



Shaping negative attitudes toward mafias through immersive virtual reality

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Abstract

Immersive Virtual Reality (IVR) can transport people to new, artificially generated environments and situations that are otherwise difficult to reproduce due to logistical and ethical constraints. Crucially, IVR has proven extremely effective in shaping attitudes and promoting desirable outcomes. Leveraging this feature, we utilized IVR to counteract the influence of mafias, one of the most detrimental phenomena in our society, by strengthening participants' opposing attitudes and exploring their behavioral intentions. In a between-subject design study, 100 participants were exposed to either a scenario depicting typical mafia-related activities (experimental condition) or a scenario showing non-mafia-related crime (control condition). We recorded participants' explicit and implicit attitudes one week before and immediately after the IVR exposure. Explicit attitudes were measured using the Attitudes towards Italian Mafias Scale, implicit attitudes with an ad-hoc Single Category Implicit Association Test (SC-IAT), and behavioral intentions by asking participants whether they would intervene, report, and testify against the crime witnessed in the virtual scenario. Participants in the experimental condition displayed more negative explicit attitudes towards mafias after experiencing the virtual scenario. However, they were also less certain about testifying against the crime, reflecting the well-known phenomenon of *omertà*, or the law of silence. Our findings confirm IVR as a valuable tool for changing attitudes by providing experiences that individuals might not otherwise encounter. This paves the way for exploring more sophisticated strategies to encourage individual and collective anti-mafia actions.

Keywords Virtual reality · Criminal organization · Mafia · Attitudes · Single category IAT

1 Introduction

Deeply rooted in the history and socio-political fabric of the country, organized crime and -particularly- mafia-like organizations are a scourge in the Italian context. These organizations, henceforth referred to simply as “mafias”, are characterized by a well-structured hierarchy defined by associative bonds, and whose members are expected to follow precise rules and codes of conduct. Mafias use intimidation, threat, and violence to exert control over a given territory by perpetuating crimes, gaining control of economic activities, and influencing electoral processes (Republic of Italy 1982). In Italy, this description applies to distinct organizations, each related to a specific southern region: Cosa Nostra in Sicily, ‘Ndrangheta in Calabria, Camorra in Campania, Sacra Corona Unita in Apulia, and Basilischi in Basilicata (we referred to as *target regions*). As a result, the presence of mafias in these territories is associated with an increased climate of violence, economic losses,

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and a poor reliance on State protection and law enforcement (Allum et al. 2019; Aziani 2022; Daniele and Marani 2011; Lavezzi 2014; Pinotti 2015; Schneider 2018).

Crucially, despite the abuses they endure, local communities rarely question, challenge, or oppose mafias (even if things are changing see Cinotti 2015). This sort of collective passivity is a phenomenon known as the law of silence, or -in Italian- *omertà* (Travaglino et al. 2016), namely a cultural code that prescribes indifference to others' illegal activities. Specifically, the code categorically prohibits cooperating with law enforcement authorities, regardless of whether one participates in, observes or is the victim of a crime (Paoli 2008). Mafias' use of violence, manifested through intimidation, threats and punishments -even deadly ones-, fosters fear of retaliation in individuals, which, combined with a lack of trust in being protected by the State, prevents the subjugated territories from rebelling and thus favoring the law of silence (Giordano et al. 2017; Roberti 2008; Travaglino and Abrams 2019). However, some authors posited other reasons that might also underpin the lack of cooperation with law enforcement authorities: for instance, Travaglino and Abrams (Travaglino and Abrams 2019) suggested that people might develop positive attitudes towards mafias, which in turn lead them to remain silent about their illegal activities. According to the authors, these attitudes stem from the belief -induced by the mafias themselves- that they represent the cultural values of the territories where they operate.

Although its intricate mechanisms have yet to be fully brought to light, *omertà* stands as a major factor that allows mafias to exert their control over their territories. In this light, strengthening adverse attitudes toward mafias might represent a first step to develop new strategies to encourage anti-mafia actions, which will contribute to weaken mafias' power and reduce the detrimental consequences of their presence.

1.1 Virtual reality experiences in shaping attitudes

Among the most interesting applications of new media, immersive virtual reality (IVR) seems well suited to pursue this goal, as it can both capture people's attention (Makransky et al. 2020; Raya et al. 2021) and be effective in shaping their attitudes (Nikolaou et al. 2022). Researchers can indeed create interactive IVR experiences even far apart from users' daily lives, allowing them to be exposed to artificial situations that are processed as really experienced (Schöne et al. 2023). The integration of visual, auditory, and tactile feedback makes the virtual world realistic and immersive, eliciting in the users a sense of presence (Diemer et al. 2015; Wirth et al. 2007), namely the perception of being physically situated within the virtual space, even while being aware

that the environment is artificial (Schubert et al. 2001; Slater and Steed 2000; Slater and Usoh 1993; Slater and Wilbur 1997; Steuer et al. 1995). This sense of total involvement may be the main driver of attitude change (Fox et al. 2014; Schuemie et al. 2001): supporting the media richness theory, which stated that the richer the immersive modes of the medium, the greater its persuasive effect (Daft and Lengel 1986), Nikolaou et al. (2022) found that IVR influences attitudes to a significantly greater extent than non-immersive interventions. In fact, IVR has been used for several attitudinal objects, such as environment, migration processes, inter-group conflicts, and minority groups (Nikolaou et al. 2022). For example, Fonseca and Kraus (2016) found that participants expressed a desire to reduce meat consumption following an IVR experience in which its negative impact on climate change was shown. Aitamurto et al. (2018) found an increase in participants' personal responsibility regarding gender inequality at work after taking the perspective of a female engineer who was not being recognized for her merits. Herrera et al. (2018) observed that participants who assumed the role of a homeless person had more positive and lasting attitudes toward homelessness. In the same vein, experiencing a virtual migration as a refugee crossing the Mediterranean in search of a better life led participants to donate more for Syrian refugees (Kim 2019) and a positive attitude toward human rights (Bujčić et al. 2020). Lastly -and particularly important for the present work- McEvoy et al. (2016) studied IVR exposure as a bullying prevention tool, comparing immersive with non-immersive conditions. Contrary to the authors' expectations, the IVR condition did not affect attitudes toward bullying or bystander intention to intervene. However, a follow-up qualitative focus group study noted a lack of photorealism and a delay in voice and body language in the virtual agents that may have made the IVR condition not effective.

In light of this evidence, in this study we explored the effect of IVR in shaping attitudes towards mafias. We measured explicit and implicit attitudes pre and post IVR exposure to a virtual scenario representing a typical mafia situation, i.e., extortion (in Italian *pizzo*) or a control scenario representing a violent situation but not related to mafia, i.e., a quarrel between two drunk men and a bartender. We hypothesized that the extortion scenario would lead to more negative attitudes towards mafias, at both explicit and implicit levels, while also exploring whether these effects varied as a function of sociodemographic factors, such as participants' gender or region of origin. Moreover, we explored whether the two scenarios would lead participants to express different behavioral intentions of reporting, intervening in and testifying against the crime they witnessed.

2 Methods

2.1 Participants

An a priori power analysis suggested recruiting 100 healthy participants that we randomly assigned to an experimental ($N=50$, 25 females and 25 males) and a control condition ($N=50$, 25 females and 25 males). The two groups did not differ in any socio-demographic dimension investigated (see Supplementary Materials).

2.2 Materials

The IVR scenarios were visually identical in the two conditions. Participants were located in a bar and seated at a small table in the far-right corner so that they had a full view of the scene. A few meters ahead was the bar counter, behind which they could see a bartender working. There were no other customers in the bar. After a few moments, two men entered the bar, approached the bar counter, and began to argue with the bartender, to the point of drawing a gun and threatening him with the weapon (Fig. 1A–E). What differentiated the

two scenarios were the dialogues: in the experimental scenario the dialogue script concerned an explicit act of extortion, while in the control scenario it concerned an antisocial conduct, not specifically related to mafias, such as a quarrel between two drunk men and a bartender. The virtual experience lasted approximately two minutes. All technical details for the virtual environment implementation and character animations are in Supplementary Materials, including an illustrative video.

2.3 Measures

- Explicit attitude: we used our Attitudes towards Italian Mafias Scale (AIMS Schepisi et al. 2023), consisting of 18 items to which participants could answer with a 7-point Likert scale.
- Implicit attitudes: we built an *ad-hoc* Single Category Implicit Association Test (SC-IAT Karpinski and Steinman 2006), through the online experiment builder Psyt toolkit (Stoet 2010, 2017). For the target category “Mafia” we used 7 items (‘Ndrangheta, Camorra, Cosa

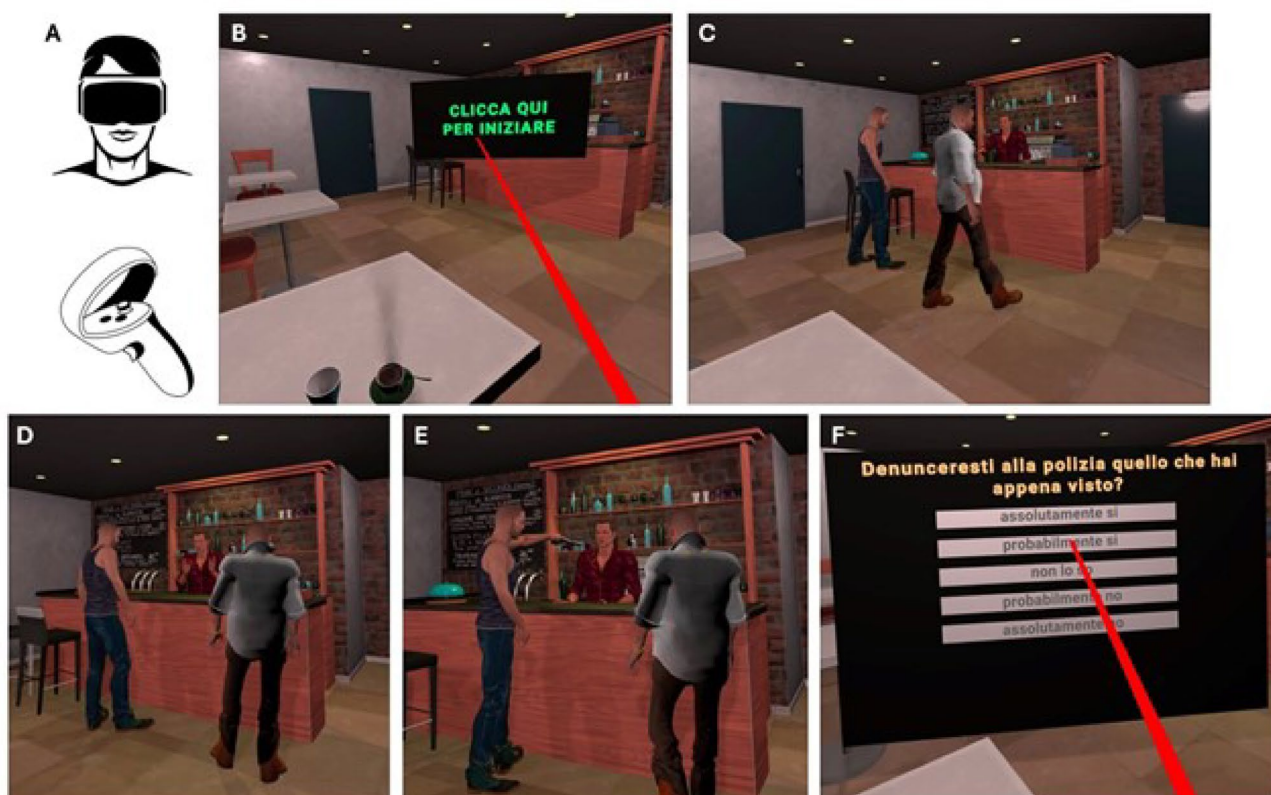


Fig. 1 The IVR scenario: the experimental and the control scenario were visually identical. **A** Icons representing the head-mounted display (HMD) and meta quest controller used to observe and interact with the environment. **B** Participant's point of view: the participants sat at a small table in the far-right corner so that they had a full view of the scene. The red line represented the raycast that pointed to the

start panel. **C** The two men approaching the bar counter, **D** arguing with the bartender, **E** to the point of drawing a gun and threatening him with the weapon. **F** Behavioral intentions measure: Q1 item example “Would you report what you just saw to the police?”; Possible answers were “absolutely yes” “probably yes” “don’t know”, “probably no” “absolutely no”

Nostra, Pizzo, Extortion, Boss, Omertà) that we previously selected in a pilot study (see Supplementary Materials for the detailed structure). We also used 7 items for the attribute category “Positive” (Joy, Love, Peace, Pleasure, Happiness, Fun, Laughter,) and 7 items for the attribute category “Negative” (Sadness, Sorrow, Evil, War, Hate, Failure, Cruelty). The total number of trials was 144+48 practice trials divided into four blocks. Following Karpinski and Steinman (2006), each trial stayed on the screen for 1500 ms maximum and was separated by 350 ms inter-trial interval. We counterbalanced the temporal order of the two combined tasks and the sides (top left, top right) initially assigned to the mafia category.

- Behavioral intentions: we investigated participants’ intentions to report, testify against and intervene in the crime they witnessed with the following questions:
- (Q1) Would you *report* what you just saw to the police?
- (Q2) Would you *testify* in a trial against those two people?
- (Q3) If you could have, would you have *intervened* to interrupt the argument?
- Possible answers were “absolutely yes” “probably yes” “don’t know”, “probably no” “absolutely no” (Fig. 1F).

Witness: we checked whether participants have witnessed a similar situation in the past with the following question: “Have you ever witnessed such an event in the past?”

- Sense of Presence: we used three questions inspired by the SUS questionnaire (Usuh et al. 2000), consisting of 3 items to which participants could answer with a 7-point Likert scale:
- (P1) To what extent were there times during the experience when the virtual environment was the reality for you?
- (P2) When you think back to the experience, do you think of the virtual environment more as images that you saw or more as somewhere that you visited?
- (P3) During the time of your experience, did you often think to yourself that you were actually in the virtual environment?

Finally, we recorded participants’ age, gender, region of origin, region of residence, education, and income.

2.4 Procedure

The experiment was divided into two sessions. For the first session, we sent participants an e-mail with the link to the Psytoolkit online platform where they read the informed consent and gave their approval to participate. Then, they

were asked to fill in the SC-IAT and the AIMS. We counterbalanced the order of presentation of the two tasks across participants.

For the second session, which took place one week after the first, we asked participants to come to the lab. Upon arrival, participants wore the HMD through which they were immersed in the virtual environment displaying either the experimental or the control scenario, according to which group they were randomly assigned. At the end of the IVR exposure, which lasted approximately two minutes, participants were presented in the HMD with the three behavioral intentions questions (Q1–Q3) and the question about their witnessing past experiences. Then, they could remove the HMD from their head and proceed to fill in the SC-IAT, the AIMS, and the sense of presence items.

At the end of the experiment, we debriefed participants and answered their questions.

The experimental procedure lasted about 15 min for the first session and 20 for the second, for which participants received a total compensation of 10 euros.

The present research was approved by the Sapienza University of Rome ethics committee (Prot. n. 0002192) and was carried out in accordance with the ethical standards of the 2013 Declaration of Helsinki.

3 Analyses and results

We performed frequentist and Bayesian analyses by using R (R Core Team 2023) and Jasp software (JASP Team 2024). See Data availability statement for scripts and outputs. We focused specifically on comparing the magnitude of change between the two experimental conditions across time.

3.1 AIMS

The eligible sample consisted of 95 participants (experimental condition N=48; control condition N=47; due to technical issues we could not match pre-post data for 5 participants, which for this reason were discarded from the analysis). The two conditions did not differ in AIMS pre-exposure to IVR [$t(90.44)=0.72$, $p=0.48$]. We calculated the $AIMS\Delta$ score by subtracting the pre-exposure AIMS score from the after-exposure AIMS score. This score met the normality ($W=0.99$, $p=0.64$) and homogeneity of variance assumptions [$F(1,93)=0.07$, $p=0.79$]. Thus, we performed an independent samples t-test with $AIMS\Delta$ scores as the dependent variable and *Condition* (experimental vs. control) as the independent variable, using a one-tailed test to evaluate our directional hypothesis that the experimental group would show a greater change compared to the control group. We found a significant difference between

the two conditions [$t(92.97)=2.40, p=0.01; M_{\text{exp}}=-0.11, SE_{\text{exp}}=0.31; M_{\text{con}}=0.04, SE_{\text{con}}=0.31$], indicating increasing negative attitudes towards mafias after IVR exposure in the experimental compared to the control scenario. We controlled for *Gender* effects and, as purely exploratory analysis, for *Target Regions*. No significant effects were found (see Supplementary Materials).

3.2 SC-IAT

The eligible sample consisted of 94 participants (experimental condition $N=48$; control condition $N=46$). The two conditions did not differ in SC-IAT pre-exposure to IVR score [$t(82.79)=1.11, p=0.27$]. We calculated the SC-IAT Δ scores by subtracting the SC-IAT pre-exposure score from the SC-IAT after-exposure score. This score met the normality ($W=0.10, p=0.98$) and homogeneity of variance assumptions [$F(1,90)=0.23, p=0.64$]. Thus, we performed an independent samples t-test with SC-IAT Δ scores as the dependent variable and *Condition* as the independent variable, using a one-tailed test to evaluate our directional hypothesis that the experimental group would show a greater change compared to the control group. We found no significant difference between the two conditions [$t(89.44)=-0.90, p=0.81$] (Fig. 2), indicating no effect of the experimental scenario on strengthening (or weakening) implicit attitudes against mafias. We controlled for *Gender* effects and, as purely exploratory analysis, for *Target Regions*. No significant effects were found (see Supplementary Materials).

3.3 Bayesian analysis

To test the robustness of our findings we performed the same analyses within a Bayesian framework (Dienes 2019) (see Supplementary Materials for detailed analysis description). Supporting the frequentist approach, analyses on AIMS Δ score revealed moderate evidence in favor of the alternative hypothesis -i.e., more negative score for the experimental condition- with a $BF=3.52$. The evidence remains moderate even when wider priors are used, as shown by the Bayes Factor robustness check (Fig. 3). In the SC-IAT Δ case, we found inconclusive evidence at best with a $BF=0.96$. The robustness check indicated more likely evidence for the null hypothesis both with narrower and wider priors (see Fig. 3).

3.4 Behavioral intentions

The eligible sample consisted of 100 participants (experimental condition $N=50$; control condition $N=50$). Given the ordinal nature of the dependent variable, we performed non-parametric Mann–Whitney tests on intentions to (Q1) report, (Q2) testify against, and (Q3) intervene in the crime witnessed in the two conditions (experimental vs. control). Results revealed no differences in intention to report ($U=1490, p=0.07$) or intervene in ($U=1379, p=0.35$), but a significant difference in intention to testify against ($U=1532, p=0.04$) (Fig. 4), with participants in the experimental condition being less sure about testifying against the crime they witnessed ($Mdn=4, IQR=2$) compared to those in the control condition ($Mdn=4.5, IQR=1$).

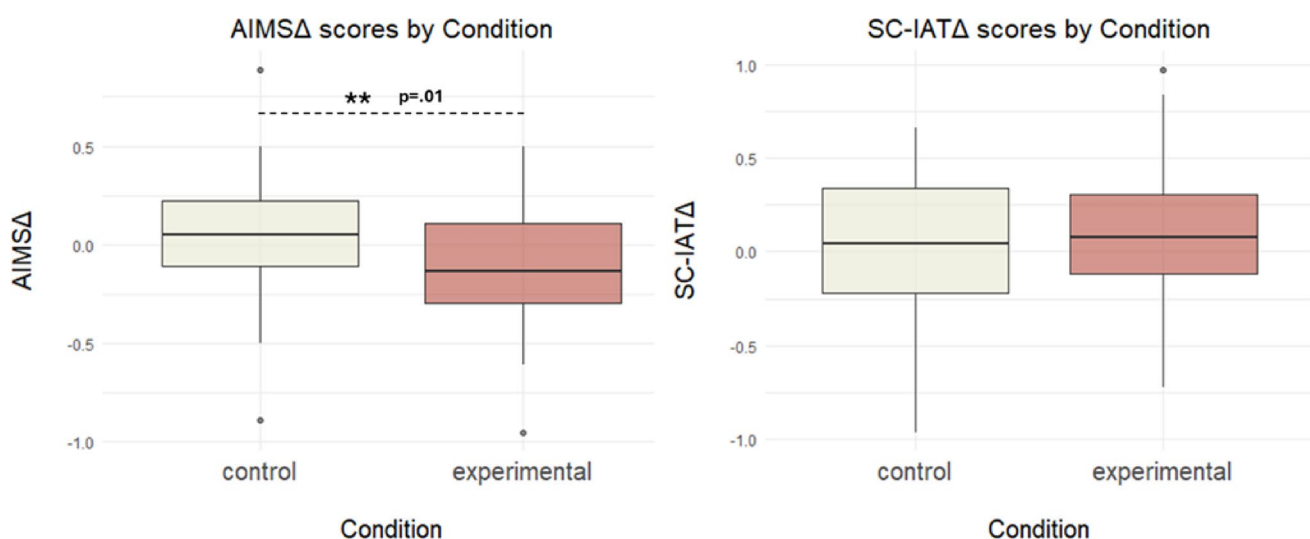


Fig. 2 AIMS Δ (Left side) and SC-IAT Δ (Right side) scores in the experimental and control groups. AIMS Δ lower values indicated more negative explicit attitudes toward mafias. SC-IAT Δ higher values indicated more negative implicit attitudes toward mafias

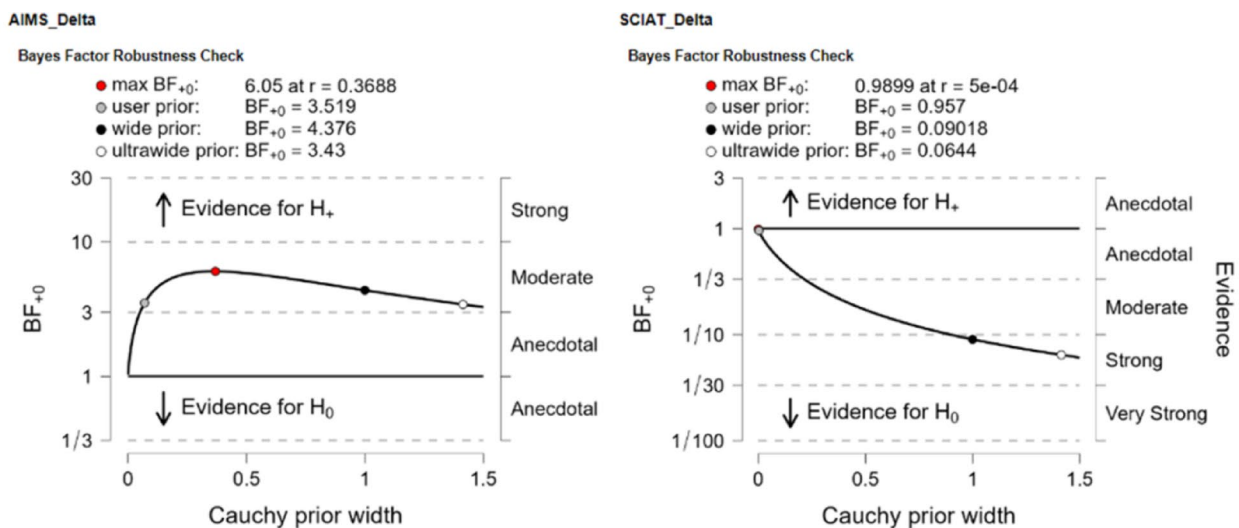
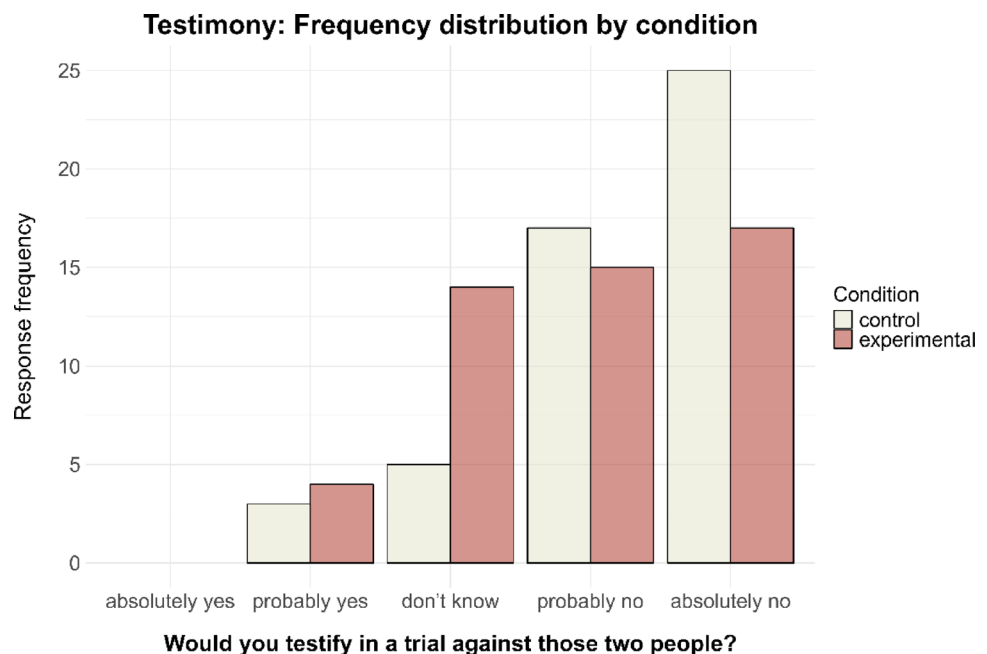


Fig. 3 AIMS Δ bayes factor robustness check (left side) and SC-IAT Δ bayes factor robustness check (right side)

Fig. 4 Intention to testify in a trial against those two people (Q2): frequency distribution by condition (experimental vs control)



3.5 Presence

We performed an independent-samples t-test with *Presence* as the dependent variable and *Condition* as the independent variable. We found no significant difference between the two conditions [$t(94.94) = -1.80, p = 0.08$].

4 Discussion

The present study aimed at investigating the effectiveness of IVR exposure to strengthen anti-mafia attitudes both at the explicit and implicit levels. Among the various forms that

mafia-related actions can take —e.g., corruption, money laundering, and even murder— the extortion scenario was selected in collaboration with the State Police Postal and Communication Department and the Ministry of the Interior. This scenario was deemed the most appropriate for subsequent use by professionals in school-based educational programs on legality, as it allowed us to address a relevant mafia-related dynamic without resorting to more extreme or violent situations. Participants exposed to this virtual scenario depicting a typical mafia situation (i.e., extortion) showed a greater increase in explicit negative attitudes towards mafias compared to those exposed to a control scenario involving violence unrelated to mafia (i.e., quarrel in

a bar). Crucially, both frequentist and Bayesian approaches gave the same results, showing the robustness of our findings on the AIMS.

The results of the SC-IAT were instead not conclusive. It is worth noting, though, that our participants showed a very negative bias toward mafias right from the beginning (see Supplementary Materials for SC-IAT data distributions). Indeed, only three participants presented a SC-IAT score higher than 0 (i.e., IAT's zero point indicating absence of association Greenwald et al. 2021), while all others had scores massively distributed toward the negative side. In this same vein, we speculate that the association between mafias and negative attributes is firmly established, probably due to cultural influences that shape quick cognitive associations (Shepherd 2011) and, for this very reason, may be difficult to strengthen further. At the same time, it may also be that people generally are unfamiliar or not thoroughly aware of mafias' codes of conduct, which may be a reason that prevents them from rationally formulating opinions about the phenomenon. This lack of awareness could explain why people's attitudes change at a more deliberate level after witnessing a mafia scenario. In other words, exposure to specific mafia-related situations can lead to more informed and thoughtful opinions, resulting in a shift of explicit attitudes, which may not have been clearly defined previously. Supporting this thesis, most of our sample stated they have never experienced similar situations. This makes clear the potential of IVR in making people live events that they do not and will never have the opportunity to experience otherwise, making them aware of social phenomena about which they can form opinions, beliefs, and emotions.

Regarding behavioral intentions, we found that participants exposed to the experimental scenario were less sure about testifying against the crime they witnessed compared to those exposed to the control scenario. Conversely, participants in the experimental scenario would report and intervene in the crime they witnessed as much as those exposed to the control scenario would do. We speculate that while testifying in a trial requires one to reveal one's own identity and thus expose oneself to the potential retaliation of the criminals, just reporting the crime may be (wrongly) perceived as safer because anonymous and effortless. Unfortunately, these results perfectly reflect the situation in Italy, where *omertà*, or law of silence, makes organized crime thrive. In a similar vein, both the experimental and the control scenarios represented situations in which intervening could have caused serious harm for the participants. Thus, it is not surprising that they would equally refrain from acting.

Summarizing the results obtained, IVR exposure seemed effective in strengthening explicit negative attitudes toward mafias. However, although the exploratory nature of behavioral intention analyses must be accounted for, attitudes do

not seem to translate into intentions to oppose mafias. Considering the negative pre-exposure scores on both the AIMS and the SC-IAT, it is hardly conceivable that participants' hesitation to testify against crime was due to supportive attitudes toward mafias (Travaglino and Abrams 2019). Rather, it is more likely that fear of retaliation is primarily responsible for their reluctance (Giordano et al. 2017; Roberti 2008; Travaglino and Abrams 2019).

This prompts us to wonder what kind of interventions can be most effective for fostering anti-mafia behaviors. Research in IVR suggests that key factors in attitude change include not only the realism of the virtual simulation, but also social presence, i.e. the sense of being present with others, and self-presence, i.e. the feeling of owning a self-avatar perceived as one's real body (Lee 2004). In our scenario, participants were not embodying any avatar; therefore, we hypothesize that the observed attitude changes may have been driven by the sense of social presence elicited by the virtual agents and their interactions, especially if perceived as personally relevant (Blascovich et al. 2002; Schutte and Stolinović, 2017). Nevertheless, this interpretation remains speculative, as no specific measures were employed to assess the degree of social presence experienced by participants. Addressing this limitation should be a priority for future research. Furthermore, we believe that also fostering and accurately measuring self-presence within this specific scenario could offer a highly promising avenue for promoting virtuous conduct. In fact, recent evidence increasingly shows that perceiving ownership and control over a virtual body can influence both cognition and behavior (Peña et al. 2009; Scattolin et al. 2022; Yee and Bailenson 2007). This has been theorized in the so-called Proteus effect, whereby the appearance of an embodied avatar can affect users' attitudes and behaviors in both virtual and real-world contexts (Banakou et al. 2018; Frisanco et al. 2022, 2024; Gorisse et al. 2023). Therefore, future developments could examine whether owning a virtual body dressed as a judge or magistrate—or resembling a character associated with crime-fighting—might enhance the promotion of anti-mafia behaviors.

Testing variations of the experimental paradigm is essential for identifying the conditions that most effectively foster attitude change and for determining which individuals are most responsive to the intervention. In this study, for instance, we examined whether gender differences might influence how participants reacted to the IVR experience. Although no significant effects emerged at either the implicit or explicit level, this line of inquiry highlights the importance of considering individual characteristics. Understanding which subpopulations are more likely to benefit from IVR exposure remains a key direction for future research, particularly as these efforts should ultimately aim toward

real-world translation, positioning such interventions as tools within educational programs that promote legality and civic responsibility. Although IVR has demonstrated substantial potential in shaping diverse attitudinal domains—including environmental attitudes, perspectives on migration processes, intergroup relations, and perceptions of minority groups (Nikolaou et al. 2022)—its application in everyday contexts remains limited, and objective evidence of its real-world effectiveness is often lacking. To advance in this direction, an important next step of this study is to examine whether the transformative potential of IVR also applies to populations with direct or indirect exposure to mafia-related phenomena. This is particularly relevant given the difficulty of assessing such familiarity through direct questioning, owing to the strong culture of silence that surrounds these issues. Future studies should therefore target communities in which mafia influence is pervasive and State authority comparatively weaker and compare their responses to those from regions where the phenomenon is less pronounced. Indeed, if our findings suggest that individuals with no prior exposure can develop more deliberate and informed attitudes toward mafias through IVR, it is plausible that individuals with first-hand or indirect experience will respond in qualitatively different ways. Capturing these differences may benefit from the inclusion of measures targeting more automatic and instinctive reactions—such as neurophysiological indices—providing a deeper understanding of how different populations experience the same threatening event. Such approaches could inform how to best leverage IVR exposure to promote civic engagement and prosocial behavior, tailoring virtual scenarios to the characteristics of the populations targeted by educational and prevention programs.

5 Conclusion

IVR is highly effective in presenting individuals with new experiences that can shape their opinions and beliefs. This is particularly relevant in fields such as legal education, where capturing young people's attention and encouraging reflection on complex phenomena is essential. Continued advances in this area will be critical for fostering innovative pedagogical approaches and developing civic education initiatives that engage participants on both a cognitive and emotional level.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10055-025-01291-1>.

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Author contributions Frisanco A.: conceptualization (supporting); formal analysis (lead); investigation (lead); methodology (supporting); project administration (lead); writing—original draft (lead); writing—review and editing (equal). Schepisi M.: conceptualization (lead); formal analysis (supporting); methodology (lead); writing—review and editing (equal). Giannini A.M.: funding acquisition (supporting); writing—review and editing (equal). Tieri G.: software (lead); writing—review and editing (equal). Aglioti S.M.: conceptualization (supporting); funding acquisition (lead); project administration (supporting); supervision (lead); resources (lead); writing—review and editing (equal).

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Data availability Supplementary materials, such as datasets, scripts, outputs, stimuli, and illustrative videos are available on the Open Science Framework repository (https://osf.io/n8h37/?view_only=729e95c2c65e4130a2574601cbfd00bd).

Declarations

Conflict of interest The authors declare no conflict of interest.

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