ashton et al., 2004; Lee & Ashton, 2004). Honesty-humility refers to individual differences in the tendency to be interpersonally genuine, to avoid fraud and corruption, to be uninterested in status and wealth, to be modest and unassuming, and the reluctance to take advantage of others to satisfy one's own needs (Lee & Ashton, 2004). Lee et al. (2005) argued that honesty-humility can be viewed as reflecting an individual's moral conscience.

A growing body of empirical research shows that the six-factor model, known by its acronym "HEXACO," provides an even more accurate description of personality than its five-factor predecessors (Ashton & Lee, 2020; De Vries et al., 2016). By virtue of the inclusion of honesty-humility, the six-factor model has also been shown to explain incremental variance in both criminal and aggressive behavior (Ashton & Lee, 2008; De Vries & Van Gelder, 2013, 2015; Dunlop et al., 2012; Međedović, 2017; Van Gelder & De Vries, 2012, 2016). In this study, agreeableness, emotionality (which is somewhat, but not entirely, similar to Big Five/FFM emotional stability (vs. neuroticism))¹, and honesty-humility, that is, the three personality correlates from structural personality models that have been shown to be the most robust predictors of aggression, form the dispositional side of our trait-state model.

1.2 | States: "Hot" affect versus "cool" cognition

In contrast to the comparatively enduring nature of traits, states show strong fluctuation over brief timescales and vary as a function of the properties of a decision situation (Anwar & Loughran, 2011; Barnum & Solomon, 2019; Pickett et al., 2018; Pogarsky et al., 2018). According to Hamaker and colleagues (2007), states may be associated with the exogenous, that is, external, environment, such as the social and physical situation, but they may also be endogenous, such as physiological, emotional, and cognitive processes taking place within the individual. An extensive list of states, or proximal factors, including rational choice variables, such as the perceived costs and benefits of a decision, anticipated shame and regret, intoxication, excitement, anger, and fear, have been the subject of criminological research.

One way to meaningfully organize states is by drawing from dual-process models of information processing, which distinguish between "cool" cognitions related to the decision process, such as perceived costs and benefits, and the "hot" affective, automatic, and nonvolitional processes brought to and triggered by the situation, that is, emotions, moods, and visceral drive states, such as sexual arousal and intoxication (e.g., Metcalfe & Mischel, 1999; Van Gelder, 2013). Following

¹ For a discussion of the differences between HEXACO emotionality and emotional stability (vs. neuroticism), see Ashton et al. (2014) and Jones (2017).

the cognition–affect distinction underlying dual-process models, we include states corresponding to each in the present study.

Two important cognitive state variables, which are often included in studies of decision-making, are perceived risk and anticipated guilt and shame. Perceived risk, that is, the perceived probability and severity of sanction or negative consequences, are at the core of deterrence and rational choice perspectives. These perspectives envision the decision process as a primarily rational cost–benefit calculus in which offenders weigh costs against benefits to ultimately arrive at their decision to commit crime or to abstain from it.

Although the original versions of deterrence and rational choice tended to focus on formal costs, that is, formal sanctions, over time “moral costs” came to be seen by various scholars as another price of crime (e.g., Grasmick & Bursik, 1990; Nagin & Paternoster, 1994). One important such moral cost is the shame and/or guilt that one anticipates to experience following the decision to offend (e.g., Bachman et al., 1992; Grasmick & Bursik, 1990; Grasmick et al., 1993; Nagin & Paternoster, 1993, 1994). Shame, according to Grasmick and colleagues (1993), is a self-imposed sanction that occurs when individuals violate norms they have internalized and functions similarly to the threat of legal sanctions by reducing the expected utility of a contemplated behavior.

Anticipated guilt and shame are emotions expected to be experienced by the decision maker after the decision rather than feelings experienced at the time of decision. They are effectively *predictions about* future emotional states, and essentially costs entering a cognitive calculus, rather than feelings experienced at the moment a choice is made (Loewenstein et al., 2001). Hence, anticipated guilt and shame, similar to perceived risk, belong to the “cool” cognitive mode of processing.

In contrast to anticipated guilt and shame, anger and fear are emotions that are experienced during the moment of decision-making, and hence, in dual-process parlance, anger and fear belong to the “hot” affective mode. Emotions have a definite antecedent cause, for example, a provocation or a threat, and are associated with an evaluative judgment, or appraisal, of an event and its significance for our well-being that triggers certain specific tendencies to respond to the eliciting event (Ellsworth & Scherer, 2003; Frijda, 1988, 2007; Smith & Ellsworth, 1985). Anger and fear tend to trigger opposite behavioral responses; whereas anger facilitates aggressive action, fear is likely to inhibit it. Although difficult to model in standard decision frameworks, both emotions have been shown to be fundamental predictors of criminal and aggressive behavior, over and above rational considerations (e.g., Barnum & Solomon, 2019; Pickett et al., 2018; Van Gelder & De Vries, 2012, 2014). Importantly, fear and anger lack the moral character of self-conscious emotions such as guilt and shame.

To summarize, states are proximal factors that refer to time-varying and situation-dependent aspects related to the decision situation at hand, that can either have a more cognitive, that is, thinking-based, character, such as perceived costs and benefits, or involve emotions and other feeling states that are experienced prior to or during the decision situation and possibly triggered by it.

1.3 | Personality pathways to aggression

In line with the trait-state hypothesis, Anderson and colleagues (1996) suggested that personality traits may operate on aggression traversing affective and cognitive pathways. Those personality traits that are related to the experience of negative emotions or to the perception of situations as provoking or threatening will be particularly associated with aggressive behavior (Bettencourt

et al., 2006). The two personality traits that align with this assumption are agreeableness and emotionality.

Individuals scoring high on agreeableness tend to forgive the wrongs that they suffered, are lenient in judging others, are willing to compromise and cooperate, and have little difficulty controlling their temper. Conversely, low scorers are easily provoked, hold grudges against those who have harmed them, are critical of others' shortcomings, and feel anger readily in response to mistreatment. Lee and Ashton (2012, p. 597) noted that the relation between agreeableness and the tendency to retaliate is not surprising, given that this personality dimension is conceptualized as governing one's tolerance toward transgressions and provocations. Hence, we expect the relation between agreeableness and intentions to aggress to primarily be mediated by state anger.

People who score low on emotionality are not deterred by the prospect of physical harm, feel little worry even in stressful situations, and feel emotionally detached from others. High scorers, in contrast, are inclined to experience fear of physical dangers, experience anxiety in response to life stresses, and feel empathy and sentimental attachments with others. Book and colleagues (2019) found the anxiety facet of emotionality to primarily account for the relationship between reactive aggression and emotionality. We therefore anticipate state fear to be the critical pathway connecting emotionality and intention to aggress. Because people high in emotionality are more aware of, and care more about, what may happen to themselves and others in a situation of conflict, however, emotionality is also expected to increase perceptions of risk (Van Gelder & De Vries, 2012, 2016). That is, the lack of anxiety and fearfulness characteristic of low scorers results in lower levels of anticipation of negative outcomes and, hence, in a higher likelihood of aggressive behavior.

Similar to agreeableness, people low in honesty-humility also have a lower threshold for provocation and may feel a strong desire to teach the offender a lesson when feeling wronged by them (Lee & Ashton, 2012; MacDonell & Willoughby, 2020), but they do so for different reasons. In contrast to agreeableness, we assume honesty-humility to operate more through cognitive rather than affective pathways when it comes to reactive aggression. Feelings of entitlement and self-importance can strengthen the conviction that one's retaliatory behavior is justified and that it is the proper course of action to correct an undesirable state of affairs.

Lee et al. (2005) argued that honesty-humility reflects an individual's moral conscience. People high in honesty-humility are therefore also more prone to experience negative emotions associated with various kinds of immoral, rule-violating, and criminal activities, as a consequence of which they are also less likely to commit them (Van Gelder & De Vries, 2012, 2014). Shame and guilt are commonly referred to as "moral emotions" (Tangney et al., 2007). As Svensson and colleagues (2017, p. 235) noted, shame and guilt emerge in response to personal failure when there is an important moral dimension in the behavior involved in this failure. Hence, it stands to reason that those scoring high on honesty-humility will be more prone to experience negatively valenced emotions, such as shame and guilt, following transgressive behavior or their failure to act in accordance with their own moral standards. Conversely, because individuals low in honesty-humility have lower moral standards, they are less likely to anticipate feelings of guilt and shame following aggressive conduct (Van Gelder & De Vries, 2014). After all, they have every "right" to correct the unjust state of affairs.

Apart from shame and guilt, honesty-humility is also likely to have an effect on intention to aggress through perceived risk. People low on honesty-humility have been found to take more risks if they believe doing so may help them obtain power over others, status, or prestige (Weller & Tikir, 2011). That is, people low on honesty-humility may perceive the risks associated with aggressive behaviors as lower and the gains associated with these behaviors as higher. In contrast,

people high on honesty-humility have been found to be more likely to cooperate, even when facing exploitation, because of their strong sense of fairness and lack of feelings of entitlement and superiority. Furthermore, research has shown that people high on honesty-humility tend to show more self-control (De Vries & Van Gelder, 2013) and lower levels of sensation seeking (De Vries et al., 2009). That is, people high in honesty-humility may be more likely to control their anger in situations in which they are wronged because they perceive such situations as more “risky” than those low on honesty-humility. Thus, we expect perceived risk to mediate the relation between honesty-humility and intention to aggress.

1.4 | Immersive scenarios: Inducing emotional arousal, generating presence, and improving realism

Testing a model that links linking stable individual-level variables to proximal ones requires a method that provides the decision context. Typically, decision-making research has relied on descriptions of hypothetical situations, that is, written scenarios or vignettes to achieve this. Ever since the pioneering work of Nagin and colleagues (e.g., Klepper & Nagin, 1989; Nagin & Pateroster, 1993, 1994; Nagin & Pogarsky, 2001), vignettes have been used to study the effects of formal and informal sanctions, moral considerations, rational choice factors, and individual differences variables.

As with other methods, however, written scenarios are not without limitations, and these limitations are more pronounced in certain situations, like those involving violence and aggression, than others. One important issue regards the inability of written scenarios to capture or elicit the more emotionally laden (e.g., disgust and anger) and visceral aspects (e.g., intoxication and arousal) involved in real-world decision-making. This inability creates a disconnect between the conditions under which behavior is studied and the circumstances under which it is normally manifested in real life, which poses consequential restrictions on the ecological validity of vignette research on violence and aggression.

Another limitation relates to the extent to which written scenarios are able to capture important nuances of social experience as the amount of contextual information a short narrative can provide is limited. Critically, scenarios are restricted in their ability to provide information about the nonverbal behavior of those present, such as facial expressions of anger, happiness or contempt, and body posture, which signal important cues determining a perceivers’ social responses (Van Gelder et al., 2018). Finally, responses to written scenarios may also inadvertently capture individual variation in people’s ability to imagine themselves in a situation and their cognitive capacity rather than faithful responses to the variables under study (Van Gelder et al., 2019).

One approach to remedy some of these shortcomings is through the use of immersive technologies such as VR, which perceptually immerse users in the situation of interest. By using VR goggles, which allow for viewing in all directions, real-world input is blocked and replaced by computer-generated or 360° video input. User movement, such as head rotation, is tracked and fed back to the user in real time to generate a lifelike viewer experience. The objective here is to establish a sense of “presence,” that is, by generating the impression that one has stepped inside a virtual environment and to momentarily forget about the physical world where one’s body is located. Furthermore, virtual scenarios provide a direct visual overview of a situation in all its contextual detail. Additionally, as contextual information is kept identical across participants

and trials (i.e., all participants experience the same environment and the identical sequence and timing of events), there is no room for the imputation of details by participants as is the case with traditional vignettes.

Finally, virtual scenarios have shown to be better able to elicit emotional and visceral reactions compared with written descriptions (McClanahan, 2020). For example, when assessing moral decision-making using traditional hypothetical scenarios such as the trolley dilemma, when compared with participants reading a written version of the dilemma, participants experiencing it in VR displayed an increased heart rate (Francis et al., 2016). Finally, Van Gelder et al. (2019) compared a virtual bar fight scenario with an identical scenario presented in written form and found that the virtual scenario was perceived as more realistic than the written scenario and more likely to trigger stronger emotional reactions in participants, with resultant changes in their decision-making.

1.5 | The present study

In this study, we test an encompassing trait-state decision-making model to predict intention to aggress using a “bar fight” scenario. In the scenario, participants take the perspective of the protagonist who is on a date with their girlfriend in a bar. While the protagonist is briefly away, another patron makes a pass at the girlfriend. A rapidly escalating verbal altercation in which insults are traded ensues, and participants are asked to indicate the likelihood that they would resort to violence in the described situation.

We include those HEXACO personality traits that have been found to be most robustly related to aggression in previous research, namely agreeableness, emotionality, and honesty-humility, and specify the pathways, that is, states, through which we hypothesize them to operate on crime. We test our trait-state model of aggressive intentions using an experimental design comparing responses to a written scenario with those to the virtual reality equivalent. Our focus is on reactive, as opposed to proactive, aggression, defined by Dodge and Coie (1987) as hostile responses to perceived threat or provocation.

The differential character of the personality traits in combination with the theoretical logic underlying trait-state models gives rise to a series of testable predictions as to how personality traits are related to state variables and intention to aggress as a result of provocation (see figure 1 for the hypothesized model). First, we hypothesize HEXACO agreeableness, emotionality, and honesty-humility to be negatively related to intention to aggress. Second, we hypothesize that the state variables anticipated shame/guilt, fear, and perceived risk to be negatively related, and anger to be positively related, to intention to aggress. Third, we hypothesize the effect of honesty-humility on intention to aggress to be mediated by anticipated guilt/shame and perceived risk, the effect of emotionality to be mediated by state fear and perceived risk, and the effect of agreeableness to be mediated by state anger. Fourth, we hypothesize presence to be negatively related to anticipated guilt/shame and positively related to state anger, state fear, and perceived risk.

Finally, we replicate findings from an earlier study by Van Gelder et al. (2019) who assessed differences between the written and the virtual bar fight scenario on the state variables and demonstrated the mediating role of anger in the relation between presence and aggression and in the relation between perceived realism and aggression.

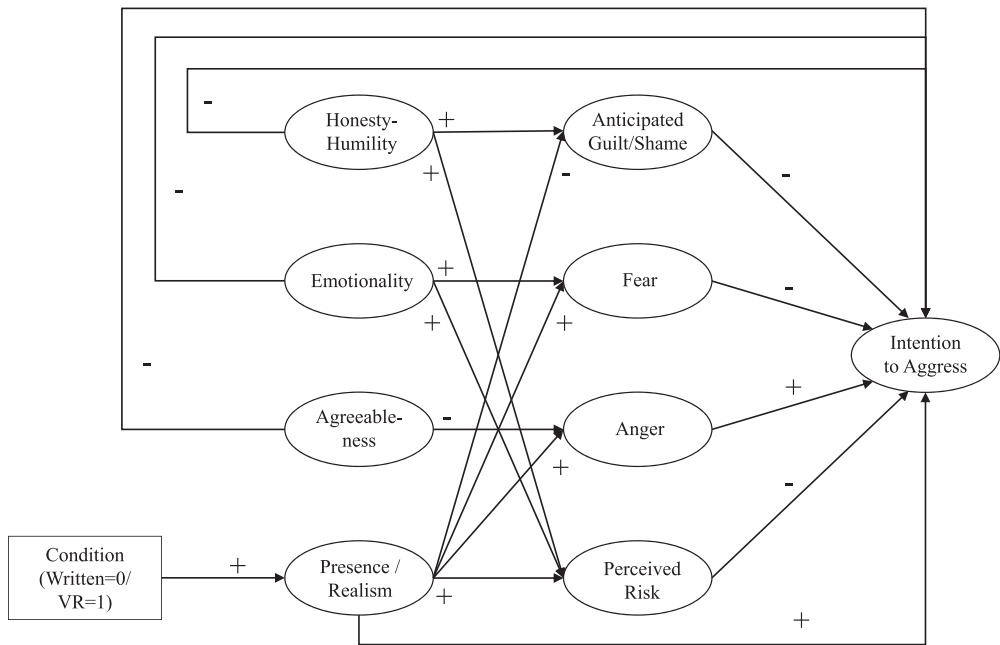


FIGURE 1 Hypothesized trait-state model of intention to aggress

2 | METHOD

2.1 | Participants

Data for the study were collected at two universities in the Netherlands at separate intervals. Data collection started in May 2015 and was concluded in May 2019. All participants ($N = 176$) were male undergraduate students ($M_{age} = 22.21$; $SD_{age} = 3.42$; age range: 17–38). Participants registered for the study through the universities’ compensation system or were directly approached by the experimenter in university cafeterias. Compensation for the study was a gift voucher of €5 or course credit. Ethics approval was granted by the ethics committee of one of the two participating universities (VCWE-2015-045).

2.2 | Materials

After reading the scenario or experiencing it in VR, participants responded to a survey presented on a laptop computer. The survey measured anticipated risk probability (henceforth “probability”), anticipated risk severity (henceforth “severity”), anticipated shame/guilt (henceforth “shame/guilt”), anger, presence, perceived realism of the scenario, and the dependent variable intention to aggress, as well as several demographic variables.

2.2.1 | Personality

We measured honesty-humility, agreeableness, and emotionality using scales from the 60-item Dutch language version of the HEXACO personality inventory (Ashton & Lee, 2008; De Vries

et al., 2009). The three scales consisted of 10 items, each measured using 5-point scales (*strongly disagree–strongly agree*). Reliabilities for the scales were similar to previous studies (Ashton & Lee, 2008; De Vries et al., 2009) with $\alpha = .75$ for honesty-humility, $\alpha = .73$ for emotionality, and $\alpha = .71$ for agreeableness.

2.2.2 | States

Perceived Risk. The perceived risk measure was a composite of the probability of anticipated negative consequences multiplied by their anticipated severity (see: Nagin & Paternoster, 1993; Van Gelder & De Vries, 2012). Both probability and severity were measured by two items using 7-point scales (e.g., “How likely is it that there will be negative consequences for you if you use violence?” (*very unlikely–very likely*) and “How severe are the potential negative consequences if things end badly for you?” (*not at all severe–very severe*). The phrasing was deliberately broad so as to encompass both formal risk, that is, sanctions, as well as other types of risks, for example, physical harm. The perceived risk measure was constructed by multiplying the first probability with the first severity item, and the second probability with the second severity item, and converting the resulting two variables back to a 7-point scale. The alpha reliability of the scale constructed from these two variables was .68.

Fear. Five items measured on 7-point scales (strongly disagree–strongly agree) taken from Van Gelder and De Vries (2012) comprised the fear measure (e.g., “Do you find the situation frightening?” “Would you be worried?” “Would you be nervous?” a (*not at all–very much*; $\alpha = .91$).²

Anger. Following Van Gelder et al. (2019), an anger scale consisting of five items measured on 7-point scales was used (“Would you be angry in this situation?”, “Would you be annoyed?”, “Would you be irritated?”, “Would you be furious?”, and “Would you feel frustrated?”) (*not at all–very much*; $\alpha = .91$).

Anticipated Shame/Guilt. A shame/guilt scale was also taken from Van Gelder et al. (2019) and consisted of two items measured on 7-point scales (“Would you feel guilty later if you were to use violence?” and “Would you feel shame later if you were to use violence?”) (*not at all–very much*; $\alpha = .88$).

Presence and Perceived Realism. Presence was measured using an adapted 13-item version of the Igroup Presence Questionnaire (IPQ) (Schubert et al., 2001; $\alpha = .90$), for example, “I had a feeling I was present in the scenario” and “I was not aware of my real environment” (*strongly disagree–strongly agree*). Perceived realism was operationalized using a scale by Van Gelder et al. (2018), consisting of six items using 7-point scales (e.g., “The situation was realistic” and “I had the idea the scenario was fictitious” [reverse-scored] [*strongly disagree–strongly agree*] $\alpha = .81$). Presence and perceived realism correlated very strongly ($r = .77$), and the correlations of each with the other variables were highly comparable (see table 1). After transforming the correlations of presence and perceived realism with all other variables to z-scores, the profile correlation between the two sets of correlations was .99, suggesting a near-perfect overlap between the profile of correlations of the two variables in this study. Because of this overlap, and because presence is arguably more important for the feelings that arise in the moment than perceived realism (as also shown by the on average stronger correlations in table 1), we decided to only focus on presence in the analyses.

Intention to aggress. Following Van Gelder et al. (2019), intention to aggress was measured by two items. One item was measured on a 7-point scale “How likely is it that you would use violence

²Note that in Van Gelder and De Vries (2012), this scale was termed “negative state affect.”

TABLE 1 Correlations, descriptives, and alpha reliabilities (diagonal) of background, traits, states, and the outcome variable ($N = 176$)

| | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. |
|---------------------------------|------|-------|------|------|------|------|------|------|------|------|------|-------|------|
| 1. Attractiveness Lisa | -.14 | .02 | .14 | -.01 | -.06 | .14 | .21 | .20 | -.06 | .17 | .15 | .11 | .14 |
| 2. Condition (0 = Scen./1 = VR) | — | -.08 | -.12 | -.08 | -.01 | -.19 | .36 | .30 | -.19 | .05 | .19 | .03 | .18 |
| 3. Age participant | | — | .07 | .17 | -.02 | -.04 | -.02 | .01 | .08 | .04 | -.03 | .14 | -.07 |
| 4. Relation (0 = No/1 = Yes) | | | — | .06 | .00 | -.04 | .04 | .04 | .01 | .05 | .17 | .05 | .06 |
| 5. Honesty-Humility | | | | — | .75 | .00 | .19 | -.10 | .00 | .18 | .08 | -.08 | .14 |
| 6. Emotionality | | | | | — | .73 | -.03 | .07 | .00 | .14 | .31 | .11 | .08 |
| 7. Agreeableness | | | | | | — | .71 | -.32 | -.26 | .31 | -.01 | -.40 | .09 |
| 8. Presence | | | | | | | — | .90 | .77 | -.33 | .36 | .54 | .14 |
| 9. Perceived Realism | | | | | | | | — | .81 | -.25 | .34 | .48 | .20 |
| 10. Shame/Guilt | | | | | | | | | — | .88 | -.02 | -.33 | .15 |
| 11. Fear | | | | | | | | | | — | .85 | .54 | .42 |
| 12. Anger | | | | | | | | | | | — | .91 | .21 |
| 13. Perceived Risk | | | | | | | | | | | | — | .68 |
| 14. Intention to Aggress | | | | | | | | | | | | | — |
| Mean | .51 | 22.21 | .45 | 3.08 | 2.67 | 3.20 | 3.12 | 3.48 | 4.39 | 3.88 | 4.58 | 24.57 | 2.80 |
| SD | .50 | 3.42 | .50 | .64 | .57 | .57 | .76 | .69 | 1.85 | 1.37 | 1.59 | 10.57 | 1.68 |

Notes: At $|r| > .19, p < .01$; at $|r| > .14, p < .05$.

against this person by pushing, kicking, or hitting him?” (*very unlikely–very likely*). The other item regarded a percentage estimate, for example, “Can you give a percentage estimate of the probability that you would use violence (that is, push, kick, or hit the other person)?” The percentage item was recoded to a 7-point scale, and an intention to aggress scale was constructed based on the mean score of both items ($\alpha = .93$).

2.2.3 | Scenario

The scenario used was taken from Van Gelder et al. (2019) and involved an adapted version of the frequently used “bar fight” scenario (e.g., Exum, 2002; Mazerolle & Piquero, 1997; Mazerolle et al., 2003; Schoepfer & Piquero, 2006). The scenario was written in the second person and described an argument at a local bar between the participant and another male who makes a pass at the participant’s girlfriend (“Lisa”). Briefly, the participant is out with his girlfriend, and as he returns from paying the tab at the bar, he finds his girlfriend being approached by another male who is asking his girlfriend for her phone number. A quickly escalating (verbal) conflict between the participant and the other male ensues (see the appendix for the full scenario).

In the written scenario condition ($N = 87$), participants read the text from the screen of a desktop computer. In the VR condition ($N = 89$), they were presented a 360° video version of the scenario, filmed from the perspective of the participant, and with a voice-over explaining the context and setting (identical to the introductory lines of the written scenario; see Van Gelder et al., 2019, for details).³

³The VR Scenario is available for research purposes in both English and Dutch and can be obtained from the first author.

2.3 | Procedure

Data were collected at two Dutch universities. Upon arriving at the lab, participants were presented with an informed consent form. After providing consent, participants in the VR condition put on Samsung Gear™ VR goggles and noise-canceling over-ear headphones. The scenario was started by the experimenter after checking the headset was comfortable and the participant had no further questions. Participants in the written scenario condition read the scenario from a computer screen. Immediately after reading or experiencing the scenario, participants answered questions on perceived risk, anger, anticipated shame/guilt, presence, perceived realism, and intention to aggress. Next, they answered the HEXACO personality items.⁴ Subsequently, participants provided background information regarding age, education, and current relationship status. After this, participants received a full debriefing on the nature of the study and any further questions were answered.

3 | RESULTS

3.1 | Plan of analysis

Our plan of analysis consisted of two parts. In the first part, we examined the extent to which the findings of Van Gelder et al. (2019) replicated in the present study. The results of these analyses are presented in the online supporting information.⁵ In the second part, we tested the hypothesized model with trait and state factors predicting aggressive behavior. Because the data set contained 22 missing values, we first checked whether these were missing at random using Little's missing completely at random (MCAR) test. Because Little's MCAR test showed they were indeed missing at random ($\chi^2(df=2353) = 2249.450, p = .94$), we imputed the missing values using the expectation maximization (EM) algorithm.

To test the hypothesized trait-state model, we employed structural equation modeling (SEM) using AMOS 26.0 (Arbuckle, 2019). When SEMs contain many items for each of the latent variables, model fit is compromised as a result of an increase in possible spurious cross-loadings and an increase in degrees of freedom relative to the sample size, thereby reducing model fit (e.g., Bentler & Chou, 1987; Hagtvet & Nasser, 2004). Parceling ensures that each indicator contains more reliable systematic variance and shows a better approximation of the expected normal distribution. Consequently, before we ran our model, we created two parcels for each of the variables to reduce the model's complexity. That is, apart from the variables guilt/shame, perceived risk, and intention to aggress, which already consisted of two items, we created two parcels using the distributed uniqueness (or domain-representative) approach (Little et al., 2013). This was done to be able to capture as much as possible general variance and—in the case of the personal-

⁴ Each of the three HEXACO scales was measured with 10 items, but we added six items of the agreeableness facet "patience" and five items of the emotionality facet "fearfulness" to check whether these full 8-item facets more strongly related to the respective states. Although these facets were indeed more strongly related to their respective states (i.e., $r = -.44$ instead of $-.40$ for the patience-anger relation, and $r = .45$ instead of $.31$ for the fearfulness-fear relation), for reasons of parsimony, we decided to only report the domain scale results.

⁵ Additional supporting information can be found in the full text tab for this article in the Wiley Online Library at <http://onlinelibrary.wiley.com/doi/10.1111/crim.2022.60.issue-3/issuetoc>.

ity domains—facet-specific variance for honesty-humility, emotionality, agreeableness, presence, fear, and anger.

3.2 | Analyses

We first computed correlations between condition (0 = Scenario, 1 = VR), attractiveness of Lisa, age, current romantic relationship (0 = No, 1 = Yes), honesty-humility, emotionality, agreeableness, presence, perceived realism, guilt/shame (i.e., anticipated guilt/shame), fear, anger, perceived risk, and intention to aggress (table 1). Honesty-humility, agreeableness, guilt/shame, and perceived risk were all significantly negatively correlated with intention to aggress. Experimental condition, presence, perceived realism, fear, and anger were all significant in the positive direction. No significant correlations with intention to aggress emerged for age, being in a romantic relationship, attractiveness of Lisa, and emotionality (although this latter relation was marginally significant [$r = .14, p = .07$]).

In the SEM that we tested, which was based on our theoretical model (see figure 1), we included all direct effects between the personality variables and presence, on the one hand, and intention to aggress, on the other. We did not include participant age, relationship status, and attractiveness of Lisa in the model because these variables did not have a significant (or particularly meaningful) relation with intention to aggress. As argued above, because of the overlap between presence and perceived realism and the stronger relations of presence with the other variables in table 1, we decided to only focus on presence (see Method section). Furthermore, because honesty-humility and agreeableness have been found to share some variance (Ashton & Lee, 2021) and because fear shares variance with anger and perceived risk, as has been corroborated in other studies (e.g., Yik et al., 2011), we include (error) covariances between these three pairs of variables. We used the comparative fit index (CFI) and Tucker-Lewis index (TLI) with values $\geq .90$ and root mean square error of approximation (RMSEA) with values $\leq .08$ as indicators of fit of the model to the data (Hu & Bentler, 1999; Cangur & Ercan, 2015).

Before conducting the main analyses, we checked in a multigroup analyses whether the relations between the traits and states, as presented in figure 1, but without the condition variable, were similar across the two conditions (scenario and VR). The results are presented in the online supporting information (table S5) and show that the fully constrained SEM, in which all parameters and errors were fixed to be equal across the scenario and VR conditions, had the best fit according to the TLI (.89), RMSEA (.06), and Akaike Information Criterion (AIC; 580.7), which were, respectively, higher (TLI) and lower (RMSEA and AIC) than the other, less constrained, models.

Consequently, the (scenario vs. VR) condition did not moderate the structural equation paths and we proceeded by testing the full model as presented in figure 1 in which condition was included as a predictor. This model, which is shown in figure 2, had an acceptable fit ($\chi^2(df = 132) = 260.74, p < .01$; CFI = .93, TLI = .91, RMSEA = .075). The direct and indirect path coefficients are shown in table 2. With respect to the direct effects, the VR condition was associated with a higher level of presence ($\gamma = .37, p < .01$). Presence, in turn, was related to all four state variables, that is, guilt/shame ($\beta = -.35, p < .01$), fear ($\beta = .40, p < .01$), anger ($\beta = .53, p < .01$), and perceived risk ($\beta = .20, p = .03$). In other words, in line with our hypothesis, feeling present in the scenario is related to the emotional experience of the scenario as well as to perceptions of risk.

TABLE 2 Unstandardized and standardized regression coefficients and significance levels for the model in figure 2 ($N = 176$)

| | Unstandardized B (SE) | Standardized β | <i>p</i> |
|--|--------------------------|-------------------------|----------|
| Measurement Model Estimates | | | |
| Honesty-Humility (H1) | .84(.18) | .76 | .00 |
| Honesty-Humility (H2) | 1.00 | .92 | |
| Emotionality (E1) | .54(.16) | .59 | .00 |
| Emotionality (E2) | 1.00 | 1.02 | |
| Agreeableness (A1) | 1.09(.18) | .80 | .00 |
| Agreeableness (A2) | 1.00 | .75 | |
| Presence (Pres1) | .97(.06) | .92 | .00 |
| Presence (Pres2) | 1.00 | .95 | |
| Anticipated Guilt/Shame (Guilt1) | 1.00 | .95 | |
| Anticipated Guilt/Shame (Guilt2) | .83(.10) | .81 | .00 |
| Fear (Fear1) | 1.00 | .95 | |
| Fear (Fear2) | .88(.08) | .79 | .00 |
| Anger (Anger1) | 1.00 | .89 | |
| Anger (Anger2) | 1.19(.08) | .91 | .00 |
| Perceived Risk (PR1) | 1.00 | .69 | |
| Perceived Risk (PR2) | 1.09(.21) | .73 | .00 |
| Intention to Aggress (IntA1) | 1.00 | .90 | |
| Intention to Aggress (IntA2) | .99(.06) | .95 | .00 |
| Structural Model (Direct Effects) | | | |
| Condition (Scenario = 0/VR = 1) → Presence | .59(.12) | .37 | .00 |
| Honesty-Humility → Anticipated Guilt/Shame | .64(.25) | .22 | .01 |
| Honesty-Humility → Perceived Risk | .22(.15) | .13 | .16 |
| Honesty-Humility → Intention to Aggress | -.13(.15) | -.05 | .39 |
| Emotionality → Fear | .54(.19) | .28 | .01 |
| Emotionality → Perceived Risk | .28(.16) | .18 | .08 |
| Emotionality → Intention to Aggress | .26(.15) | .12 | .09 |
| Agreeableness → Anger | -.95(.21) | -.33 | .00 |
| Agreeableness → Intention to Aggress | -.64(.25) | -.20 | .01 |
| Presence → Anticipated Guilt/Shame | -.80(.18) | -.35 | .00 |
| Presence → Fear | .64(.12) | .40 | .00 |
| Presence → Anger | .88(.12) | .53 | .00 |
| Presence → Perceived Risk | .26(.12) | .20 | .03 |
| Presence → Intention to Aggress | .43(.14) | .23 | .00 |
| Anticipated Guilt/Shame → Int. to Aggress | -.22(.05) | -.28 | .00 |
| Fear → Intention to Aggress | -.15(.12) | -.13 | .21 |
| Anger → Intention to Aggress | .57(.13) | .50 | .00 |
| Perceived Risk → Intention to Aggress | -.35(.13) | -.24 | .00 |

(Continues)

TABLE 2 (Continued)

| | Unstandardized | Standardized | <i>p</i> |
|---|----------------|--------------|----------|
| | B (SE) | β | |
| Structural Model (Total Indirect Effects) | | | |
| Condition (Scenario = 0/VR = 1) → Int. to Aggress | .55(.12) | .18 | .00 |
| Honesty-Humility → Intention to Aggress | -.22(.15) | -.09 | .03 |
| Emotionality → Intention to Aggress | -.18(.16) | -.08 | .07 |
| Agreeableness → Intention to Aggress | -.54(.23) | -.17 | .00 |
| Presence → Intention to Aggress | .49(.14) | .26 | .00 |

Notes: $\chi^2(df = 132) = 260.74, p < .01$; CFI = .93, TLI = .91, RMSEA = .075.

With respect to personality, results largely confirmed the hypotheses. Honesty-humility was positively related to feelings of (anticipated) guilt/shame ($\gamma = .22, p = .01$), emotionality was positively related to feelings of fear ($\gamma = .28, p < .01$), and agreeableness was negatively related to feelings of anger ($\gamma = -.33, p < .01$). Emotionality was only marginally related to perceived risk ($\gamma = .18, p = .08$), however, and honesty-humility was not related to perceived risk ($\gamma = .13, p = .16$). Furthermore, three of the four state variables—all but fear—were significantly related to intention to aggress in the hypothesized direction (e.g., guilt/shame [$\beta = -.27, p < .01$], fear [$\beta = -.13, p = .21$], anger [$\beta = .50, p < .01$], and perceived risk [$\beta = -.24, p < .01$]).

To test whether indirect effects arose independent of direct effects, the direct effects of personality and presence on intention to aggress were included in the model. Honesty-humility did not have a significant direct relation with intention to aggress ($\gamma = -.05, p = .39$) and emotionality only had a marginally significant direct relation with intention to aggress ($\gamma = .12, p = .09$). Both agreeableness and presence had significant direct relations with intention to aggress (respectively, $\gamma = -.20, p = .01$ and $\beta = .23, p < .01$). Combined, the personality and presence predictors and state mediators explained 67.0 percent of the variance in intention to aggress.

To estimate the indirect effects of condition and personality on intention to aggress, we conducted 500 maximum likelihood bootstraps using a 90 percent bias-corrected confidence interval. The standardized total indirect effect of condition on intention to aggress was significant ($\beta = .18$; 90 percent CI from .12 to .25), as were the standardized total indirect effects of honesty-humility, emotionality, agreeableness, and presence on intention to aggress (respectively, $\beta = -.09, -.08, -.17, \text{ and } .26$; respectively, 90 percent CIs from $-.02 \text{ to } -.20, -.01 \text{ to } -.21, -.08 \text{ to } -.29, \text{ and } .16 \text{ to } .39$).

Although not hypothesized, because the correlation matrix showed a significant relation between agreeableness and anticipated guilt/shame, we also tested a model in which this path was added to the model. This model showed a somewhat better fit than the original model ($\chi^2(df = 131) = 253.64, p < .01$; CFI = .94, TLI = .92, RMSEA = .073; $\Delta\chi^2(df = 1) = 7.10, p = .01$), and all predictors and mediators explained a total of 68.0 percent (i.e., 1.0 percent extra compared with the original model) of the variance in intention to aggress. Agreeableness was significantly related to anticipated guilt/shame ($\gamma = .26, p < .01$). Apart from a somewhat lower, and now marginally significant, relation between honesty-humility and anticipated guilt/shame ($\gamma = .15, p = .09$), changes in estimates were negligible. The total indirect effect of honesty-humility on intention to aggress was still significant using a 90 percent bias-corrected confidence interval ($\beta = -.07$; 90 percent CI from $-.01 \text{ to } -.17$). Information on this model is provided in the online supporting information (model 2, table S6).

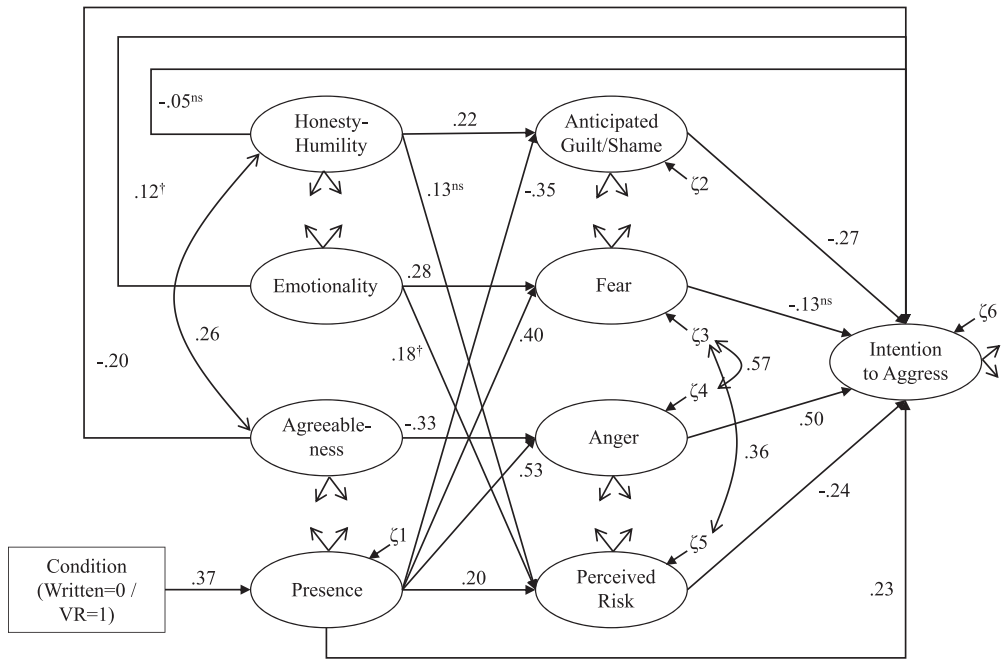


FIGURE 2 Model with the effects of VR, presence and personality through states on intention to aggress. Notes: $\chi^2(df = 132) = 260.74, p < .01$; CFI = .93, TLI = .91, RMSEA = .075; manifest variables are omitted and parameters are reported in table 2, $N = 176$

4 | DISCUSSION

In this study, we proposed and tested a trait-state model that lays out the pathways through which personality is related to intention to aggress. We argued that the way people process information surrounding the decision situation, and hence respond to it, is influenced by their scores on the personality traits agreeableness, emotionality, and honesty-humility. Building on prior research that showed individual dispositions to operate on criminal decision-making at least in part via state variables (Nagin & Paternoster, 1993, 1994; Nagin & Pogarsky, 2001, 2003; Van Gelder & De Vries, 2012, 2014), we predicted agreeableness to mainly operate on aggressive intentions via anger. Emotionality was hypothesized to operate via state fear and perceived risk, and honesty-humility through anticipated shame/guilt and perceived risk. Finally, we compared the virtual scenario with the written scenario in terms of their ability to trigger emotional states relevant to the decision situation, to establish a sense of being present in the scenario, and to generate a sense of realism.

The key findings of the study can be summarized as follows. First, we found strong support for the hypothesized trait-state model of aggressive decision-making. The indirect effects linking personality to aggressive intentions by and large followed the hypothesized pathways, and three of the four states were significantly associated with intention to aggress. There were three exceptions: The pathways linking emotionality and honesty-humility to perceived risk were not significant, nor was the pathway linking fear to intention to aggress. Emotionality, however, still had a significant indirect negative effect on intention to aggress through fear and perceived risk combined. Second, in line with expectations, the results show that presence was higher in the VR condition than in the written scenario condition and that it was positively related to each of

the four state variables. Furthermore, and in line with expectations, the virtual scenario was perceived as more realistic than the written vignette. Third, as expected, participants who saw the virtual scenario reported stronger feelings of fear and anger than did those who read the vignette. In other words, this finding supports the argument that, compared with written vignettes, virtual scenarios are better able to elicit the emotions characteristic of situations of interpersonal violence and aggression, and hence to display superior validity, at least in the context under study.

This study extends previous work in several relevant ways. For one thing, previous studies that have related personality to aggression have typically employed correlational designs using self-report measures of (trait) aggression-related criteria or hypothetical scenarios. Experimental designs have been much less frequently used. Moreover, to the best of our knowledge, the present study is the first to use immersive technology to examine the relation between personality and aggressive behavior. Furthermore, we have stepped away from the common practice in the criminal decision-making literature of relying on a singular concept. This literature has seen the application a range of overlapping constructs that, besides the dominant self-control construct, includes temporal discounting, impulsivity, present orientation, thoughtfully reflective decision-making, inhibition, and cognitive reflection. These constructs coincide in their explanation of the choice for crime in terms of a failure to consider the longer term consequences of one's actions or the tendency to deliberately devalue them. Despite important differences between them, they are all reflective of a short-term mindset (see Van Gelder et al., 2020). The personality approach taken in the article is by no means at odds with this view or negates the importance of short-term mindsets in crime causation, but it extends it by demonstrating that other dispositions are also related to aggressive conduct and, importantly, do so for different reasons. Thus, the use of different personality traits can better explain the reasons underlying decisions to engage in crime and, when used in combination with states, dissect the processes through which this happens. The additional advantages that current personality approaches carry is that they rely on widely agreed dimensions of personality and validated instruments for measuring them, have a factor structure that consistently replicates across samples and cultures, and are composed of orthogonal, that is, theoretically and empirically, independent factors.

Finally, by laying bare the mechanisms that connect stable individual traits to transitory states in the explanation of aggression, the current study has taken a new step in understanding its etiology, with implications for improving our understanding of other types of antisocial behavior and crime as well. Establishing meaningful relations between specific traits, states, and specific types of offenses could, besides providing important theoretical input, also imply an important step forward in the treatment of offenders as the identification of the specific pathways through which traits operate on aggression allows for more targeted interventions.

The present research was prone to several limitations that could be addressed in future work. First and foremost, we did not include actual behavioral measures of aggression but instead relied on behavioral intentions. Future work could make use of more interactive virtual environments involving actual acts of aggression, for example, through the use of haptic suits. We note that the fact that the scenario did not allow for actual interaction or influencing the course of events did carry the advantage that it was standardized across participants and allowed for a direct comparison with the written scenario.

Second, in the VR condition, participants took off the headset prior to filling out the survey materials. Although the time interval between exiting the scenario and starting the survey was kept short, it could still have been enough to “cool off” and respond less in a heat-of-the-moment fashion that would have been the case in the real-life situation in which such a time lag would be absent. One way to remedy this limitation in future research would be to embed survey

questions in the virtual environment (see Alexandrovsky et al., 2020), which could result in larger differences in reported emotional states between the conditions.

Third, we did not specify a causal ordering between affective and cognitive states in our model but instead gave them equal status. Hence, we could not assess whether cognitions may influence affect or vice versa. Although assessing causality between affect and cognition was not the purpose of the present study, we think this would be an interesting avenue to pursue for future research.

Another point of attention concerns the sample used in this study, which consisted of undergraduate students. Although the use of such samples has been criticized for placing restrictions on generalizability, in the present context, we think that a student sample was in fact appropriate as the scenario was tailored to this population. As Levine (2003) observed, for violence research, using students is not a weakness per se, as they belong to the strata of young people most at risk of violent assault and spend much time and money in the night-time economy where they are also more likely to witness or experience violence. In other words, students have experience of, and exposure to, the phenomena that were under study in the present research. Furthermore, the fact that the differences in scores on the state variables between the written and VR condition were similar to those reported by Van Gelder et al. (2019) who used a more heterogeneous sample inspires confidence in the results.

Future research might like to build on the current findings by using a daily diary design in which traits are measured beforehand and states and actual aggressive behaviors are measured using an experience sampling method (ESM; Borah et al., 2021; Hektner et al., 2007). An important question would be whether people low on agreeableness, honesty-humility, and emotionality are also more likely to gravitate toward interpersonal conflict situations, as predicted by the situation-trait-outcome activation (STOA) model (De Vries et al., 2016). For this, it would be important to also measure situational affordances (i.e., situations that allow for certain personality traits to be expressed) to find out whether people low on these three traits are also more likely to be attracted to situations that afford aggressive behaviors (De Vries et al., 2016; Rauthmann et al., 2014; Reis, 2008). In such a design, VR may play an important role to investigate situation activation by allowing participants to choose the type of (virtual) environment they want to be in (for a burglary example, see Van Sintemaartensdijk et al., 2020), which, according to the STOA model, is likely to reflect on someone's personality.

In closing, we see the present effort as a promising avenue for future research on aggressive and criminal decision-making research in terms of both the theoretical approach taken as well as the VR methodology used. Although we are currently only at the beginning of exploring its potential for crime research, the lessons learned from the present study, as well as the rapid development of VR hardware and software, imply that future immersive virtual scenarios will allow researchers to more closely approximate the decision-making event and to do so in more revealing ways. As a result of the ability to mimic situations that either have a low base-rate or are hard or unethical to investigate in real life or in the laboratory, we believe immersive virtual technologies have the ability to take the field of criminology into exciting, new, and uncharted, territories.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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APPENDIX

Written scenario

Imagine the following situation

It's Friday night and you are out with your girlfriend Lisa in Irish Pub Molly Malone's in the center of Amsterdam. You and Lisa, with whom you have been dating for two years now, went to Molly's for food. The food was great and you enjoyed a nice glass of wine with it. After the main course you decide against taking dessert or coffee but to head home instead. You walk to the bar to pay. The bartender asks you whether you enjoyed the food while presenting you the bill of €47,- You tell him the food was great while paying him with a €50,- note and tell him to keep the change. While returning to your table you see a guy in his early 20s that you don't know standing close to and talking with Lisa. Walking back to your table you hear him ask for Lisa's phone number. The following dialogue unfolds:

YOU: "What's going on? Are you hitting on my girlfriend?"

GUY: (keeps looking at Lisa) "I don't see a ring on her finger so she can talk to whoever she wants to."

YOU: "Lisa, let's go."

GUY: (to you): "Maybe you should go."

YOU: (louder) "I am not talking to you!"

GUY: (turning towards you): "But I am talking to you."

YOU: (raised voice) "Fuck off!"

GUY: (raised voice) "You fuck off!"

YOU: (raised voice and threatening) "And now stop it!"

GUY: (provocative) "Or what...?"