Affect, emotions, and crime decision-making: emerging insights from immersive 360° video experiments

Shaina Herman[1] · **Timothy C. Barnum**[1] · **Paola Emilia Minà**[2] · **Peter Wozniak**[1] · **Jean-Louis van Gelder**[1,3]

Abstract

Objectives This study investigates the effectiveness of immersive 360° video technology in evoking and manipulating two emotions, anger, and sexual arousal, relevant to criminal decision-making. Additionally, we provide a focused review of emotions in decision-making research in criminology, offering a comprehensive foundation for our study.

Methods We conducted immersive 360° video experiments emulating real-world situations ($n = 101$). We measured self-reported emotions before and after exposure to the virtual scenarios, considering both between- and within-person effects.

Results The scenarios effectively elicited the criminogenic emotions in the controlled virtual environments.

Conclusions Immersive technologies, such as 360° video and virtual reality, can serve as a bridge between laboratory-based investigations and real-world criminogenic situations, offering an ecologically effective tool for exploring the intricate relationship between state affect and decision-making processes.

Keywords Emotions · Affect · Anger · Arousal · Crime decision-making · 360° Virtual reality · Immersive technology

✉ Shaina Herman
   s.herman@csl.mpg.de

[1] Max Planck Institute for the Study of Crime, Security and Law, Freiburg, Germany

[2] La Sapienza University, Rome, Italy

[3] Institute of Education and Child Studies, Leiden University, Leiden, The Netherlands

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"We are not thinking machines that feel, we are feeling machines that think."
— António R. Damásio (1994)

Introduction

Principles of decision-making have a rich history in criminological research and lie at the heart of many criminal justice policies. Such research often highlights would-be offenders' risk perceptions (see Barnum & Nagin, 2023; Nagin, 2013; Paternoster, 2010). It has become increasingly clear that subjective expectations about the prospect of experiencing consequences from criminal involvement serve as a key mechanism linking choice to behavior (Anwar & Loughran, 2011; Barnum et al., 2021; Barnum & Nagin, 2021; Bucci, 2023; Thomas et al., 2018). Despite advancements in how these *cognitive* assessments shape crime decisions, criminology has seen a relative dearth of research on the *affective* processes underpinning these decisions. This is somewhat puzzling given the inherent emotional nature of many crimes and the concomitant growth in research on affect and decision-making in fields such as psychology, behavioral economics, and neuroscience (e.g., Blanchette & Richards, 2010; Damásio, 1994; Dukes et al., 2021; Lerner et al., 2015).

This is not to say criminologists have ignored the role of affect in shaping decision-making and behavior (Andenaes, 1966; Bouffard et al., 2000; Collins, 2008; Katz, 1988; Zimring et al., 1973). The motivational properties of state affect, including emotional and visceral experiences, feelings, and moods, for example, have long been noted in qualitative works (Anderson, 1999; Cherbonneau & Jacobs, 2019; Copes & Hochstetler, 2013; Jacobs & Cherbonneau, 2017; Wright et al., 1996). However, explicit tests of the independent and joint influences of state affect and cognition on crime decisions have been lacking, obfuscating the role (if any) emotions have within criminological frameworks.[1]

Researching the role of emotions in crime decisions; however, is both methodologically and ethically challenging. Unlike cognitive risk assessments such as sanction certainty perceptions, emotions are not readily studied with hypothetical vignettes. These generally involve short written scenarios where researchers manipulate situational features of the crime opportunity, such as the presence of a capable guardian, to change *objective* levels of risk (Bouffard et al., 2017; van Gelder & Nagin, 2023). Written scenarios, however, are limited by their divergence from actual, real life offending opportunities. In particular, brief written descriptions of situations are unlikely to elicit emotions that real-life situations do. Consequently, participants must estimate future emotions while in a "cold state." Research has shown that people have difficulty *predicting* their own future behavior in circumstances involving strong visceral states (Loewenstein, 1996; Van Boven &

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[1] State affect is transient, fleeting, and often aligned with specific situational factors. Dispositional or trait affect, on the other hand, reflects enduring emotional tendencies that transcend specific situations (van Gelder & de Vries, 2012).

Loewenstein, 2005). Therefore, empirical approaches are required that more meaningfully capture emotion-laden features of a crime opportunity (van Gelder, 2023).

Unlike research in psychology and economics that examines prosocial outcomes, studying crime poses unique challenges in a controlled laboratory environment. Ethical considerations also restrict researchers from observing crime in natural settings. These restrictions help explain why most research on affect in criminology has focused on trait or dispositional influences (e.g., Agnew, 1992; Giordano et al., 2007). Consequently, state affect has largely been relegated to a secondary position in criminological research and theory, frequently disregarded as irrational, unmeasurable, or uninformative (Nagin, 2007; but see van Gelder, 2013).

The current study has two objectives. First, we provide a focused literature review on affect, emotions, and crime decision-making to better understand the state of the literature.[2] Two broad conclusions emerge: (1) it is increasingly difficult to deny the direct and indirect effects of emotions on crime decisions; and (2) some theoretical and methodological housekeeping is necessary to clarify the role of emotions, including how they are operationalized, evoked, manipulated, and measured.

The second objective is to introduce an innovative approach aimed at meaningfully approximating the emotional experiences relevant to real criminogenic situations. Our method involves utilizing immersive 360° video experiments, placing study participants in a familiar barroom setting where they encounter realistic crime opportunities. These immersive scenarios were designed to differentially evoke two types of criminogenic affective states: (1) anger and frustration and (2) sexual excitement and arousal. Our primary goal is to demonstrate that our method can safely and successfully manipulate emotions in situ; a result that could foster theory development through more precise examinations of *both* affective and cognitive processes during crime decisions.

Our results provide an initial glimpse into the efficacy of immersive technologies for manipulating criminogenic emotional experiences akin to real world feelings. Among other things, this approach allows researchers to evaluate crime-related behavioral intentions *in the heat of the moment* through actual, situationally induced feelings. We situate this study in terms of recent advances in crime decision-making and explain how principles of *emotion* can be integrated into criminological theory and leveraged for crime prevention policy.

Affectivism and crime decision-making

In a recent essay in *Nature Human Behavior*, Dukes et al. (2021) discussed the growing recognition of affective phenomena and their impacts on decision-making research, termed the rise of affectivism. Beginning in the 1980s, research has consistently demonstrated the explanatory power of emotions, feelings, moods, and

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[2] We interchangeably use the terms emotions, emotional experiences, and state affect as they collectively cover a spectrum of emotions, visceral states, feelings, and moods (Loewenstein, 1996). Nevertheless, we recognize the importance of these distinctions, which we elaborate on in the discussion.

other affective processes in understanding human behavior. Such research underscores interrelationships between affect, cognition, and behavior, which have produced insights on emotional intelligence, emotion regulation, addiction, decision-making, and social interactions (Dukes et al., 2021). It is increasingly recognized emotions and cognitions, rooted in interconnected brain systems, continuously and reciprocally influence judgments, decisions, and relevant conclusions (Damásio, 1994; see also Blanchette & Richards, 2010; Lerner et al., 2015; Pham, 2007).

Criminological decision-making researchers, however, have not kept pace with other behavioral domains regarding the role of emotions and state affect; this despite studying an intrinsically emotional behavior. Earlier, we argued that this is partially due to ethical and methodological challenges. In what follows, we present a targeted literature review that focuses on state affect, emotions, and crime decision-making.[3] The goal is to identify recurring themes, inconsistencies, address discrepancies, and outline a way forward for better integrating affective states and emotions into criminological theory and research.

Focused literature review: affect, emotions and crime decision-making

We conducted a focused keyword search on Google Scholar and other online platforms for relevant articles containing the terms: affect, emotions, visceral states, feelings, mood, criminal decision-making, offender decision-making, rational choice theory, and deterrence. We confined the search to peer-reviewed studies within criminology that use quantitative method.[4] Specially, we included research on *state affect*, denoting fleeting emotional experiences prompted by particular situational factors. In contrast to trait affect, which signifies stable dispositional characteristics across various situations, affective states are transient, exhibiting variations in intensity and duration based on the specific circumstances. State affect encompasses *emotions, feelings, moods, visceral reactions,* and *arousal drive states* (Loewenstein, 1996). We excluded research on *anticipated* emotions and *dispositional affect* and confined our attention to examinations of traditional rational choice considerations and offending outcomes, such as self-reported behaviors and behavioral intentions.[5] Table 1 summarizes our search results, organized by publication year and the

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[3] We acknowledge the pervasive role of emotions, both state and trait, within criminological discourse. Nonetheless, we have chosen to narrow our focus to the examination of crime decision-making processes. Existing areas involve emotions and criminal justice (e.g., Karstedt, 2002), fear of crime/victimization (e.g., LaGrange & Ferraro, 1989), and punitive attitudes toward crime among citizens (e.g., Hartnagel & Templeton, 2012).

[4] The decision to exclude qualitative and ethnographic studies was a methodological choice. Our innovative method is most directly relevant to explicit tests of affect within a decision-making framework. For additional work in this area, see van Gelder et al. (2013).

[5] Emotions like regret or remorse occur *following* a decision (Loewenstein et al., 2001; Warr, 2016). Thus, anticipated emotions are not experienced at the time of the decision but are projected to occur later. In this regard, they resemble other economic choice variables, such as judgments about the certainty or severity of punishment. This should not be confused with *anticipatory* affect, which refers to an immediate emotional response in anticipation of a future event. Thus, people experience anticipatory emotions 'in the moment' via emotional forecasting and therefore proxy as real-life affective states (Loewenstein, 2000).

Table 1 Peer-reviewed studies on criminal decision-making, affect, and cognition ($N=19$)

Survey studies	Affect	Affect source	Behavior(s) and method	Predictions (direction)	Results
Loewenstein et al. (1997)	Sexual arousal	AEP	Sexual coercion; arousal evocation task before written vignettes	1) Direct effect on intent (+) 2) Affect mediated by cognitions	1) Support 2) No support
Bouffard (2002)	Sexual arousal	AEP	Sexual coercion; arousal evocation task before written vignettes	1) Direct effect on intent (+) 2) Direct effect on benefits (+) and costs (−) 3) Indirect effect through benefits 4) Indirect effect through costs	1) Support 2) Mixed 3) Support 4) No support
Exum (2002)	Intoxication; anger	AEP	Assault; arousal evocation task before written vignettes	1) Independent and interactive effect on Intent (+) 2) Independent and Interactive effect on benefits (+) 3) Independent and interactive effect on costs (−) 4) Affect mediated by costs and benefits	1) Support 2) No support 3) No support 4) No support
Carmichael and Piquero (2004)	Anger	MAA	Assault; affect in response to written vignettes	1) Direct effect on intent (+) 2) Direct effect on costs (−) 3) Direct effect on benefits (+) 4) Affect moderates costs (−) 5) Affect moderates benefits (+)	1) Support 2) No support 3) Support 4) No support 5) Support
Ariely and Loewenstein (2006)	Sexual arousal	AEP	Sexual preferences and deviance; arousal evocation task prior to questionnaire	1) Direct effect on preferences (+) 2) Direct effect on questionable intentions (+) 3) Direct effect on risky intentions (+)	1) Support 2) Support 3) Support

Table 1 (continued)

Survey studies	Affect	Affect source	Behavior(s) and method	Predictions (direction)	Results
Bouffard (2011)	Sexual arousal	AEP	Sexual coercion; arousal evocation task before written vignettes	1) Direct effect on Intent (+) 2) Direct effect on costs (−) 3) Affect moderates costs (−)	1) No support 2) Mixed 3) Support
van Gelder and de Vries (2012)	Fear	MAA	Composite criminal choice (4 behaviors); affect measured in response to written vignettes	1) Direct effect on criminal choice (−) 2) Not explicitly predicted: affect correlated with costs (+)	1) Support 2) Support
van Gelder and de Vries (2014)	Fear	MAA	Composite criminal choice (illegal downloading and fraud); arousal evocation task prior to written vignettes; affect measured in response to written vignettes	1) Direct effect on criminal choice (−) 2) Direct effect on costs (+) 3) Arousal evocation task moderates effect on criminal choice (+)	1) Support 2) Support 3) Support
Bouffard and Miller (2014)	Sexual arousal	AEP	Sexual coercion; arousal evocation task before written vignettes	1) Direct effect on interpretations (+) 2) Direct effect on intent (+)	1) Mixed 2) Mixed
Kamerdze et al. (2014)	Positive mood; negative mood	AEP	Cheating; drunk driving; Arousal evocation task before written vignettes	1) Positive mood direct effect on intent (−) 2) Negative mood direct effect on intent (−) 3) Indirect through costs 4) Indirect through preferences	1) Mixed 2) No support 3) No support 4) Mixed
Bouffard (2015)	Anger; fear	AEP[a]	Drunk driving; affect measured before written vignettes	1) Fear direct effect on intent (−) 2) Anger direct effect on intent (+) 3) Fear direct effect on costs (−) 4) Anger direct effect on costs (+)	1) No support 2) Support 3) Mixed 4) Mixed

Table 1 (continued)

Survey studies	Affect	Affect source	Behavior(s) and method	Predictions (direction)	Results
van Gelder and de Vries (2016)	Lure	MAA	Composite criminal choice (6 behaviors); affect measured in response to written vignettes	1) Feelings of lure on intent (+) 2) Affect mediates personality traits on intent	1) Support 2) Support
Pickett et al. (2018)	Fear of arrest	MAA	Insurance fraud; drunk driving; purchasing stolen goods; affect measured in response to written vignettes	1) Direct effect on intent (−) 2) Mediates effect of costs on intent	1) Support 2) Support
Leclerc and Lindegaard (2018)	State affect	MAA	Sexual assault; seven affective states measured retroactively about before, during, and after sexual assault incident	1) Sexual excitation (+) during assault and regret (+) after 2) Affective states very throughout the commission of crime 3) Affective states vary across victims 4) Affective states depend on situational factors	1) Support 2) Support 3) No support 4) Mixed
Barnum and Solomon (2019)	Anger; fear	MAA	Assault; affect measured in response to written vignette	1) Direct effect of anger on intent (+) 2) Direct effect of fear on intent (−) 3) Anger moderates costs (−) 4) Anger moderates benefits (+) 5) Fear moderates costs (+) 6) Fear moderates benefits (−) 7) Indirect through costs and benefits	1) Support 2) Support 3) Support 4) Support 5) Support 6) Support 7) Mixed
Roche et al. (2020)	Fear of arrest	MAA	Composite criminal choice (6 behaviors); affect measured in response to questionnaire	1) Direct effect on criminal choice (−) 2) Mediates costs on criminal choice	1) Support 2) Support

Table 1 (continued)

Survey studies	Affect	Affect source	Behavior(s) and method	Predictions (direction)	Results
Chatzimike-Levidi and Collard (2023)	Negative affect (fear)	MAA	Composite criminal choice (fraud, purchase of stolen goods, drug trafficking); affect measured in response to written vignettes	1) Direct effect on criminal choice (−) 2) Direct effect on cost 3) Mediates effect of cost on choice	1) Support 2) Support 3) No support
Virtual reality studies					
van Gelder et al. (2019)	Anger	VRM	Assault; affect measured in response to virtual vignette	1) Direct effect on intent (+) 2) Direct effect on VR realism and presence (+) 3) Anger mediates effect of presence and realism on intent	1) Support 2) Support 3) Mixed
van Gelder et al., (2022)	Anger; fear	VRM	Assault; affect measured in response to virtual vignette	1) Direct effect of anger on intent (+) 2) Direct effect of fear on intent (−) 2) Anger and fear mediate effect of presence on intent 3) Anger and fear correlated with costs	1) Support 2) Support 3) Mixed

References are organized by year and type of affect measured

AEP studies that evoked affect prior to evaluation, *MAA* studies that measured affect after evaluation, *VRM* studies that measured affect in response to VR simulations

[a]AEP measured affect prior to evaluation but did not manipulate affect

method for "capturing" affect. In total, we identified 19 studies that met our inclusion criteria. Next, we delve into these findings, highlighting key inconsistencies, particularly in the interplay between affective and cognitive perceptions and their influence on behavior.

There have been two general approaches to study and elicit emotions in the context of crime and decision-making. Several studies "prime" or evoke feelings, emotions, and/or moods in study participants *prior* to evaluating a (hypothetical) crime opportunity. Another approach is to query participants *after* they evaluate a hypothetical scenario, allowing researchers to capture anticipatory affect, how one *would* feel, regarding a crime opportunity. This research has largely focused on fear, anger, and sexual excitement/arousal as criminogenic affective states. We unpack the theoretical and methodical implications of these two strands of research below.

Evoking and measuring affect prior to evaluation

Beginning in the late 1990s, the initial approach to studying affect in crime decision-making involved experimentally manipulating emotions and affective states *before* participants evaluated crime scenarios. In this paradigm, researchers exposed participants to various stimuli, such as confederates deliberately angering participants or viewing pornography. Subsequently, participants responded to crime-relevant questions, often involving a hypothetical crime opportunity. An important advantage to this approach is that participants experience actual feelings and arousal, such that they evaluate the scenarios in an affectively charged or "hot" state.

In a seminal study, Exum (2002) randomly assigned participants to experience anger, intoxication, both anger and intoxication, or neither. Anger was induced by falsely accusing participants of being late to the lab session, while intoxication was induced through alcohol consumption. Subsequently, participants evaluated a written scenario depicting a conflict in a bar and assessed the perceived risks, costs, and benefits of committing assault. The findings revealed that anger and intoxication interacted to increase intentions to engage in aggression. However, contrary to initial hypotheses, these affective states had no discernible effect on traditional rational choice variables, such as judgments of the costs and benefits from offending.

Researchers have also induced feelings of sexual arousal in laboratory settings by exposing participants to pornography (Ariely & Loewenstein, 2006; Bouffard, 2002, 2011; Bouffard & Miller, 2014; Loewenstein et al., 1997). Following the arousal stimulus, participants responded to questions related to a hypothetical scenario involving sexual behavior and aggression. It was expected that arousal would increase intended sexual risk-taking, including rape, by altering perceptions of risks, costs, and benefits. The results consistently showed associations between increased arousal and behavioral outcomes, but the link between experimentally manipulated arousal and traditional decision-making variables was again inconsistent.

In total, eight out of the nineteen studies identified used the pre-evaluation evocation method. These studies focused primarily on sexual arousal (Ariely & Loewenstein, 2006; Bouffard, 2002, 2011; Bouffard & Miller, 2014; Loewenstein et al., 1997), one on anger (Exum, 2002), and one on the emotional valence of a positive

versus negative mood (Kamerdze et al., 2014). Varying slightly, Bouffard (2015) queried both state anger and fear prior to the vignette but did not include an experimental manipulation. Across these studies, the most consistent finding is that affect significantly influences intentions to offend. However, the effects of these various affective states on decision-making cognitions remain unclear.

Measuring affect after evaluation

The second approach involves measuring anticipatory emotional experiences or emotional responses that arise in anticipation of future events or outcomes. Here, participants receive a hypothetical criminal opportunity, typically in writing, and then report how they *would* feel if they were to experience the described event. An advantage of this approach over the pre-evocation method is that emotions are directly linked to the situation under evaluation, allowing for contemporaneous measurement alongside decision variables and behavioral outcomes.

Nine of the studies presented in Table 1 followed this approach, with six of them directly querying subjective emotions in response to the content of the scenario (e.g., "how *angry* would you feel in this situation?") (Barnum & Solomon, 2019; Carmichael & Piquero, 2004; Chatzimike-Levidi and Collard, 2023). Two studies query emotional responses to probabilistic estimates of being arrested, also derived from specific crimes or scenarios (Pickett et al., 2018; Roche et al., 2020). These studies involved feelings of anger, fear, lure, and fear specific to the prospect of being arrested.

Several hypotheses are reflected in these nine studies: (1) emotions directly influence behavioral intentions; (2) emotions moderate the effect of traditional rational choice considerations on behavior intentions; (3) a bidirectional relationship between emotions and cognitions indirectly influences behavioral intentions; and (4) emotions mediate the relationship between personality traits and criminal intent. The most consistent finding is the significant impact of anticipatory affect on behavioral intentions—anger and lure are positively, and fear was negatively associated with offending. Moreover, these studies partially support hypotheses 2 and 3. Multiple studies demonstrated the conditional influence of emotions on decision-making. For example, Carmichael and Piquero (2004) and Barnum and Solomon (2019) observed that increased feelings of anger resulting from provocation led participants to overweight benefits and underweight costs associated with assault.

Furthermore, a series of studies addressed the interrelated influences of affect and cognition on crime decisions. For example, Barnum and Solomon (2019) demonstrated that increased anger operates indirectly through perceived benefits to shape intentions to commit assault, while fear operates through perceived costs to reduce intentions to aggress. Relatedly, Pickett et al. (2018) and Roche et al. (2020) demonstrated that the anticipation of being arrested for committing a crime activates negative feelings of fear and thereby reduces the intention to offend. This work highlights the bidirectional interplay of affective and cognitive processes.

Lastly, four studies provide evidence for hypothesis 4. That is, key individual differences in certain predispositions influence whether an individual thinks

"affectively" versus "cognitively" (i.e., system 1 vs system 2 thinking) under certain circumstances. In this way, anticipatory emotions elicited by the context of a crime opportunity can mediate the relationship between various personality traits and the decision to engage in crime (Chatzimike-Levidi & Collard, 2023; van Gelder & de Vries, 2012, 2014, 2016).

Collectively, these studies reinforce the prevailing role of affect in criminal decision-making theory and underscore the importance of capturing emotions associated with specific criminal events. This point is underscored by Leclerc and Lindegaard (2018) who retrospectively examined offenders convicted of sexual assault, querying their emotional experiences in the moments leading up to, during, and after a sexual assault. The authors identified within-subject variation in feelings throughout the crime, such that sexual excitement spiked during the act, while feelings of regret and remorse intensified afterwards. The intensity and duration of these emotions was in part the product of the act itself, but also situational factors like alcohol consumption and relationship to the victim.

Understanding the discrepancies

The current state of criminological research on affect and cognition in criminal decision-making suggests two things. First, studies have operationalized state affect loosely and inconsistently, such that theories outside of criminology are needed for conceptual clarity. Second and relatedly are the apparent methodological challenges of studying in-the-moment crime decision-making. While studies using evocation tasks and hypothetical scenarios contribute valuable insights, they tap into qualitatively distinct affective experiences, that each influence behavior differently.

Drawing on appraisal theory and dual process models, Barnum and Solomon (2019) distinguished two sources of emotional influence. Feelings that emerge from ambiguous or unnoticed sources, such as those captured with the first approach, are *incidental* and normatively unrelated to the decision-making environment (Loewenstein & Lerner, 2003; Loewenstein et al., 2001). Rather than yield a clear motivational influence, incidental emotions tend to distort perceptions in an assimilative manner to align with the emotional state. Consequentially, and especially in the context of crime, it is difficult to predict how incidental emotions will affect decision-making and behaviors.

In contrast, *integral* emotions constitute an immediate affective response triggered by perceived or imagined aspects of a *specific situation*. The approach involving anticipatory emotional experiences aims to capture integral influences. These integral emotional inputs exert strong motivational influences because, unlike incidental influences, they arise directly from features of the decision environment, which, in this case, is a crime opportunity. According to appraisal and related theories, the anticipated, goal-oriented motivations influencing decision-making depend on the specific nature of the affective experience, which narrows the focus on expected outcomes (Lerner et al., 2015). For example, consider a situation where anger intensifies after physical provocation—this scenario is more likely to trigger a violent response than feelings of fear. Anger motivates retaliation by emphasizing

the benefits of violence, while fear prompts withdrawal by highlighting the associated risks (Barnum & Solomon, 2019).

Overlooking this distinction has muddied criminological theorizing about emotions, judgments, and behavior. These gaps in our understanding reflect a more fundamental challenge: criminologists have limited ability to directly observe and measure emotional experiences in real-time crime contexts. As noted earlier, both methods of evoking and measuring emotions have distinct limitations. Notably, priming tasks prior to evaluation of a criminal opportunity produce feelings unrelated to the context of the actual crime decision. On the other hand, while hypothetical scenarios attempt to address this limitation by probing situation-specific emotions, this approach suffers from long-noted drawbacks. These include imputation bias based on limited information, a lack of realism, and, most notably for our current discussion, people's inherent difficulty in "predicting" future emotions (see Van Boven & Loewenstein, 2005; Wilson & Gilbert, 2005).[6]

As such, existing research has limited ability to approximate the "real-world" interplay between incidental or integral affect within a crime decision. Consequently, more can be known about the actual conditions under which criminogenic emotional influences manifest and intensify. The remainder of this paper addresses this gap by demonstrating how immersive technology such as VR combines strengths from the alternative approaches above to advance knowledge.

Beyond implicit priming and written scenarios: immersive 360° videos

Immersive 360° virtual scenarios offer several advantages over traditional written vignettes. First, relative to written vignettes, virtual scenarios allow for manipulating, evoking, and capturing emotionally laden aspects of real-world situations (Diniz-Bernardo et al., 2021). Written scenarios have limitations in conveying subtle cues that shape how individuals interpret and respond to violent situations (Ruggiero et al., 2017). As such, virtual scenarios facilitate "presence" or perceptual realism that written scenarios cannot (for an overview on this comparison, see van Gelder, 2023). Furthermore, the inherent ambiguity of a 150-word written scenario allows for idiosyncratic imputation of details by each participant, potentially introducing bias. Virtual scenarios, however, provide a fully controlled and manipulable environment across participants. As such, virtual scenarios can approximate more accurate visceral reactions than their written counterparts, offering a novel approach to better understand how criminogenic emotional experiences shape decisions and behaviors.

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[6] To clarify, anticipatory emotions require the assumption that study participants can effectively predict or forecast how they or others would feel in the future based on their current emotional state and the events likely to occur. Empirical support for this assumption, however, has been mixed suggesting anticipatory emotions and real-life emotions may not be a perfect 1-to-1 correlation. This can result in idiosyncratic heterogeneity across participants.

Van Gelder et al., (2019, 2022) provide initial evidence for immersive technology as a complementary tool for measuring affective experiences akin to those arising in real-world criminal settings. These studies are the final two entries in Table 1. The authors compared data from a virtual and written bar fight scenario. Respondents perceived the virtual scenario as more realistic and capable of eliciting stronger emotional responses. Importantly, participants' sense of "presence" mediated the association between emotions and violent intentions. Notably, this effect was primarily confined to participants who viewed the virtual scenario. This work underscores the potential of immersive technologies like 360° videos in seamlessly integrating the measurement strategy of hypothetical vignettes, capturing situation-specific emotions while also harnessing the capacity to evoke genuine feelings, akin to lab-based priming studies, but in the context of real-world situations. In this way, immersive scenarios offer an ethically sound and promising approach to complement existing paradigms and provide fresh insights into the complex relationship between affect, emotions, and cognition in crime decision-making.

Current study

The current study builds on the work of van Gelder et al., (2019, 2022). Van Gelder and colleagues employed non-experimental scenarios to examine *naturally* occurring level of anger and fear. To further this research, we randomly assigned participants to one of three different virtual scenarios designed to elicit and *manipulate* distinct affective experiences: anger/annoyance, sexual excitement/arousal, and a neutral control condition. This methodological approach addresses previously unexplored inquiries, serving as a proof-of-concept exploration of the following questions:

Can immersive 360° scenarios effectively induce situational anger and sexual excitement?
Does this method reliably target *specific* emotions? In particular, does it amplify anger without concurrently escalating fear?
To what extent do 360° videos induce within-subject changes in affective experiences?

Method

Sample

Given the nature of the virtual scenarios described below, our target demographic was young adult males proficient in German. Participants were recruited in the city of Freiburg, Germany using flyers at local universities, bars, and restaurants. The flyer provided detailed information about the project, compensation, and included a QR code that linked to the project email for inquiries. Following this, research assistants contacted interested individuals and initiated prescreening. Screening

parameters included sex, German language proficiency, as well as epilepsy or seizure tendencies, which both contraindicate use of 360° videos and other VR technologies (van Gelder et al., 2019). Participants were compensated 10€ for approximately 30-min of their time. Approval was obtained from the Ethics Council of the Max Planck Society (application number 2021_37).

A total of 104 male individuals took part in the study. We recruited participants ranging from 18 to 30 years old. This age range is particularly reflective of persons encountered in bar and pub environments. After excluding three participants due to technical problems during data collection, our ultimate sample consisted of 101 individuals, each providing comprehensive data on our primary dependent variables. Using G*Power, we determined that this final sample size is sufficient to detect a minimum effect size of $f = 0.31$ with 80% statistical power across the three experimental groups.

Virtual environment and 360° video scenarios

The goal of the current study is to assess the efficacy of virtual simulations for evoking and manipulating real-life, situational emotions and motivations inherent to crime decisions. To achieve this, we use 360° video technology to construct an immersive virtual environment (VE), portraying emotion-laden scenarios involving opportunities for violence (see van Gelder et al., 2019). The VE is set in an Irish Pub, chosen for its worldwide prevalence and consistent features. Professional actors, along with a director and production company, were employed to recreate a range of lifelike scenarios commonly encountered in barroom settings (see van Gelder et al., 2023 for details about the scenario set and development).[7] To create the full 360° environment, two segments were independently filmed and seamlessly stitched together in post-production. The first segment covers approximately 220° of the sphere, while the second covers about 140°. This setup ensures that participants, viewing the scenario in virtual reality goggles, can seamlessly experience the full 360° environment throughout each scenario. The specific segments used in the current study are part of the larger MAXLab_ABISS (Aggression and Bystander Intervention Scenario Set) project conducted at MAXLab, a facility dedicated to VR-based behavioral and social science research (https://csl.mpg.de/en/maxlab).[8]

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[7] All scenario components were filmed in German from the participants' point-of-view (POV) positioned at the bar using a RED Helium camera with an 8 K-sensor in combination with an Entaniya M12 280 fisheye lens, which has a circular field of view of 280°.

[8] MAXLab_ABISS was developed to study a broad set of research questions relating to aggression and bystander invention or guardianship, with a specific focus on how emotions, such as anger and fear, and visceral drive states, such as excitement and arousal, influence judgments and subsequent behavior. The scenario set is structured in modular fashion in that its components can be combined in different ways to allow for different factorial research designs. Full scenarios consist of three consecutive components. There are two versions of an introduction, five versions for the emotion evocation, and two main scenario versions. This results in a total of 20 (= 2 × 5 × 2) possible complete scenario configurations. The current study uses three of the five emotion evocation segments. All scenario materials are available for research purposes. See van Gelder et al. (2023) for more information about the motivation, creation and application of MAXLab_ABISS and how to obtain it.

The current study uses the three video segments to evoke emotions from MAX-Lab_ABISS, each about 2 min long. One condition is designed to elicit anger/annoyance, a second-target sexual arousal/excitement, whereas the final condition is emotionally neutral. Each evocation segment begins with a 20-s exterior shot of the pub, featuring text on the door that provides context and reasons for the participants' presence at the bar.[9] Importantly, the prompt specifies to viewers they are alone, without any friends or acquaintances, in the virtual barroom, as they experience the events depicted in the scenario. This serves to minimize potential confounding factors associated with the presence of friends. Following the written prompt, the scene transitions to black and subsequently reopens inside the bar. Here, the participant (POV) is positioned at the center of the bar, observing standard barroom activity—such as the bartender serving drinks, and patrons drinking and talking—during the initial 45 s of the scenario. This familiarizes participants with the environment and promotes immersion in the scenario (see van Gelder, 2023; van Gelder et al., 2019; 2022). Following this immersion period, one of three evocation segments seamlessly begins.

In the anger evocation condition, a male patron approaches the bar to order drinks in a loud and obnoxious manner. The patron, acting as the "antagonist," acknowledges the POV and proceeds to engage the participant with taunts and provocations. The interaction culminates with the antagonist burping in the face of the POV before returning to his table. The antagonist's behavior was scripted and filmed to induce anger and annoyance without causing excessive intimidation, which could also trigger fear.

In the arousal segment, an attractive female in a short black dress approaches the bar to order a drink. She acknowledges the POV, initiates eye contact, engages in flirtatious gestures, and informs the bartender that the POV can charge his next beer to her "birthday tab."[10] This subtle nuance was utilized as an indicator of interest on behalf of the woman. Figure 1 displays screenshots from the viewer's POV for the anger and arousal conditions, capturing the moment when either the antagonist or attractive woman initiates interaction. English transcripts for the anger and arousal conditions are included in the Appendix.[11] And while the neutral condition is a similar length to the anger and arousal conditions, nothing of significance occurs.

Procedure

In the current study, participants were randomly assigned to one of three experimental conditions (see Fig. 2). Data were collected during the spring of 2022 at

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[9] The text on the door reads (English translation): "Imagine the following: You are going to a concert with a group of your friends to see one of your favorite bands, and you are looking forward to it. You arrive at the meeting place too early and decide to go to a bar to wait for your friends inside because it's cold outside. You will automatically enter the bar shortly.".

[10] It is important to clarify that the woman does not directly offer the POV a drink, which could inadvertently evoke unintended feelings such as nervousness or intimidation.

[11] Low resolution video links to view the anger and arousal evocation segments from the participant POV and accompanying English transcript can be found in the supplemental material.

Fig. 1 Screen shots of participant POV for anger and arousal conditions. *Note*: Screenshots taken from POV of participant. Participants in the control condition see the same VE but are not engaged by any of the bar patrons

MAXLab Freiburg, the research lab of the Max Planck Institute for the Study of Crime, Security and Law. Upon arrival, participants submitted valid COVID-19 vaccination records and/or negative test results.[12] Following this, a brief introduction and informed consent were provided. After consenting, participants proceeded to a cubicle to complete an initial onboarding survey, which included baseline emotions—i.e., baseline emotions were captured *prior* to participants entering the VE and learning any details about the scenario. Following the initial survey, participants

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[12] During data collection, Freiburg was experiencing strict COVID-19 restrictions in public spaces, including stores, workplaces, and public transit. Proof of either an up-to-date vaccine or a negative test within the past 24-h and medical masks were compulsory.
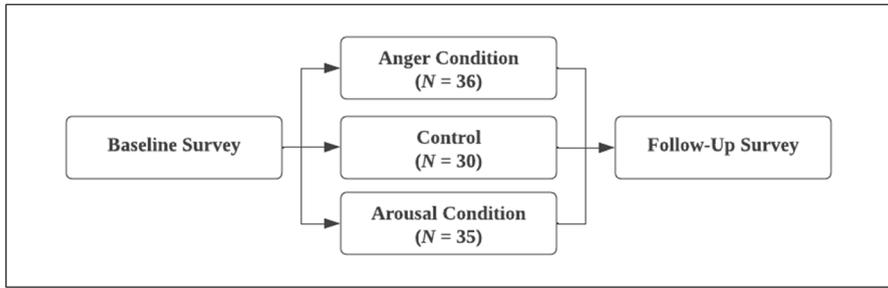
Fig. 2 Experimental design. *Notes*: Randomization was achieved using a random-number generator prior to recruitment. Participants rated nine emotions and feelings directly in the VE with an eye gaze feature immediately following the respective scenario

were positioned at a table with a height equivalent to the bar featured in the VE. This "bar prop" was utilized to help participants with their orientation in the VE. Next, participants underwent onboarding, which entailed practice survey questions to acclimate to the eye-gaze function needed to respond to survey items in VR, as well as a visual/audio task to acquaint themselves with spatial audio and navigation within the 360° environment.

At this point, the research assistant exited the room to ensure participant privacy. Participants initiated their designated scenario by directing their gaze to a button labeled "Los gehts!" [let's start!] within the virtual reality setting. Immediate after the scenario had ended, participants were presented the in-VR survey.

Measures

Baseline emotions Baseline emotions were measured using a strategy adapted from Barnum and Solomon (2019) and van Gelder et al. (2019). Specifically, participants were provided with the question, "How do you feel at this moment?" and then responded to 3 anger related items (disgust, anger, and annoyed), 2 fear items (afraid and nervous), 2 arousal items (sexual arousal and excited), and 2 filler emotions (bored and carefree) presented in random order. Answer categories ranged from (1) "not at all" to (7) "very much."

In-VR emotions To mitigate any "cool-down" period between the virtual experience and reported emotions, participants were queried about their emotional experience directly within the VE immediately following scenario completion using an eye-gaze function (see Mauss & Robinson, 2009). The same nine emotions captured at baseline were assessed, using the identical response scale. Participants were instructed to rate how they currently felt "*at this moment*." This wording choice intentionally circumvents biases introduced by asking participants to rate how they *think* they would feel in the situation. By prompting participants to report their *current* emotional state, we sought to avoid the challenges of emotional forecasting (Loewenstein, 1996).

Recall the anger condition was designed to elicit anger while avoiding fear induction. It is important to acknowledge; however, that both anger and fear are negatively valenced affective states (Lerner & Keltner, 2001). Despite yielding opposite influences on decisions and behavior, prior research consistently shows *positive* correlations between them. In the current data, correlations between the three anger items and two fear items range from $r = 0.188$ (angry and scared) to 0.364 (disgusted and scared). Consequently, potential conceptual overlap between anger- and fear-related items may exist, potentially limiting the ability to detect differences in experimental effects. Thus, a factor analysis was conducted to examine whether individual items represent two distinct emotional constructs as expected. Indeed, results from a principal component factor analysis with a promax rotation suggest two distinct constructs—*anger* λ (*disgust* = 0.830; *anger* = 0.921; *annoyed* = 0.870; fear = 0.166; nervous = 0.133), and *fear* λ (disgust = 0.203; anger = 0.084; annoyed = 0.177; *fear* = 0.847; *nervous* = 0.846). These findings replicate Barnum and Solomon (2019) who used similar measures but with a US sample of adults.

Realism Perceived realism was operationalized using a scale adapted from van Gelder et al. (2018), consisting of five items (e.g., "The situation was realistic" and "I had the idea the scenario was fictitious"). Items were on a 5-point scale ranging from (1) "strongly disagree" to (5) "strongly agree" (reverse-coded; $\alpha = 0.650$).

Female attraction Participants in the arousal condition also answered the additional question, "How attractive do you find the woman in the scenario?" Responses ranged from (1) "not at all attractive" to (5) "very attractive."

Sample characteristics Finally, we include several individual-level characteristics commonly observed in criminal decision-making research, for descriptive purposes and balance assessment post-randomization. Our primary focus, however, remains on experimental outcomes regarding emotions. Nevertheless, we discuss sample characteristics to underscore the appropriateness of the sample for the current analysis.

We measure *age in years*, percent *Native German* (yes = 1), and percent *heterosexual* (yes = 1). We additionally captured three experiential variables related to the materials used in the current experiment. First, respondents reported whether they ever experienced virtual reality, on a 4-point scale ranging from "never" to "6 or more times." *General drinking* was measured with the question, "On how many days in the past week did you consume at least one alcoholic beverage?" Responses ranged from (1) "no days" to (5) "6 to 7 days." Binge or *risky drinking* was measured by asking participants, "In the past month, how many times have you had five or more drinks containing alcohol in one evening?" Responses ranged from (1) "never" to (6) "8 or more times."

Finally, we measured two personality dimensions derived from the 60-item German version of the HEXACO (Ashton & Lee, 2008; de Vries et al., 2009)

that consistently correlate with emotional experiences within criminal opportunities—*emotionality* and *agreeableness* (van Gelder & de Vries, 2012, 2014). These dimensions contain 10 items, each measured on 5-point Likert scales (strongly disagree–strongly agree; $\alpha = 0.653$ for emotionality and 0.822 for agreeableness).[13]

Results

The analysis proceeded in three stages. First, we examined sample characteristics and baseline emotion-measures. Second, we conducted a series of one-way ANOVAs to examine between-group differences in emotions and feelings after the 360° video simulation. Third, we analyzed changes in emotional states pre- and in-VR within participants.

Sample characteristics

Table 2 presents the sample characteristics. On average, participants were 26 years old, primarily native Germans, and predominantly heterosexual.[14] The sample also had limited to moderate prior experience with VR, frequented bars regularly, and consumed significant amounts of alcohol. Mean levels of emotionality and agreeableness align with previous studies, demonstrating the predictive value of these constructs in situational emotional experiences with similar immersive scenarios (e.g., van Gelder et al., 2022). Therefore, the current sample appears well-suited for investigating emotional and affective experiences with the current scenario set.

Table 2 also presents ANOVAs comparing sample characteristics and baseline emotions across experimental groups. No differences were detected for any of these variables across conditions. The individual-level correlates with affective processes underlying crime decision-making were balanced across experimental groups. Furthermore, participants scored close to the lowest scale point on the target emotions and affective states at baseline. Thus, any observed variations in emotions across experimental conditions are interpreted as causal.

Between-group comparisons

Table 3 presents group mean comparisons of in-VR emotions by experimental condition. All comparisons are statistically significant at $\alpha = 0.05$. The final column reports the model effect size (*f*) for each ANOVA, which range from 0.268 (nervous) to 0.708 (sexual arousal). These magnitudes suggest medium to large effects

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[13] See http://hexaco.org/hexaco-inventory for specific wording and coding.

[14] Among the 8 participants who identified as non-heterosexual, three were in the anger condition, two in the arousal condition, and three in the neutral condition. Without these individuals, the results were unchanged.

Table 2 Sample characteristics, baseline emotions, and balance tests ($n = 101$)

Variables	Mean (%)	sd	Min	Max	p-value[a]
Age	25.911	3.089	19	33	0.409
Native German	89.109%	–	0	1	0.765
Heterosexual[b]	92%	–	0	1	0.948
Prior VR experience[d]	2.083	0.981	1	4	0.481
General drinking	2.822	0.963	1	5	0.922
Risky drinking	3.218	1.446	1	6	0.707
Emotionality	2.819	0.540	1.4	4.2	0.436
Agreeableness	3.185	0.663	1.5	4.8	0.618
Baseline emotions[c]					
Disgusted	1.101	0.392	1	4	0.393
Angry	1.424	0.784	1	5	0.181
Annoyed	1.505	1.044	1	7	0.842
Scared	1.212	0.643	1	6	0.541
Nervous	2.455	1.239	1	6	0.244
Sexually aroused	1.343	0.673	1	5	0.623
Excited	4.111	1.384	1	7	0.485
Bored	1.827	1.065	1	5	0.920
Carefree	4.626	1.764	1	7	0.457

[a]One-tailed p-values from ANOVA testing the null hypothesis of equality across experimental conditions

[b]One person did not disclose this information but was not missing on any other items, thus the case was retained. Of the 8 who did not identify as heterosexual, 3 were in the anger condition, 3 were in the arousal condition, and 2 were in the neutral condition. The results remain substantially unchanged without these 9 individuals

[c]Two participants provided no information on baseline emotions but completed the rest of the survey, including post-VE emotions. These subjects were retained. Baseline emotions $n = 99$

[d]Five participants did not answer the question about prior VR experience. The resulting sample size for the analysis of this specific variable is n = 96

(Cohen, 1988), offering initial evidence that VR can induce different types of *situational* emotions, with varying intensities, conducive to crime-related outcomes.

Next, we turn to specific differences across experimental groups, which are presented in Fig. 3. Each group is designated by dark and light green bars. The dark green bar reports the group mean for the in-VR emotions measures, with 95% confidence intervals. In contrast, the light green bar shows the corresponding pre-VE baseline mean for comparison. Most pronounced is the disparity in anger-related emotions between participants in the anger conditions and their counterparts in the control group. Adjusting for differences in sample size (see Hedges & Olkin, 2014), participants in the anger condition reported feelings of disgust, anger, and annoyance in excess of participants in the control group by 1.741, 1.635, and 1.433 standard deviations, respectively, reflecting consistently large effects.

Table 3 Summary statistics and one-way ANOVAs for post-VE emotions

Variables	Full sample		Anger condition		Neutral condition		Arousal condition		p value	Effect size f
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Disturbed	2.584	1.845	4.028	1.765	1.267	0.691	2.229	1.592	***	0.611
Angry	2.267	1.476	3.472	1.521	1.433	0.817	1.743	1.010	***	0.564
Annoyed	2.792	1.835	3.944	1.706	1.633	1.497	2.600	1.538	***	0.514
Scared	2.337	1.551	2.306	1.564	1.700	1.179	2.914	1.634	**	0.369
Nervous	3.376	1.561	3.194	1.451	3.000	1.619	3.886	1.530	*	0.268
Sexually aroused	2.139	1.319	1.306	0.624	1.800	1.215	3.286	1.126	***	0.708
Excited	3.832	1.727	2.806	1.527	4.167	1.683	4.600	1.459	***	0.490
Bored	2.950	1.780	3.111	1.753	3.600	1.850	2.229	1.516	**	0.363
Carefree	4.436	1.627	4.083	1.500	5.300	1.557	4.057	1.571	**	0.359
n	101		36		30		35			

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$. p-values from one-way ANOVAs. Emotions measured on 7-point scale

While these findings are encouraging, our aim was to induce anger-related feelings *without concurrently heightening fear*. Figure 3 demonstrates that this goal is achieved, as there are no significant differences in the mean levels of fear and nervousness between the anger and control conditions. Thus, although overall fear levels increased slightly in-VR for all participants, these differences cannot solely be attributed to the provocations experienced in the anger condition. Interestingly, the disparities in fear-related emotions were partly influenced by the arousal condition. In post-experiment debriefings, some males reported a combination of nervousness and excitement when unexpectedly approached by the attractive woman, a topic we revisit in supplementary analyses.

Turning to arousal-related feelings, a significant difference in group-mean sexual arousal was observed between the arousal condition and control group. Feelings of arousal among participants in the arousal condition were 1.3 standard deviations higher than in the control group. Although in the nominally hypothesized direction, the difference in excitement between groups was not statistically significant at $p < 0.05$. This null finding is likely attributable to the elevated baseline excitement levels, a notion reinforced by the substantial disparity between the arousal and anger conditions (1.2). Notably, excitement levels decreased among participants who viewed the anger segment.

Finally, we observed the highest levels of boredom and feeling carefree in the control group. Additionally, the control group exhibited significantly more boredom than the arousal group did, while control respondents were significantly more likely to report feeling carefree than in both evocation conditions at $\alpha = 0.05$. Overall, between-group comparisons show that the 360° video scenarios can elicit and manipulate *specific situational* feelings and emotions. Next, we explore potential within-subject emotional changes induced by the immersive experience.
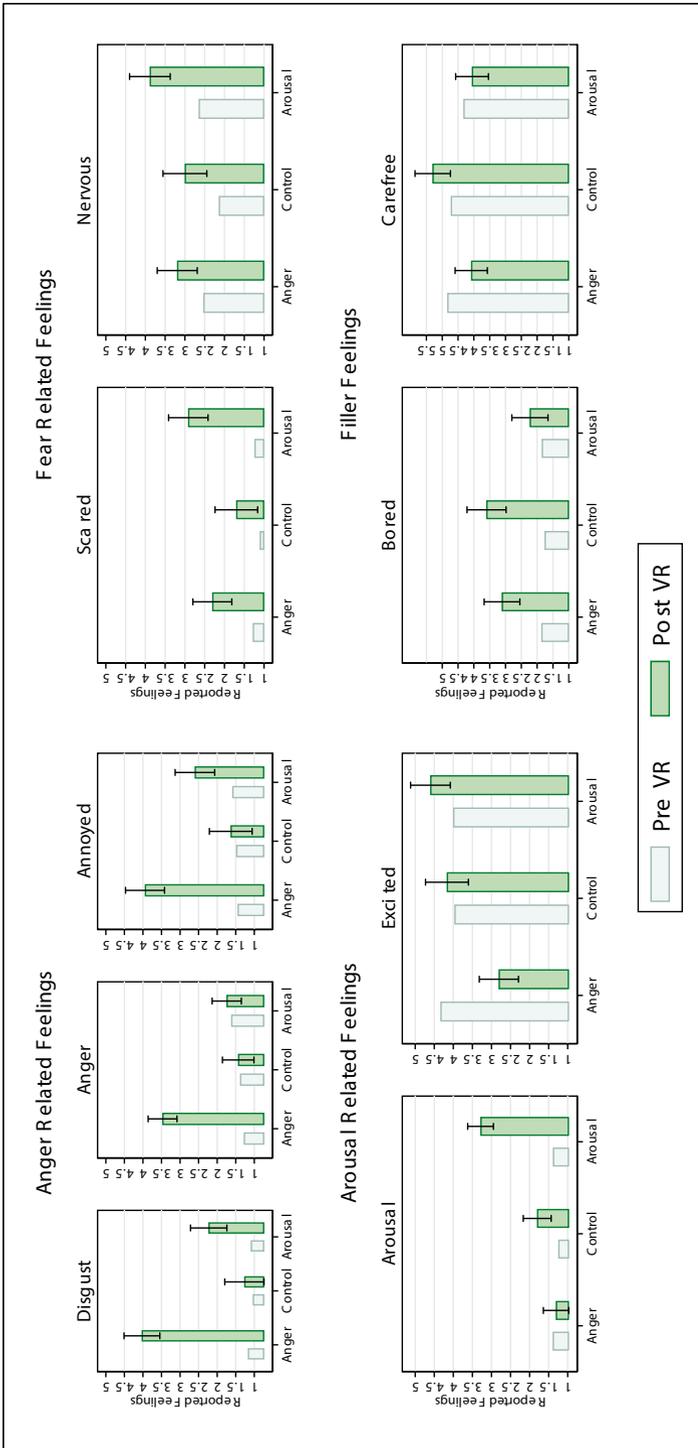
Fig. 3 Between group comparisons of reported feelings by experimental conditions ($n=101$). *Notes*: Emotions measured on a 7-point scale. Graphs were truncated for ease of interpretation

Within-subject analyses

For each emotion, we created a variable capturing the difference in levels before and after VR: $\Delta_{emotion} = Emotion_{vr} - Emotion_{baseline}$. Subsequently, we conducted a series of ANOVAs testing the null hypothesis of no difference in within-subject change across experimental conditions.[15] All differences were statistically discernable at $\alpha = 0.05$, except for the average change in nervousness ($p = 0.27$). The largest effect size was observed for the change in anger ($d = 1.28$).

Figure 4 illustrates the average within-subject changes across experimental conditions. In line with the between-group analyses, changes in anger-related emotions were substantial and significantly greater than in the control and arousal conditions. From baseline to in-VR measurement, disgust, anger, and annoyance increased by an average of 2.5 points on a 7-point scale, reflecting a 36% increase, with the most significant change observed in disgust ($+2.9$). Comparatively, changes in fear-related items were minor and did not attain statistical significance within the anger and control conditions. Notably, the only significant change in fear-related feelings occurred between participants in the arousal condition and the control group.

We also observed significant within-subject changes for participants in the arousal condition. On average, participants in the anger condition experienced a decrease of 0.90 standard deviations in excitement between the baseline and in-VR measures. Conversely, those in the arousal condition exhibited an *increase* of 2.1 standard deviations in feelings of sexual arousal compared to their baseline. Both changes were significantly different from each other and from the control group. These findings emphasize the effectiveness of 360° videos in not only eliciting emotions but also manipulating them in real-time.

Finally, it is important to acknowledge that emotions were measured on a scale ranging from 1 to 7, with a substantial proportion of respondents reporting baseline levels of 1. This raised the possibility of "boundary effects" because the minimum response can only increase or remain unchanged. To examine this, we generated paired-coordinate plots of each respondent's "change" from baseline to in-VR for each emotion by experimental condition.[16] Figure 5 reinforces that the within-subject findings reflect meaningful changes in emotions, rather than boundary effects. For example, even with mid-level baseline estimates, most participants in the anger condition still increased in feelings of anger in-VR. This pattern was also reflected in arousal-related feelings such that participants in the arousal condition experienced increased arousal whereas those in the anger condition experienced decreased arousal.

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[15] As a robustness check, we estimated within-subject change using the *-mixed-* command in Stata and received identical results. We present the difference score estimates here for ease of interpretation.

[16] Because of the consistency in the anger and arousal items in both the between- and within-subject analyses, for clarity of presentation, we average the three anger and two arousal measures for purposes of Fig. 5.
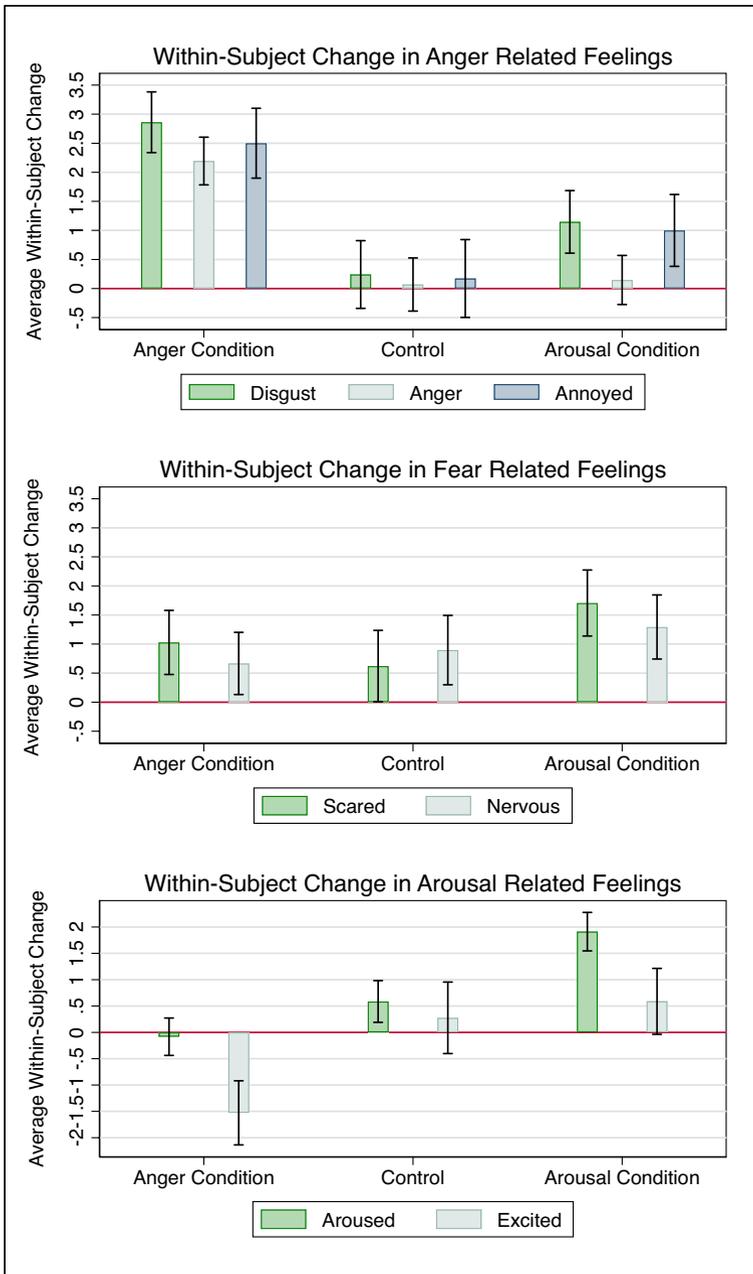
Fig. 4 Average within-subject change in emotions by experimental condition
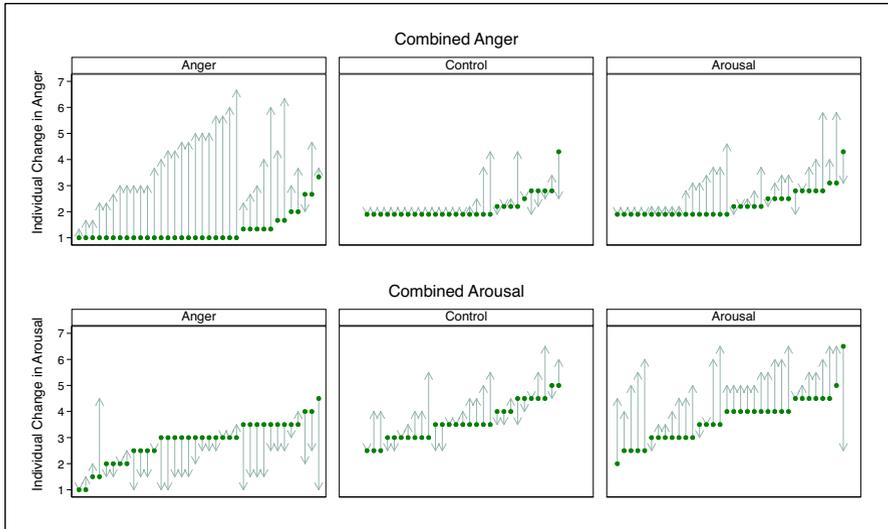
Fig. 5 Paired-Coordinate plots presenting individual change in anger and arousal by experimental conditions ($n = 99$). *Notes*: The three anger-related and 2 arousal-related items were averaged to make the two different emotion measures. Green dots represent each respondent's reported feeling of anger or arousal before the virtual scenario. Light green arrows represent each respondent's change in reported feelings post VR. Two cases were missing on pre-VR emotions

Supplemental analyses

We performed two supplementary analyses addressing the possibility that reported emotions could be artifactual rather than genuine. The analyses suggest this is not the case. First, participants reported that the immersive scenarios were highly realistic ($\overline{X} = 4/5$), in line with other studies using similar methods (e.g., van Gelder et al., 2018, 2019). Although realism varied across conditions, the average for each group is consistent with prior research, as shown in Fig. 6.

We also measured the perceived attractiveness of the woman in the arousal condition among the males in that group. Generally, participants considered the woman highly attractive ($\overline{X} = 4.3/5$). Importantly, perceived attractiveness correlated with emotional experiences in a commonsensical way. As shown in Fig. 7, attraction is negatively correlated with all three anger-related items and positively correlated with the two arousal-related items. The strongest association is between attraction and sexual arousal ($r = 0.453$). Furthermore, attraction is positively related to the two fear-based items, confirming what we learned in post-experiment debriefing.
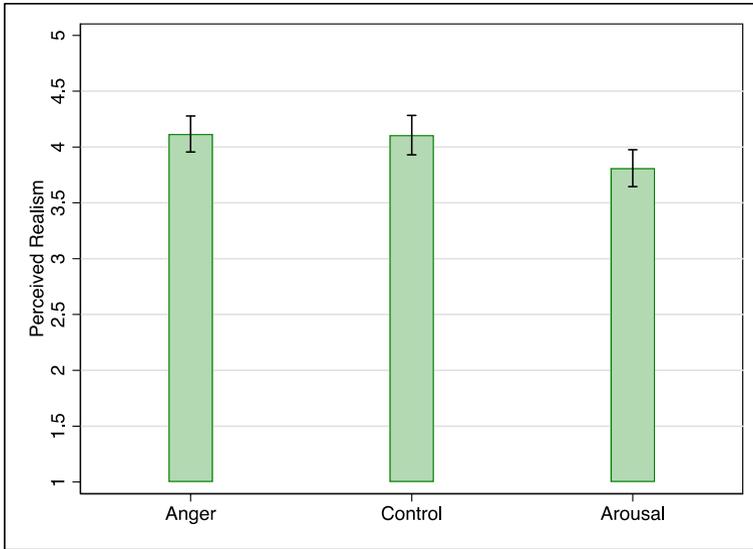
Notes: One participant was missing on all five realism items. As such the resulting sample size for the realism analysis is n =100.

Fig. 6 Perceived realism by experimental conditions
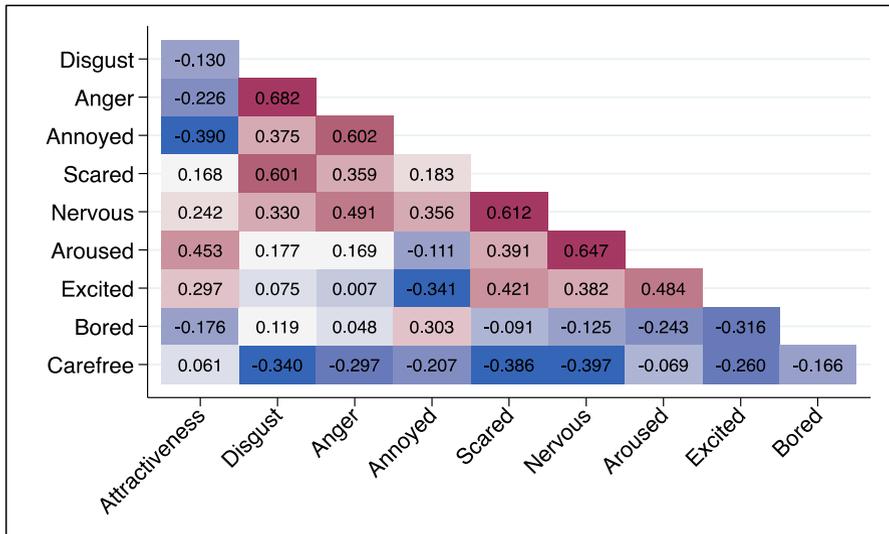
Fig. 7 Bivariate correlations between perceived female attractiveness and post-virtual scenario emotions. *Notes*: The first eight participants in the arousal condition did not have a chance to answer the attractiveness question due to a survey error. After the error was fixed, each of the remaining 27 participants in the experimental group answered the question. All 35 participants are similar on sample characteristics and emotional experiences, suggesting the missing cases did not affect the reported results

Discussion

The role of affect and emotions in criminal decision-making continues to garner interest; yet, ethical and methodological limitations have led to inconsistent findings and constrained theoretical progress, particularly relative to recent advancements in other disciplines. The current study addressed this disparity through two primary objectives. First, our focused literature review revealed inconsistencies across studies: (1) in the measurement and manipulation of affective states and emotions and (2) regarding the distinction between incidental and integral affect. Second, we introduced and tested an immersive 360° video scenario approach that safely manipulates targeted emotional experiences within environments reflective of crime opportunities. Importantly, this approach is well suited to bridge the two avenues of affective criminal decision-making research, effectively eliciting genuine feelings akin to lab-based evocation studies, facilitating the assessment of decision-making processes in a "hot state," and, in line with hypothetical vignette studies, measure emotional and affective states directly related to the immediate situation.

To refine theories of affect, criminologists should continue to leverage perspectives that integrate affective and cognitive processes, such as appraisal theory (Lerner & Keltner, 2000, 2001), "hot/cold" dual process models (Metcalfe & Mischel, 1999; van Gelder, 2013), and risk as feelings (Loewenstein et al., 2001; Slovic et al., 2013). These approaches particularly underscore the influence of integral emotions connected to a specific situation. In appraisal theory, for example, integral emotions help shape decision-making and behaviors *contemporaneously*. The fear of flying prompting someone to drive and thereby elevating their mortality risk reflects this.

Since crime opportunities often evoke intense emotional reactions, these perspectives lead to testable hypotheses on how emotions shape decisions related to crime outcomes. Consider the impact of anger and fear in appraisal theory. Although both emotions have strong motivational properties, they influence decisions and behaviors differently (Barnum & Solomon, 2019). When an individual experiences anger, it often accompanies a heightened sense of certainty and control, diminishing the perception of risk or even obscuring it entirely. Conversely, fear is typically linked to feelings of uncertainty and a sense of limited control, resulting in an overestimation of risk. And while certain emotions like anger and fear are conceivably linked to violent and aggressive outcomes, less clear is how specific emotional states lead to specific behaviors and under what conditions. Here, immersive 360° scenarios and similar approaches can help unpack the "black box" of crime decision-making by immersing participants in a wide range of situations conducive to numerous criminal and analogous behaviors (e.g., Wright et al., 1996). The importance of continuing this research is highlighted by Jacobs and Cherbonneau's (2017) work on nerve management, in which they found auto thieves engaged in a number of tactics like self-medication to mitigate the "fear of offending," suggesting a complex relationship between specific affective states and certain behaviors.

Immersive technologies like the 360° scenario method used here can also explore "carryover effects" in crime decision-making. Recall that incidental

emotions, stemming from external factors unrelated to the immediate situation, can spill over between contexts and interact with integral emotions (Keltner & Lerner, 2010). In this way, emotions from one situation can influence how individuals process emotional stimuli in another. For instance, an individual upset about an unrelated event, like job loss, might experience heightened integral emotional reactions to provocation because of a narrowed cognitive focus. Closely related is the social psychological phenomenon of triggered displaced aggression (e.g., Bushman et al., 2005; Miller et al., 2003). Researchers could integrate pre-evocation methodology with virtual scenarios to explore whether rumination about previous negative experiences amplifies or even displaces situational emotions during a virtual scenario.

For further insights, subjective emotional experiences can be supplemented with physiological data. VR goggles can be outfitted to capture ancillary movements such as eye-tracking, reaction times, and pupil dilation, providing objective metrics to identify distinct decision-making patterns and underlying sources of emotional experiences (e.g., Porcelli & Delgado, 2017). Moreover, researchers can investigate cardiovascular, salivary, and neurological biomarkers in real-time by monitoring physiological responses to lifelike criminogenic stimuli. This approach may reveal insights not captured by traditional survey instruments (see Diniz-Bernardo et al., 2021).

Importantly the implications of 360° videos and related approaches are not confined to rational choice and other psychologically oriented criminological scholarship. They extend broader than this. As Nagin (2007) observed, the results of studies manipulating affective states "have profound implications for how criminology goes about testing theories, whether they have an emotional dimension or not. For example, tests of wide-ranging theories often rely on survey data in which people respond in a "cool," non-aroused state. Their responses are then associated with self-reports or administrative reports of crime." Responses in a cool state to various crime relevant considerations, such as moral judgments and social attachments, "may provide very poor measurements of that factor in the aroused emotional states that commonly accompany criminal behavior (p. 266)."

Thus, immersive technology can be used to investigate strain theories by immersing participants in stress-inducing virtual environments and manipulating strain intensity and duration. This can provide insight on real-time physiological responses, coping mechanisms, and subsequent crime outcomes (see, e.g., Jönsson et al., 2010; Wallergård et al., 2011). Virtual simulations may also be useful for investigating criminogenic peer processes such as peer pressure. Thomas and Nguyen (2022) found that study participants responding to written vignettes reported a greater willingness to engage in deviance when the social consequences were framed as status losses rather than status gains (see also Barnum & Pogarsky, 2022). This suggests the negative emotionality associated with status loss among peers can perpetuate offending. Similar immersive scenarios would be useful where positive and negative peer interactions are manipulated. VR and other immersive platforms can also help refine discourse on self-control, by fleshing out emotionally laden aspects such as depletion and future orientation (e.g., Muraven et al., 2006; van Gelder et al., 2015). Finally, virtual environments and

360° video simulations can be leveraged to assess the deterrent effect of various environmental interventions highlighted in the situational crime prevention paradigm (see, e.g., van Sintemaartensdijk et al., 2021).

There are various policy implications from virtual techniques in criminological research as well. For instance, police work can be chaotic and uncertain, with emotions likely to influence officers' use of force, assessment of risk, and interactions with the public. Kleider and colleagues (2010) found that adverse emotions can counteract an officer's training and increase errors in judgment (see also Abernethy & Cox, 1994; Berking et al., 2010). Virtual simulations can recreate dynamic, emotionally charged encounters, allowing researchers to investigate the role of situationally induced emotions. Virtual environments provide realistic yet safe training environments, enabling officers to practice split-second decision-making in high-stress circumstances. (e.g., Morley et al., 2021).

Immersive methods are potentially applicable to other criminal justice decision-makers as well, including legal professionals, correctional and probation officers, and counselors. These individuals also face time-sensitive, high-stakes decisions as part of their regular responsibilities (Bielen et al., 2021; Salmanowitz, 2016). For example, virtual techniques can also be directed toward jury members and witnesses, to uncover phenomena that are otherwise challenging to detect, potentially revealing biases that can influence decisions and perpetuate injustice (e.g., Reichherzer et al., 2022).

Finally, research might probe the effectiveness of 360° scenarios and comparable methods for reintegration purposes. Juveniles and adults with involvement in the criminal justice system, preparing to reintegrate into society, undoubtedly confront stress-inducing situations, such as entering a new school or seeking employment. Virtual simulations offer a valuable tool for recreating these situations, enabling individuals to practice and hone their life skills (see, e.g., Seinfeld et al., 2018). Scholars and practitioners could integrate the immersive experience with programs like "Becoming a Man," merging cognitive-behavioral insights to impart slow and thoughtful reflection (Heller et al., 2017). This approach aims to enhance prosocial behavior and foster future-oriented thinking (see, e.g., van Gelder et al., 2015).

This study underscores the ability of immersive scenarios in eliciting and manipulating criminogenic emotions within controlled yet ecologically valid contexts. By being able to evoke affective states, immersive technologies, like 360° video and virtual reality offer a unique platform for refining theory testing to encompass emotional processes prevalent in criminal opportunities. Although immersive simulations do not precisely replicate real-world experiences, our findings suggest that the elicited emotional responses can approximate situational emotions influencing crime-related decisions. We are optimistic about the broader application of immersive technologies in advancing criminological and social science research. The adaptability and versatility of these methods as a dynamic tool hold promise, and as technology evolves, so too will the possibilities for its application.

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Shaina Herman is a post-doctoral researcher in the Department of Criminology at the Max Planck Institute for the Study of Crime, Security and Law in Freiburg, Germany. Her current research focuses on

perceptions, moral evaluations, and attitudes underlying choice processes, particularly in the contexts of criminal and guardian decision-making. She utilizes cutting-edge methodologies, such as virtual reality, for theory testing and advancement.

Timothy C. Barnum is a senior researcher in the Department of Criminology at the Max Planck Institute for the Study of Crime, Security and Law. His current research interests include criminal and guardian decision-making, social influence, and the use of novel methodologies for testing criminological theories.

Paola Emilia Minà holds a master's degree in Psychology and Social Processes and Cognitive Neuroscience from "La Sapienza" University of Rome. She has previously worked as a research assistant at the Max Planck Institute for the Study of Crime, Security and Law and is currently working at the "Io Centro ets" rehabilitation center in Rome. Her ongoing research focuses on exploring neuronal circuits associated with addiction, personality disorders, and criminal behavior.

Peter Wozniak is an expert in virtual reality (VR) and augmented reality (AR). He currently serves as the Lab Director of the recently established MAXLab Freiburg virtual reality research laboratory in the Criminology department of the Max Planck Institute for the Study of Crime, Security, and Law. His focus is on the intersection of VR, AR, and spatial human-computer interaction, exploring innovative avenues at the forefront of technology and immersive experiences.

Jean-Louis van Gelder is Director of the Max Planck Institute for the Study of Crime, Law and Security in Freiburg, Germany, and Full Professor at the Institute for Education and Child Studies, University of Leiden, The Netherlands. His research interests focus on the role of emotions and personality in criminal decision making, the applications of novel technologies such as virtual reality to the study of crime, and the relation between short-term mindsets and criminal behavior.