

One format fits all? Sensory sensitivity and AI-generated cyberbullying narratives: a study protocol

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Abstract

Sensory Processing Sensitivity (SPS), a temperamental trait affecting 20–30% of adults, shapes how individuals perceive and react to environmental stimuli. As AI-generated immersive content becomes increasingly common in digital interventions, it remains unknown whether format choices interact with SPS to modulate emotional response. This paper presents the protocol of a planned experimental study comparing audio podcasts and expressive virtual humans in a cyberbullying narrative intervention. Findings will offer the empirical groundwork for sensitivity-informed design of AI-mediated interventions, a prerequisite before content can be meaningfully personalised to distinct sensory profiles.

1. Introduction

Digital interventions for cyberbullying increasingly use artificial intelligence (AI) to deliver emotionally engaging content. Virtual humans – expressive avatars with synthetic voice and facial animation – are becoming a prevalent medium for narrative-based prevention tools, on the assumption that greater social presence elicits stronger empathic responses (Gratch et al., 2007). A previous pilot study by the authors showed that AI-generated audio podcasts increased online empathy but failed to modify moral disengagement (Francisco et al., 2025), a belief system known to be resistant to change (Bandura, 1999).

A critical yet underexamined issue is whether these rich, immersive formats are equally effective across users. Sensory Processing Sensitivity (SPS) is a temperamental trait, present in an estimated 20–30% of the adult population, characterised by deeper cognitive processing of stimuli and stronger emotional reactivity (Aron & Aron, 1997; Lionetti et al., 2018). Neuroimaging evidence shows that high-SPS individuals display greater activation in brain regions associated with perception, empathy, and self–other processing (Acevedo et al., 2014), yet the same lowered perceptual threshold can lead to overstimulation and emotional exhaustion (Roxburgh, 2023).

The need to balance deep engagement with the risk of sensory overload carries direct implications for the design of AI-mediated content: a format that enhances empathic engagement for typical users may overwhelm high-SPS users, potentially triggering avoidance rather than prosocial reflection. To date, no study has directly tested how SPS interacts with audio compared to audio-visual AI-generated narratives. Before digital interventions can be responsibly personalised to distinct sensory profiles, the underlying interaction between SPS and presentational format needs validation; without it, any claim of sensitivity-informed design would be speculative.

The present protocol addresses this prerequisite. By testing whether SPS interacts with format (audio-only vs. audio-visual) and narrative perspective (third person vs. first-person victim) in shaping empathic and physiological reactivity to cyberbullying narratives, the study provides the foundational evidence on which any subsequent personalisation work must rest.

2. Proposed method

2.1. Design

The study employs a between-subjects experimental design with five groups: (i) audio podcast, third-person narration; (ii) audio podcast, first-person narration (victim); (iii) virtual human, third-person narration; (iv) virtual human, first-person narration (victim); and (v) text-only control. SPS is treated as a continuous moderator. Each participant attends two laboratory sessions approximately one week apart, allowing counterbalanced exposure to male- and female-victim narratives.

2.2. Participants

A convenience sample of approximately 230 university students aged 18–25 will be recruited on campus, targeting retention of at least 196 participants after attrition (approximately 40 per experimental group). This sample size provides 80% statistical power to detect medium-sized effects (Cohen's $f = 0.25$) in the primary ANOVA and moderation analyses ($\alpha = 0.05$), based on an a priori power analysis conducted with G*Power.

2.3. Stimuli

Stimuli are fictional but ecologically valid cyberbullying narratives developed and validated in a previous pilot study (Francisco et al., 2025). Narratives are generated as native Portuguese audio using NotebookLM. Virtual-human versions pair the audio with an expressive avatar animated with congruent facial expressions and lip-sync.

2.4. Measures

Participants' baseline profiles will be assessed at the beginning of Session 1. These include the evaluation of individual Sensory Processing Sensitivity using the *Highly Sensitive Person Scale – Revised* (Pluess et al., 2024; Portuguese adaptation under development by the authors) and the assessment of behavioral history based on the *Cyberbullying Inventory for College Students* (CICS).

To evaluate the impact of the intervention and the different presentational formats, online empathy and moral disengagement will be measured as primary outcome variables. These will be assessed using the *Empathy in Virtual Contexts Questionnaire* (EQVC; Francisco et al., 2023) and the *Process Moral Disengagement in Cyberbullying Inventory* (PMDCI). While a previous pilot study using audio podcasts showed no significant changes in this construct (Francisco et

al., 2025), the current protocol introduces expressive virtual humans and first-person perspectives. These high-immersion features are expected to enhance the humanization of the victim, potentially overcoming the cognitive stability of moral disengagement mechanisms observed in simpler formats. After each exposure in both sessions, participants will complete a stimulus evaluation questionnaire. Additionally, during exposure, biometric data (electrodermal activity, heart rate, and respiration) will be recorded continuously via Bioplux sensors. Simultaneously, facial expressions and gaze will be captured with FaceReader 9.0 for the automatic extraction of action units and valence indices.

2.5. Procedure

Data collection will only begin upon ethics approval. After informed consent, in Session 1, participants complete the initial battery for baseline profiles (HSPS-R and CICS) and the pre-exposure administration of the outcome measures (EQVC and PMDCI), followed by a 60-second resting baseline. Sensors are then calibrated, and the first narrative is presented according to group allocation, with synchronous recording of physiological and facial data. At the end of the Session 1 exposure, the stimulus evaluation questionnaire is administered.

Session 2 (approximately one week later) replicates the exposure procedure with the counterbalanced victim gender. At the end of the Session 2 exposure, the stimulus evaluation questionnaire is administered. Following this, participants complete the post-exposure administration of the EQVC and PMDCI to evaluate intervention-driven changes. All video recordings are processed offline by FaceReader 9.0 and deleted immediately after numerical extraction, in line with GDPR requirements.

2.6. Analysis Plan

SPS is modelled primarily as a continuous moderator based on HSPS-R total scores. Given that no validated categorical cut-offs yet exist for the HSPS-R, exploratory latent profile analyses (LPA) will be conducted by combining HSPS-R subscales with baseline cyberbullying involvement (CICS). These profiles will then be used to identify user subgroups and predict differential responses to each format (audio-only vs. audio-visual) regarding: (a) change in self-reported empathy (pre- to post-exposure); (b) change in moral disengagement levels (PMDCI) (pre- to post-exposure); (c) facial valence indices and physiological arousal during exposure.

3. Expected contributions

This work is expected to yield three contributions. First, methodological: the combination of native-language AI-generated stimuli with multimodal physiological and facial measurement reduces self-report bias in a domain where social desirability is known to confound empathy and moral-disengagement research. Second, theoretical: results will clarify how SPS – a neurobiologically grounded individual difference – interacts with presentational format, extending the environmental sensitivity framework (Pluess, 2015) into human–AI interaction. Third, and most importantly, applied: findings will provide the empirical foundation required before AI-mediated interventions can be responsibly personalised to distinct sensory profiles. The study is thus positioned not as an inclusive-design intervention in itself, but as a necessary first step towards sensitivity-informed design – one that clarifies whether format choices matter for sensitive users before prescribing how content should be adapted for them.

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Ethics and study status

This protocol constitutes a methodological extension of a prior study by the authors (Francisco et al., 2025), which received full ethics approval. The current protocol – which adds virtual human stimuli, multimodal physiological and facial measurement, and SPS as a moderator – is under review by the Research Ethics Committee. Data collection will begin upon approval; depending on timing, preliminary data may or may not be available at the time of presentation.

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