The Journal of Forensic Psychiatry & Psychology

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rjfp20

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To cite this article: Luca Adolfo Tiberi, Véronique Delvaux, Xavier Saloppé, Audrey Vicenzutto & Thierry H. Pham (16 Oct 2024): Signal detection analysis of affective prosody recognition in forensic inpatients who have committed sexual offenses, The Journal of Forensic Psychiatry & Psychology, DOI: 10.1080/14789949.2024.2415911

To link to this article: https://doi.org/10.1080/14789949.2024.2415911

Published online: 16 Oct 2024.

THE JOURNAL OF FORENSIC PSYCHIATRY & PSYCHOLOGY
https://doi.org/10.1080/14789949.2024.2415911

Signal detection analysis of affective prosody recognition in forensic inpatients who have committed sexual offenses

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ABSTRACT

Socio-affective functioning, or the way we interact and relate to others, is one of the four dynamic sexual recidivism risk domains. Accurately recognizing emotions enables the inference of mental and affective states supporting social adaptation. As little attention has been paid to affective prosody recognition in forensic inpatients who have committed sexual offenses (FICSOs), this study assessed the accuracy and sensitivity scores of 111 male participants assigned into three groups: FICSOs ($n = 35$), forensic inpatients who have committed non-sexual offenses (FICNSOs, $n = 26$) and community members (CoM, $n = 50$). Collected data also include response bias, emotion labeling reflection time, task easiness and task easiness reflection time. Using non-parametric group comparisons (Kruskal–Wallis H and Mann–Whitney U), results highlight, overall, a pervasive impairment of affective prosody recognition in FICSOs and FICNSOs compared to CoM. However, there was no difference in disgust sensitivity scores between FICSOs and CoM. FICSOs and FICNSOs took significantly longer than CoM to select an emotional label, especially for happiness. In addition, a metacognitive impairment was found in FICSOs and FICNSOs as they found the task significantly easier than CoM while being less sensitive.

ARTICLE HISTORY Received 30 May 2024; Accepted 7 October 2024

KEYWORDS Sexual offending; emotion recognition; affective prosody; forensic inpatients; signal detection theory

Introduction

Spoken communication is defined as the use of speech to exchange ideas and information, and to engage in social interactions based on the sharing of opinions, emotions and attitudes. Phonologically speaking, the speech signal can be analyzed as a sequence of segmental units, i.e. vowels and

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consonants, on which are overlaid suprasegmental features, i.e. complementary features not time-limited to segments, such as tones, intonation, stress, tempo and rhythm (Crystal, 2008). Prosody refers to these suprasegmentals, in particular to three major components: intonation, stress and rhythm. Intonation relates to pitch modulations over time, which create functional melodic contours in speech. Rhythm involves the modulation of loudness and length, reflected in alternations of stressed (prominent, louder, longer) and unstressed (weaker, shorter) syllables (Grice et al., 2023). Rhythm governs how suprasegmental units of speech are organized temporally in relation to one another.

These prosodic features modulate the way speech is produced and interpreted across different linguistic and communicative contexts. Indeed, prosody serves multiple interrelated functions, contributing to syntactic structure and parsing (grammatical function), speaker intent and between-speaker interactions (pragmatic function), discourse organization (discourse function), phonological structure (phonological function) and emotional expression (attitudinal function) (Bambini et al., 2016; Grice et al., 2023; Hirschberg et al., 2020). Affective prosody specifically refers to communicating an emoter's affective and mental states using suprasegmental aspects of speech such as pitch, energy and duration variations independently from the semantic information (Coulombe et al., 2023; Scherer, 2003; Wright et al., 2018). Indeed, the attributes of prosody, whether linguistic or affective, are defined in the auditory domain, with close acoustic/articulatory correlates: (i) pitch, associated with the fundamental frequency (f0), i.e. the lowest frequency of the periodic waveform associated with vocal fold vibration and measured in Hertz (Hz); (ii) loudness, corresponding to the intensity/acoustic energy of the speech signal, measured in decibels (dB); (iii) length, thus duration, measured in milliseconds (ms) (Kamiloğlu et al., 2020; Lacheret, 2011). Therefore, recognizing prosodic features based on these acoustic characteristics enables the inference of affective and mental states, which defines affective prosody recognition (Wright et al., 2018).

Conveying and accurately recognizing emotions are essential in human interactions (Adolphs, 2010; Arnold & Candea, 2021; Morningstar et al., 2017) as they sustain the adaptative behavior selection (Crick & Dodge, 1994). Contrary to other major communication channels, such as face or body, voice covers a longer distance and does not even require the emoter's presence to be processed (Liebenthal et al., 2016), conferring a unique status to affective prosody recognition in communication. Models of the emotion recognition process are numerous, but they are primarily focused on the facial channel (see, for example, Adolphs, 2002; Haxby et al., 2000). Wright et al. (2018) recently postulated the existence of *Acoustic Characteristics Conveying Emotions* (ARACCE), similar to dictionary entries, enabling the observer to match acoustic cues (e.g. high pitch combined with high intensity and quick speed rate) with the abstract representation of emotion (e.g. anger).

Like any other process, emotion recognition accuracy varies throughout development. Recent research and systematic literature reviews (Baglione et al., 2023; Filippa et al., 2022; Martzoukou et al., 2022; Morningstar et al., 2018) highlighted that affective prosody recognition starts early in human life and declines with age. For example, 12-month-old infants adapt their behaviors based on their parents' paralinguistic cues (Morningstar et al., 2018). The developmental trajectory of emotion recognition is slower for affective prosody than facial expression. Nevertheless, young children (6–9 years old) can accurately recognize affective prosody (Morningstar et al., 2018) despite some difficulties found only for sadness (Filippa et al., 2022). In addition, recognizing affective prosody in young children (5–6 years old) involves only one emotion category (Filippa et al., 2022). This sensitivity improves during childhood as adolescents (12–14 years old) can recognize mixed and contradictory emotions. This result emphasizes the increasing accuracy in affective prosody recognition from childhood to adolescence (Filippa et al., 2022; Morningstar et al., 2018), whereas the maturation stage is yet to be confirmed (Morningstar et al., 2018). Finally, research also confirms the tendency of reduced accuracy in older, especially for negative emotions (Baglione et al., 2023; Martzoukou et al., 2022). The two studies found distinctive deficits, as Baglione et al. (2023) highlighted that older individuals (M_{age} = 63 years old) are less accurate than middle-aged (M_{age} = 50 years old) and young (M_{age} = 30 years old) in recognizing anger, sadness, disgust and happiness. Equal evidence for reduced and preserved accuracy is found for fear. Martzoukou et al. (2022) found slightly different results with reduced accuracy for anger, sadness and fear but a preserved accuracy for happiness when older participants (M_{age} = 72.20 years old) are compared with young adults (M_{age} = 23 years old). This last result supports the widely known Socioemotional Selective Theory (Carstensen et al., 1999; Murphy & Isaacowitz, 2008), claiming that as older people are aware of their mortality, they tend to orient their attention toward positive emotions. Although there are three hypotheses, i.e. perceptual deficits, executive functioning deficits and brain aging (especially frontal lobes), none provide solid evidence (Baglione et al., 2023).

Research and meta-analyses (Banse & Scherer, 1996; Elfenbein & Ambady, 2002; Laukka & Elfenbein, 2021; Laukka et al., 2016) show that the general population accurately recognizes affective prosody within their own and across cultures. Overall, anger is the most recognized emotion, whereas disgust seems to be the least recognized. Other negative emotions, such as sadness and fear, seem fairly recognized, with accuracy scores close to anger. In contrast, happiness is sometimes found as the least recognized emotion (Elfenbein & Ambady, 2002) or among the three most recognized emotions with anger and sadness/fear (Banse & Scherer,

1996; Laukka & Elfenbein, 2021; Laukka et al., 2016). According to Banse and Scherer (1996), the confusion in recognizing emotions can be attributed to shared quality, intensity and valence. For example, hot and cold anger manifest the same discrete emotion (same quality and valence). Hot anger represents the intense manifestation of anger, characterized by prototypical features of highly intense, negative emotion conveying anger (high F0, high mean energy and increased speed rate). In contrast, cold anger represents the mild manifestation of anger, with more nuanced and less prototypical features. Similarly, two emotions with high intensity, e.g. elation and hot anger, could be confused despite their different quality (happiness vs. anger) and valence (positive vs. negative).

Confusing or inaccurately recognizing affective prosody or other emotional cues can lead to inappropriate behaviors, such as offending (Smeijers et al., 2020). In the forensic literature to date, only facial expressions of emotions have been extensively investigated in offending populations, especially with antisocial or psychopathic personality disorder (Chapman et al., 2018; Dawel et al., 2012; Marsh & Blair, 2008). Results showed pervasive deficits in recognition, not restricted to negative (e.g. fear, anger) discrete emotions. Conversely, little research has been carried out on a specific subgroup of offenders: individuals who have committed sexual offenses (Chapman et al., 2018; Gillespie et al., 2015, 2021; Tiberi et al., 2023, 2024). This is unfortunate as sexual offending is a crucial health concern, with high victimization prevalence among adults and children. Epidemiological research on sexual violence found that 27.30% of women and 10.80% in the USA reported experiencing unwanted sexual contact (Basile et al., 2014). Recently, the prevalence of worldwide past-year sexual assaults against women and men was, respectively, up to 59.20% and 55.55% (Dworkin et al., 2021). High prevalences of sexual abuse are also found in children, with 9.00% to 20.40% for girls and 6.20% to 14.1% for boys (Moody et al., 2018).

To prevent sexual reoffending, the research identified factors, such as criminogenic needs, that must be addressed to reduce recidivism risk. The *Structured Assessment of Risk and Need* (SARN) (Thornton, 2002) identifies socio-affective deficits as one of the four dynamic risk domains in assessing sexual recidivism risk. However, despite a growing number of research on emotions in individuals who have committed sexual offenses (Garofalo et al., 2019; Gunst et al., 2017), studies on emotion recognition remain scarce (Gillespie et al., 2021). Most previous studies on the subject are limited to recognizing facial expressions of emotion. To the authors' best knowledge, only one has assessed affective prosody recognition among incarcerated men who had committed sexual offenses.

Indeed, Suchy et al. (2009) assessed 62 male participants: 41 incarcerated men who had committed sexual offenses and were at the time of the study in

community treatment centers and 21 community members. From these 41 incarcerated men, 18 were assigned to the pedophilic interest (i.e. sexual interest toward prepubescent children younger than 13 years old) group and 23 were assigned to the non-pedophilic interest group. Using the prosody perception task from the New York Emotion Battery (Borod et al., 1992), consisting of neutral semantic sentences read with affective prosody (anger, disgust, happiness, fear, sadness, unpleasant and pleasant surprise), Suchy et al. (2009) found that incarcerated men with non-pedophilic interest made significantly more errors in accuracy than community members, especially for unpleasant surprise.

Yet, there is no study assessing affective prosody recognition with forensic inpatients who have committed sexual offenses. In Belgium , these individuals are declared Not Guilty By Reason of Insanity by a Court of Law and placed in a Forensic Hospital under a care order rather than condemned (Moniteur Belge, 2014). In such facilities, the prevalence of individuals who have committed sexual offenses is high, with 20.90% with an index sexual offense and 11.90% with a previous sexual offense conviction (Jeandarme et al., 2019). This prevalence rises if the unit nature (Medium Risk vs High Risk) is considered, with 7.50% for the Medium-Risk and 40.40% for the High-Risk. Affective prosody has been increasingly studied among populations with psychiatric disorders such as schizophrenia symptoms or bipolar disorders and highlights lower scores in prosody recognition accuracy in comparison with healthy participants (Ding & Zhang, 2023). However, no study has been conducted on forensic inpatients who are at the crossroads between mental health and law.

The current study

The current study assesses affective prosody recognition in forensic inpatients who have committed sexual offenses compared with forensic inpatients who have committed non-sexual offenses and community members. To encompass the prosodic emotion recognition process, we sought to adopt a detailed analysis not restricted to accuracy scores, which is only one part of the decision-making process in emotion recognition (Faith et al., 2022). Signal Detection Theory (SDT) (Stanislaw & Todorov, 1999) sustains that noise always accompanies stimuli in everyday life. Indeed, when facing a stimulus, four outcomes are possible: Hit Rate (HR), when the individual accurately recognizes the stimulus as a stimulus; False Alarm (FA), when they confound the stimulus with the noise; Miss (M), when they do not recognize the stimulus, whereas it was present; and Correct Rejection (CR), when they accurately recognize the noise as a noise. Resorting to sensitivity ($d' = zHR–zFA$) and bias response ($c = -(zHR + zFA)/2$) instead of accuracy

enables the investigation of decision-making (Faith et al., 2022). Sensitivity is the participant's competency to recognize the signal when it is actually presented (Stanislaw & Todorov, 1999). However, as this index results from subtracting FA from HR, it provides nuanced information compared to accuracy (Faith et al., 2022). The higher the *d'*, the more sensitive the participant is. The response bias is an index calculating the distance between an unbiased ideal theoretical observant who maximizes the HR and CR while decreasing the M and the FA, and the actual participant performance (Faith et al., 2022; Stanislaw & Todorov, 1999). It enables to determine the conservative or liberal tendency of the participant when facing stimuli. The closer *c* is to -∞, meaning the participant's response style is liberal, the more the participant selected the emotional label despite lacking discrimination (high HR, FA and low M, CR). The closer *c* is to +∞, the more conservative the participant's response style. The likelihood of selecting the emotional label is low despite good discrimination (low HR, FA and high M, CR).

In addition, behavioral measures, generally overlooked among emotion recognition studies (Kosonogov & Titova, 2019) were added: (1) the Emotion Labeling Reflection Time (ms) regarding the time for the participants to select an emotional label, (2) the Easiness Labeling Mean Scores to assess the easiness to recognize affective prosody stimuli and (3) the Easiness Reflection Time (ms) to assess the time needed to select the stimulus' easiness.

Expectations are that both forensic inpatient groups, especially those who have committed sexual offenses characterized by socio-affective deficits (Thornton, 2002), would exhibit significantly lower scores in recognition accuracy and sensitivity when compared with the other two groups. Regarding reaction times, previous studies on forensic inpatients (Cronje et al., 2024) and systematic literature reviews or meta-analyses on individuals who have committed sexual offenses (Dillien et al., 2020; Joyal et al., 2014; Turner & Rettenberger, 2020) suggest expecting longer processing times from forensic inpatients than community members. No difference should be expected between the two forensic inpatient groups. Finally, task easiness is rarely investigated in emotion recognition studies on offenders (for example, Pham & Philippot, 2010; Tiberi et al., 2024). Task easiness relates to metacognitive skills (Flavell, 1979), which are generally impaired in individuals with psychiatric disorders (Hoven et al., 2019; Sun et al., 2017). Therefore, the expectation is that task easiness scores will be significantly lower in forensic inpatients than in community members.

Materials and methods

Participants

The initial sample was composed of 115 male participants divided into three groups: forensic inpatients who have committed sexual offenses ($n = 37$), forensic inpatients who have committed non-sexual offenses ($n = 27$) and community members ($n = 51$). Forensic inpatients were institutionalized in a High-Risk Secure Forensic Hospital in Belgium . Descriptive analyses identified four recurrent and extreme outliers: two for the forensic inpatients who have committed sexual offenses (5.40%), one for the forensic inpatients who have committed non-sexual offenses (3.70%) and one for the community members (2.00%). We excluded these outliers for the following analyses. Therefore, the final sample consisted of 111 male participants: forensic inpatients who have committed sexual offenses ($n = 35$), forensic inpatients who have committed non-sexual offenses ($n = 26$) and community members ($n = 50$).

To be eligible for this study, all participants must have French as their mother tongue and no hearing difficulties that could not be compensated by wearing a hearing aid. Forensic inpatients had to be assessed as 'clinically stable to sustain assessment' by their psychologist and nursing team and be able to read basic words as the six discrete emotion labels (e.g. 'anger,' 'disgust,' etc.). Community members must report no history of psychiatric diagnoses and be able to read basic words.

Instruments

Demographics

Socio-demographic data, such as age, ethnicity and years of education, were collected using a short socio-demographic questionnaire. This questionnaire also ensured that participants did not report any auditive impairment. The forensic inpatients' length of stay and criminal history were collected by consulting their hospital records. Based on their criminal record, forensic inpatients were categorized as 'forensic inpatients who have committed sexual offenses' if they committed at least one sexual offense or as 'forensic inpatients who have committed non-sexual offenses' if no sexual offense was registered.

Mini international neuropsychiatric interview (MINI) (Sheehan et al., 1998)

The MINI is a structured clinical interview assessing 17 Major Mental Disorders, based on the DSM-IV-TR (Axis I) (American Psychiatric Association, 2000), through 120 dichotomous questions (yes/no). These disorders are organized into 17 independent modules (2 optional) and can be

categorized as follows: Mood Disorders, Anxiety Disorders, Substance Use and Abuse, Psychotic Disorders, Post-Traumatic Disorder and Eating Disorders. The two optional modules are Major Depressive Episode with Melancholy Features and Antisocial Personality Disorder. The French-validated version (Lecrubier et al., 1997) used has good psychometric qualities (sensitivity, specificity, test–retest reliability), with excellent diagnostic inter-rater agreement ($\kappa_s \geq .84$) for forensic inpatients in the same hospital (Vicenzutto et al., 2018). As data collection started before the validation of MINI for DSM-5, we used the previous version of the MINI to ensure data consistency.

Structured clinical interview for DSM-IV axis II disorders (SCID-II) (First et al., 1997)

The SCID-II assesses 13 personality disorders based on the DSM-IV-TR (Axis II) (American Psychiatric Association, 2000). Assessment consists of a 119 dichotomous (yes/no) self-questionnaire, followed by a clinical interview regarding the positive items the inpatient checks. Three main personality disorder categories are measured: Cluster A or the 'bizarre personalities' (e.g. Schizotypal), Cluster B or the 'dramatic/emotional personalities' (e.g. Borderline) and Cluster C or the 'anxious personalities' (e.g. Dependent). In addition to 'Non-Specific Personality Disorder,' two personality disorders are included in the SCID-II: Negativist and Depressive Personality Disorders. The French-validated version (Bouvard et al., 1999) that was used presents excellent inter-rater agreement ($\kappa_s \geq .81$) for Cluster disorders with forensic inpatients of the same hospital (Vicenzutto et al., 2018). As for the MINI, the data collection started before the validation of the SCID-PD for DSM-5. Therefore, the SCID-II version was used to ensure data consistency.

Geneva multimodal expression protocol (GEMEP) (Bänziger et al., 2011)

The GEMEP is a dynamic multimodal emotion expression corpus comprising 145 audio, video and audio–video stimuli. The audio stimuli consist of a set of pseudosentences ('*ne kali bam soud molen!*' and '*koun se mina lod belam?*') and a nonverbal utterance (/*aaa*/). Ten French-speaking actors (five males and five females) voiced twelve emotions, including hot anger, fear, happiness and sadness. Half of the actors voiced five supplemental emotions, including disgust and surprise. From this corpus, we extracted 2 'practice' audio stimuli and 48 'task' audio stimuli based on the highest accuracy scores from the original validation sample for the task. Only the data for the 'task' stimuli are analyzed. The average recognition accuracy for audio stimuli in the validation sample was .34 for all emotions, .36 for the 12 emotions and .26 for the 5 supplemental emotions. The GEMEP is commonly used because, in addition to average accuracy scores for prosodic recognition, this corpus also investigated the authenticity and the believability of emotions depicted,

with high correlations ($r = .53$) between the two scores. The 48 audio stimuli lasted between 3 and 5 s. We initially aimed to balance the task stimuli following the equation [(6 emotions * 2 genders)*4], with the selected emotions being the six discrete emotions, i.e. anger, disgust, happiness, fear, surprise and sadness. However, based on the available stimuli and their accuracy scores, we selected 10 stimuli for anger and fear (5 expressed by female voices and 5 by male voices), 9 stimuli for happiness (5 expressed by male voices and 4 by female voices) and sadness (5 expressed by female voices and 4 by male voices) and 5 stimuli for disgust (3 expressed by female voices and 2 by male voices) and surprise (3 expressed by male voices and 2 by female voices).

Procedure

Forensic inpatients were approached by their psychologist or the research team or spontaneously volunteered. Regarding community members, we posted calls on social media (Facebook and Instagram) and placed printed flyers in highly frequented areas (e.g. supermarkets, doctor's waiting rooms, etc.). On average, two meetings were organized with voluntary inpatients. The first one (±2 h) took place inside the inpatient's care unit and intended to explain the research aims, answer potential questions and fill out some self-questionnaires (e.g. Demographics). The second meeting (±2 h), located in a quiet room in another care unit dedicated to assessment, took place to run the experimental task (GEMEP). Psychiatric diagnoses of forensic inpatients (MINI and SCID-II) were assessed by trained professionals at least 1 month after they arrived at the High-Risk Security Hospital. Trained psychologists or psychiatrists from the High-Risk Security Hospital collected medication and length of stay data. The criminological data were extracted from the inpatients' criminal records. The data were then transmitted anonymously to the Center of Research in Social Defense for coding and analysis. The first author extracted these data for the analyses. Only one meeting (2 h) was required with community members. It occurred in a quiet room in the Faculty of Psychology and Educational Sciences (UMONS).

We ran the experimental task with an *HP ZBook15* (15.6 inches; 1920 × 1080) with *E-Prime 2.0* (Schneider et al., 2002). Stimuli were presented across two blocks of trials using a pseudorandomized order. A 'break' screen was placed between the two blocks of trials, and a 'task finished' screen was placed at the end of the second block. Each trial started with a fixation cross (2,000 ms). Although no visual stimulus was presented, this cross was placed to maintain the participants' attentional focus on the ongoing task. The audio stimulus followed the fixation cross and lasted between 3 and 5 s, depending on the stimulus. Two questions followed each stimulus, '*What emotion did you perceive?*' and '*Was it easy or difficult to recognize?*'. Participants were

instructed to listen to the audio stimulus and answer each question once it appeared on the laptop screen using a Cedrus response box (RB-730 model) placed on a 3D reading support with an angle of 20°. A six forced-choice paradigm was used with the six discrete emotion labels and a six-point Likert scale (1 = '*Very difficult*'; 6 = '*Very easy*'). Answers and reflection times, i.e. the necessary time to answer the questions, were collected.

The Faculty Ethics Committee (Ref. *UMONS-2019.11.22-TL-001*) from the Faculty of Psychology and Educational Sciences (UMONS) and the Ethics Committee from the High-Risk Secure Forensic Hospital (Ref. *DV/VJ/PB/2019*) granted ethical approval in 2019. The authors followed ethical recommendations from the Helsinki Declaration and the European General Data Protection Regulation (2016) regarding data collection and storage. The participants received an information letter explaining the research aims and signed an informed consent sheet.

Data analysis

Statistical analyses were computed using the *IBM Statistics Package for Social Sciences* (SPSS) version 26 (IBM Corp, 2018). Prior to the data analysis, mean accuracy, task easiness, emotion labeling reaction times and easiness reflection time scores were computed across all emotions and for each of the six discrete emotions. Based on the SDT (Stanislaw & Todorov, 1999), sensitivity (*d'*) and response bias (*c*) for each of the six discrete emotions were also computed.

Descriptive statistics include socio-demographics, i.e. age, years of education, length of stay, IQ total score (assessed with WAIS-IV; Wechsler, 2011), psychiatric diagnoses, criminal history and medication. Socio-demographics were compared using Kruskal–Wallis *H* followed by pairwise Mann–Whitney *U* comparisons with Dunn–Bonferroni *p*-value threshold adaptation ($p = 0.16$). Psychiatric, criminal and medication data were compared using Fisher's exact test. Task data did not follow the Gaussian distribution, as assessed through the normality test (Shapiro–Wilk), Skewness and Kurtosis z indices analysis and QQPlots. Therefore, we resorted to Kruskal–Wallis *H* comparisons tests, followed by pairwise Mann–Whitney *U* comparisons, with Dunn–Bonferroni correction ($p = 0.16$). Non-parametric ($r = \frac{z}{\sqrt{N}}$) and frequency (Cramer's *V*) effect sizes were computed for all comparisons. Non-parametric effect sizes were interpreted following Cohen's (1992) norms: .20 = small; .50 = moderate; .80 = large.

As the groups differed regarding age, years of education and length of stay, zero-order bivariate non-parametric correlations (Spearman's ρ) between these variables and task outcomes were run to investigate the strength and direction of associations. Correlations were interpreted according to Cohen's (1992) norms: .10 = small; .30 = moderate; .50 = large.

Table 1. Descriptive and comparative analyses (Kruskal-Wallis *H* and Mann–Whitney *U*) on sociodemographic variables between the three groups.

	FICSOs			FICNSOs			CoM			Statistics	
	n	*M (SD)*	*Min.–Max.*	*n*	*M (SD)*	*Min.–Max.*	*n*	*M (SD)*	*Min.–Max.*	*H* or *U*	*p*
Age	35	47.33 (14.56)	22.03-68.83	26	40.11 (10.51)	26.32-61.67	50	33.66 (13.78)	18.05-64.79	20.49	**≤ .001**
Years of Education	35	4.89 (4.89)	0.00-12.00	26	6.69 (4.10)	0.00-12.00	50	15.38 (2.77)	12.00-20.00	76.66	**≤ .001**
Length of Stay	35	13.12 (8.93)	0.85-28.35	26	4.77 (3.56)	0.40-12.54	N/A	N/A	N/A	204.00	**≤ .001**
IQ (WAIS-IV)	27	78.41 (16.78)	53.00-131.00	21	76.14 (13.44)	46.00-104.00	N/A	N/A	N/A	265.50	.708

FICSOs = Forensic Inpatients who have Committed Sexual Offenses; FICNSOs = Forensic Inpatients who have Committed Non-Sexual Offenses; CoM = Community Members; N/A = Not Applicable.

Results

Preliminary and descriptive results

Participants' socio-demographic characteristics are found in Table 1. Forensic inpatients who had committed sexual offenses ($U = 424.50$, $p \leq .001$, $z = -4.02$, $r = .43$) and forensic inpatients who had committed non-sexual offenses ($U = 370.00$, $p = .002$, $z = -3.07$, $r = .35$) were significantly older than community members. They also were less educated (respectively, $U = 51.00$, $p \leq .001$, $z = -7.51$, $r = .81$; $U = 25.50$, $p \leq .001$, $z = -6.99$, $r = .80$) than community members. Forensic inpatients who had committed sexual offenses have been hospitalized longer in the High-Risk Secure Forensic Hospital than the forensic inpatients who had committed non-sexual offenses ($U = 204.00$, $p \leq .001$, $z = -3.66$, $r = .53$). No difference was found between the two forensic inpatient groups concerning age and total IQ. Differences reported can be considered moderate, except for education with a large effect (Cohen, 1992).

Psychiatric diagnoses, medication and criminal history for the two forensic inpatient groups are presented in Table 2. Forensic inpatients who had committed sexual offenses exhibited fewer mental disorders, especially psychosis (3.00%, $\chi^2 = 10.84$, $p \leq .001$, Cramer's $V = .43$) than the forensic inpatients who had committed non-sexual offenses (36.00%). No difference was

Table 2. Descriptive and comparative analyses (χ^2 test) on psychiatric disorders, medication and criminal history between the two forensic inpatient groups.

	FICSOs		FICNSOs			
	n	% (*n*)	*n*	% (*n*)	χ^2	*p*
Psychiatric Disorders						
Mental Disorders (former Axis I)	33	39.40 (13)	25	84.00 (21)	**11.67**	**≤ .001**
Personality Disorders (former Axis II)	33	87.90 (29)	25	88.00 (22)	0.00	.999
Axis I-II Comorbidity	33	57.60 (19)	25	84.00 (21)	**4.64**	**.045**
Medication						
Anxiolytic and Sleep-Inducing	35	62.90 (22)	26	65.40 (17)	0.04	.999
Typical Antipsychotic	35	34.30 (12)	26	65.40 (17)	**5.78**	**.021**
Atypical Antipsychotic	35	48.60 (17)	26	88.50 (23)	**10.51**	**≤ .001**
Antidepressant	35	57.10 (20)	26	69.20 (18)	0.93	.426
Anticonvulsant	35	17.10 (6)	26	34.60 (9)	2.46	.142
Hormone Therapy	35	8.60 (3)	26	3.80 (1)	0.54	.629
Other	35	14.30 (5)	26	42.30 (11)	**6.05**	**.019**
Criminal History						
Current sexual offense	35	88.60 (31)	N/A	N/A	N/A	N/A
Current violent non-sexual offense	35	22.90 (8)	26	61.50 (16)	**9.35**	**.003**
Current non-violent non-sexual offense	35	25.70 (9)	26	76.90 (20)	**15.69**	**≤ .001**
Past sexual offense	35	45.70 (16)	N/A	N/A	N/A	N/A
Past violent non-sexual offense	35	28.60 (10)	26	46.20 (12)	2.00	.186
Past non-violent non-sexual offense	35	51.40 (18)	26	69.20 (18)	1.95	.195
Sexual offending – adult victim	34	11.80 (4)	N/A	N/A	N/A	N/A
Sexual offending – child victim	34	67.60 (23)	N/A	N/A	N/A	N/A
Sexual offending – mixed-age victim	34	20.60 (7)	N/A	N/A	N/A	N/A

FICSOs = Forensic Inpatients who have Committed Sexual Offenses; FICNSOs = Forensic Inpatients who have Committed Non-Sexual Offenses; N/A = Not Applicable.

found regarding personality disorders. Forensic inpatients who had committed sexual offenses consumed significantly fewer typical (34.30%, $\chi^2 = 5.78$, $p = .021$, Cramer's $V = .31$), atypical antipsychotic (48.60%, $\chi^2 = 10.51$, $p \leq .001$, Cramer's $V = .41$) and other medication such as antiparkinsonian and substitution treatment (14.30%, $\chi^2 = 6.05$, $p = .019$, Cramer's $V = .31$) than forensic inpatients who had committed non-sexual offenses (typical antipsychotic: 65.40%; atypical antipsychotic: 88.50%; other medication: 42.30%).

Criminal history analysis indicated that forensic inpatients who had committed sexual offenses had significantly fewer current violent non-sexual offenses (22.90%, $\chi^2 = 9.35$, $p = .003$, Cramer's $V = .39$) and current non-violent non-sexual offenses (25.70%, $\chi^2 = 15.69$, $p \leq .001$, Cramer's $V = .51$) than forensic inpatients who had committed non-sexual offenses (respectively: 61.50% and 76.90%).

Comparisons results

Tables 3 and 4 report scores for recognition accuracy, sensitivity, response bias, emotion labeling reflection time, easiness mean and easiness reflection time.

All emotions combined

Comparative analyses showed significant differences between the three groups for accuracy ($H = 61.43$, $p \leq .001$), emotional labeling reflection time ($H = 9.07$, $p = .011$) and task easiness ($H = 11.60$, $p = .003$). No difference was found for easiness reflection time ($p = .635$).

When compared pairwise, results highlighted significantly lower accuracy scores for forensic inpatients who had committed sexual offenses ($U = 128.00$, $p \leq .001$, $z = -6.68$, $r = .72$) and non-sexual offenses ($U = 76.50$, $p \leq .001$, $z = -6.29$, $r = .72$) in comparison with community members. Forensic inpatients who had committed sexual offenses took significantly more time than community members to label emotions ($U = 583.00$, $p = .009$, $z = -2.61$,

Table 3. Emotion recognition scores (all emotions combined) for forensic inpatients who have committed sexual offenses, forensic inpatients who have committed non-sexual offenses and community members.

	FICSOs ($n = 35$)	FICNSOs ($n = 26$)	CoM ($n = 50$)
All emotions combined	*M (SD)*	*M (SD)*	*M (SD)*
Accuracy	.45 (0.12)	.44 (0.11)	.66 (0.08)
Emotion Labeling Reflection Time	4696.73 (2617.70)	4424.18 (2071.94)	3290.72 (1524.18)
Easiness Mean Score	3.99 (1.35)	4.28 (0.95)	3.49 (0.58)
Easiness Reflection Time	2085.03 (1236.58)	2127.34 (973.03)	1793.04 (519.77)

FICSOs = Forensic Inpatients who have Committed Sexual Offenses; FICNSOs = Forensic Inpatients who have Committed Non-Sexual Offenses; CoM = Community Member.

$r = .28$). No difference was found between forensic inpatients who have committed non-sexual offenses and community members ($p = .018$). Conversely, only forensic inpatients who have committed non-sexual offenses reported higher task easiness than community members ($U = 340.50$, $p \leq .001$, $z = -3.39$, $r = .39$). Differences can be interpreted as small to moderate, apart from the accuracy differences, with moderate to large differences.

Regardless of the outcome, no differences were found between the two forensic inpatient groups.

Discrete emotions

Comparative analyses highlighted significant differences in sensitivity between groups for anger ($H = 34.29$, $p \leq .001$), disgust ($H = 8.82$, $p = .012$), happiness ($H = 48.97$, $p \leq .001$), fear ($H = 37.53$, $p \leq .001$), surprise ($H = 17,88$, $p \leq .001$) and sadness ($H = 35.79$, $p \leq .001$). More subtle differences were found for the other outcomes. Only significant differences were found for happiness ($H = 42.88$, $p \leq .001$) and sadness ($H = 19.20$, $p \leq .001$) response bias. Significant differences were found for emotion labeling reflection times concerning anger ($H = 8.05$, $p = .018$), happiness ($H = 19.00$, $p \leq .001$) and fear ($H = 11.38$, $p = .003$). Regarding task easiness, significant differences were found for disgust ($H = 23.24$, $p \leq .001$), fear ($H = 8.96$, $p = .011$), surprise ($H = 25.82$, $p \leq .001$) and sadness ($H = 26.98$, $p \leq .001$).

Similarly to the across emotions analysis level, no difference was found for the task easiness reflection time and no differences were found between the two forensic inpatient groups regardless of the outcome.

Sensitivity

Forensic inpatients who had committed sexual offenses performed significantly lower than community members for all emotions with moderate (anger: $U = 258,00$, $p \leq .001$, $z = -5,52r = .60$; happiness: $U = 255,50$, $p \leq .001$, $z = -5,53$, $r = .60$; sadness: $U = 264,50$, $p \leq .001$, $z = -5,46$, $r = .59$; fear: $U = 283,50$, $p \leq .001$, $z = -5,28$, $r = .57$) or small (surprise: $U = 470,50$, $p \leq .001$, $z = -3,61$, $r = .39$) effect size, apart for disgust ($p = .093$).

Forensic inpatients who had committed non-sexual offenses had lower scores than community members for all emotions, with moderate effect sizes for happiness ($U = 102,50$, $p \leq .001$, $z = -5.99$, $r = .69$) and fear ($U = 209.00$, $p \leq .001$, $z = -4.83$, $r = .55$), and small effect sizes for sadness ($U = 260.00$, $p \leq .001$, $z = -4.27$, $r = .49$), anger ($U = 287.00$, $p \leq .001$, $z = -3.98$, $r = .45$), surprise ($U = 343.00$, $p \leq .001$, $z = -3.36$, $r = .38$) and disgust ($U = 387.00$, $p = .004$, $z = -2.88$, $r = .33$).

Table 4. Emotion recognition scores (discrete emotions) for forensic inpatients who have committed sexual offenses, forensic inpatients who have committed non-sexual offenses and community members.

	FICSOs ($n = 35$)	FICNSOs ($n = 26$)	CoM ($n = 50$)
Emotions	*M (SD)*	*M (SD)*	*M (SD)*
Anger			
d′	2.17 (0.64)	2.26 (0.80)	3.03 (0.52)
c	0.45 (0.45)	0.43 (0.42)	0.43 (0.32)
Emotion Labeling Reflection Time	3999.50 (2591.53)	3344.48 (1456.00)	2743.42 (1681.10)
Easiness Mean Score	3.88 (1.49)	4.36 (1.08)	4.06 (0.82)
Easiness Reflection Time	2158.98 (1361.77)	2190.18 (1154.09)	1873.69 (615.20)
Disgust			
d′	1.10 (0.76)	0.83 (0.73)	1.40 (0.77)
c	0.91 (0.46)	0.89 (0.32)	0.96 (0.38)
Emotion Labeling Reflection Time	5112.09 (2742.13)	5551.75 (3615.70)	4069.27 (2182.31)
Easiness Mean Score	3.86 (1.45)	4.16 (1.07)	2.88 (0.84)
Easiness Reflection Time	2042.03 (1315.19)	2064.86 (1019.51)	1703.49 (528.30)
Happiness			
d′	0.80 (0.81)	0.56 (0.68)	1.89 (0.63)
c	1.14 (0.38)	1.19 (0.43)	0.55 (0.42)
Emotion Labeling Reflection Time	4393.78 (3299.07)	4097.81 (2107.82)	2437.30 (1203.64)
Easiness Mean Score	4.13 (1.31)	4.37 (0.97)	3.96 (0.81)
Easiness Reflection Time	2187.87 (1438.10)	2040.87 (997.45)	1797.49 (487.03)
Fear			
d′	1.25 (0.95)	1.29 (0.94)	2.40 (0.65)
c	0.63 (0.43)	0.62 (0.45)	0.51 (0.34)
Emotion Labeling Reflection Time	4094.35 (2820.53)	3815.85 (2893.78)	2555.75 (1561.47)
Easiness Mean Score	4.02 (1.42)	4.35 (1.02)	3.60 (0.79)
Easiness Reflection Time	1948.79 (1219.49)	2043.88 (1051.39)	1847.37 (719.13)
Surprise			
d′	0.98 (0.62)	0.98 (0.67)	1.58 (0.74)
c	0.63 (0.46)	0.71 (0.46)	0.70 (0.35)
Emotion Labeling Reflection Time	5019.34 (3881.23)	5777.11 (4089.10)	4101.87 (2353.23)
Easiness Mean Score	3.96 (1.46)	4.19 (1.12)	2.90 (0.63)
Easiness Reflection Time	1852.06 (1298.05)	2152.51 (1206.62)	1662.77 (514.54)
Sadness			
d′	0.75 (0.65)	0.94 (0.74)	1.67 (0.58)
c	0.86 (0.41)	0.82 (0.49)	0.48 (0.31)
Emotion Labeling Reflection Time	6033.73 (3871.70)	5248.06 (2514.59)	4685.71 (3000.62)
Easiness Mean Score	4.03 (1.37)	4.14 (0.93)	2.96 (0.70)
Easiness Reflection Time	2204.73 (1454.45)	2257.43 (1084.40)	1760.73 (603.23)

FICSOs = Forensic Inpatients who have Committed Sexual Offenses; FICNSOs = Forensic Inpatients who have Committed Non-Sexual Offenses; CoM = Community Members; *d′* = Sensitivity; *c* = Response bias.

Response bias

Forensic inpatients who had committed sexual offenses were more conservative than community members only when recognizing happiness with a moderate effect size ($U = 241.00$, $p \leq .001$, $z = -5.66$, $r = .61$) and sadness with a small effect size ($U = 419.50$, $p \leq .001$, $z = -4.06$, $r = .44$). The same trend was found for forensic inpatients who had committed non-sexual offenses with moderate effect size for happiness ($U = 180.50$, $p \leq .001$, $z = -5.14$, $r = .59$) and small effect size for sadness ($U = 371.00$, $p = .002$, $z = -3.06$, $r = .35$).

Emotion labeling reflection time

Forensic inpatients who had committed sexual offenses took significantly more time to select the emotional label than community members, with a small effect size, for anger ($U = 591.00$, $p = .011$, $z = -2.54$, $r = .27$), happiness ($U = 470.00$, $p \leq .001$, $z = -3.62$, $r = .39$) and fear ($U = 527.00$, $p = .002$, $z = 3.11$, $r = .34$).

In contrast, only happiness labeling reflection time necessitated significantly more time, with a small effect size, from forensic inpatients who had committed non-sexual offenses than community members ($U = 320.00$, $p \leq .001$, $z = -3.61$, $r = .42$).

Task easiness

Task easiness analysis showed that forensic inpatients who had committed sexual or non-sexual offenses reported emotions to be easier to recognize than community members, except for anger and happiness. Specifically, forensic inpatients who had committed sexual offenses reported higher task easiness, with moderate effect size, for sadness ($U = 435.00$, $p \leq .001$, $z = -3.93$, $r = .43$), surprise ($U = 467.50$, $p \leq .001$, $z = -3.65$, $r = .39$) and disgust ($U = 496.00$, $p \leq .001$, $z = -3.39$, $r = .37$). The same pattern of result is found for forensic inpatients who had committed non-sexual offenses for surprise ($U = 214.50$, $p \leq .001$, z =-4.78, $r = .55$), sadness ($U = 219.00$, $p \leq .001$, $z = -4.73$, $r = .54$) and disgust ($U = 233.50$, $p \leq .001$, $z = -4.57$, $r = .53$). In addition, they reported easier task easiness for the recognition of fearful prosody, with a small effect size ($U = 379.50$, $p = .003$, $z = -2.97$, $r = .34$).

Correlations results

The correlation results (Table 5) showed subtle and specific associations within each group. Two main patterns were found. First, age was mainly positively and moderately associated with reflection time outcomes (emotion labeling and task easiness) for forensic inpatients who had committed sexual offenses. Second, this pattern was only found in community members for anger and sadness (emotion labeling reflection time) and fear (easiness reflection time). However, results highlighted negative moderate associations of age with task easiness. Finally, no specific pattern was found for forensic inpatients who had committed non-sexual offenses.

Discussion

Accurately recognizing affective prosodic cues is essential for adaptative human relationships (Arnold & Candea, 2021). Socio-affective functioning, or the way we relate and interact with others, is one of the four dynamic

Table 5. Correlation results (Spearman's ρ) between age, years of education, length of stay and task outcomes within each group.

	FICSOs ($n = 35$)			FICNSOs ($n = 26$)			CoM ($n = 50$)	
	Age	YoE	LoS	Age	YoE	LoS	Age	YoE
All emotions combined								
Mean Accuracy	−.11	.04	−.26	.29	.04	−.01	−.14	−.06
Emotion Labeling Reflection Time	**.41***	−.24	.22	.16	−.02	.01	.22	.07
Easiness Mean Score	−.02	.15	.12	−.04	−.18	−.27	**−.37****	−.18
Easiness Reflection Time	**.35***	−.11	.24	.02	.06	.13	.24	.07
Anger								
d′	−.31	.10	−.16	.30	.15	−.01	−.03	.10
c	−.17	−.20	−.06	.11	−.06	−.07	.13	−.13
Emotion Labeling Reflection Time	**.44*****	−.23	**.38***	.26	.08	.26	**.31***	.03
Easiness Mean Score	.02	.19	.11	−.10	−.21	−.25	**−.35***	−.04
Easiness Reflection Time	.29	−.11	.24	−.04	.19	.20	.25	.10
Disgust								
d′	.02	.22	−.04	−.05	.36	.19	**−.33***	−.14
c	−.02	−.08	−.09	−.08	−.04	.32	.22	.08
Emotion Labeling Reflection Time	.31	−.31	.20	.12	.13	−.08	.16	−.02
Easiness Mean Score	.05	.09	.14	−.01	−.01	−.09	−.11	−.11
Easiness Reflection Time	**.37***	−.19	.33	.11	−.12	.09	.07	−.19
Happiness								
d′	−.12	.13	−.25	.24	−.15	−.15	.17	.09
c	.14	.13	.08	.21	**−.40***	−.01	−.17	.06
Emotion Labeling Reflection Time	**.40***	−.21	.22	.13	.-.10	.09	.07	.08
Easiness Mean Score	−.06	.10	.12	.03	−.04	−.29	−.27	−.08
Easiness Reflection Time	.29	−.07	.18	−.01	.03	.04	.25	.17
Fear								
d′	−.05	−.09	−.31	.15	−.07	−.07	−.18	−.11
c	**.52*****	−.21	**.50****	−.19	.38	−.03	.09	.05
Emotion Labeling Reflection Time	**.41***	−.24	.23	.13	.17	.07	−.01	−.07
Easiness Mean Score	−.10	.14	.06	.06	−.19	−.16	**−.28***	−.15
Easiness Reflection Time	.30	−.07	.25	−.04	.13	.14	**.31***	.16
Surprise								
d′	−.20	.03	−.26	.11	.18	.08	−.02	−.01
c	−.03	−.02	−.01	−.02	−.18	−.04	**−.32***	−.16
Emotion Labeling Reflection Time	**.41***	−.23	.29	.01	−.18	−.15	.07	.09
Easiness Mean Score	−.08	.19	.05	.09	−.12	−.11	−.28	−.25
Easiness Reflection Time	.30	−.01	.20	−.05	−.05	.06	.11	−.17
Sadness								
d′	.08	−.24	−.15	.28	−.06	−.13	−.03	−.03
c	−.15	−.01	−.05	−.11	.13	−.05	.19	.08
Emotion Labeling Reflection Time	.30	−.14	.06	.19	.03	−.08	**.31***	.13
Easiness Mean Score	−.06	.15	.12	.06	−.08	−.29	**−.33***	−.21
Easiness Reflection Time	**.39***	−.12	.21	−.01	.04	.11	.19	.06

FICSOs = Forensic Inpatients who have Committed Sexual Offenses; FICNSOs = Forensic Inpatients who have Committed Non-Sexual Offenses; CoM = Community Members; YoE = Years of Education; LoS = Length of Stay; d′ = Sensitivity; c = Response bias; *p ≤ .05; **p ≤ .01; ***p ≤ .001.

risk factor dimensions to assess sexual recidivism (Thornton, 2002). Yet, studies are scarce on emotion recognition in individuals who have committed sexual offenses (Chapman et al., 2018; Tiberi et al., 2023). Sexual offending is an international public health concern, with high prevalences of victimization in both women (up to 59.20%) and men (up to 55.50%) (Dworkin et al., 2021). Research on the underlying factors that can precipitate sexual offending is

central to preventing these offenses. Additionally, the few available research on emotion recognition mainly focused on facial expressions. To the authors' best knowledge, only Suchy et al. (2009) investigated affective prosody recognition in incarcerated men with and without pedophilic interest. No study has been undertaken with individuals Not Guilty By Reason of Insanity, whereas a high prevalence (40.40%) of individuals who have committed sexual offenses are found in Belgium's High-Risk Secure Forensic Hospital (Jeandarme et al., 2019).

The discussion will first focus on the results in the light of the international literature. Then, it will highlight the main contributions and limitations of this study. Finally, we will consider the most relevant directions for future research in emotion recognition with forensic inpatients who have committed sexual offenses. These directions imply the constitution of more homogeneous groups, using adult and child stimuli and resorting to in-depth research in affective prosody categories underlying the emotion recognition process.

Accuracy and sensitivity

When all emotions are collapsed, results highlighted that forensic inpatients who had committed sexual offenses and those who had committed non-sexual offenses were less accurate than community members. The same pattern of impaired recognition applied for each discrete emotion apart from disgust, where no difference was found between forensic inpatients who had committed sexual offenses and community members. Disgust has long informed individuals of a toxic or smelly object in the environment (Tybur et al., 2013). As societies evolved, disgust nowadays informs interpersonal and moral disgust. This function aims to protect individuals' physical and psychological integrity and social order (Rozin et al., 2009). Sexual offending, especially against children, elicits more disgust in the community than non-sexual offenses (Bastian et al., 2013; Rade et al., 2016). Specifically, the intensity of disgust is higher if the abuse is perpetrated by a stranger rather than a family member (Hartley & Bartels, 2022). Psychologists who treat these individuals are not spared these negative feelings (Way et al., 2004). Considering that a majority (87.50%) of the forensic inpatients who had committed sexual offenses in our sample abused a minor at least once, we hypothesize that they were more likely confronted with disgust in their judicial and/or care pathway. This could lead them to be as sensitive to disgust as healthy community members.

In addition, our results confirm the findings of Suchy et al. (2009), who only found a trend of impaired recognition of prosodic sadness in individuals who had committed sexual offenses in comparison to community members, whereas we found a significant impairment. Conversely, our findings align with the recent systematic review of Baglione et al. (2023), contradicting the

socioemotional selectivity theory (Carstensen et al., 1999; Murphy & Isaacowitz, 2008) on happiness. Nevertheless, future research should include other positive emotions as 'happiness' was the only positive emotion in our experimental design.

The lack of previous research on affective prosody in individuals who have committed sexual offenses limits the contextualization of our findings in the forensic literature. To overcome this limit, we may cautiously rely on studies that resorted to facial expressions of emotions. Indeed, although prosodic and facial emotion cues imply specific brain regions in the recognition process (see (Schirmer & Adolphs, 2017), for a review), a recent structured equation modeling suggested the existence of a supra-modal common factor in emotion recognition across face, voice and body posture (Connolly et al., 2020). Based on the suggested cross-channel common factor underlying emotion recognition, our results are partially in line with previous findings of a pervasive impairment in the recognition of emotional cues of individuals who have committed sexual offenses (Gery et al., 2009; Gillespie et al., 2015; Hoaken et al., 2007; Hudson et al., 1993), especially in forensic institutions (Tiberi et al., 2024).

Response bias

Turning to response bias, the two forensic inpatient groups were less likely to select the labels of happiness and sadness than community members. Our results do not align with previous findings showing a more liberal response style in the recognition of angry facial expressions of emotion in incarcerated individuals who had committed non-sexual offenses (Gillespie et al., 2015). Moreover, where Gillespie et al. (2015) found a more conservative response style for disgust or fear and a less conservative response style for sadness, we found the opposite for sadness and we found no differences between groups for disgust and fear. Conservative response style implies that some uncertainty remains when hearing the stimuli. Despite good discrimination (high rates of Miss and Correction Rejections), we suggest that forensic inpatients may need complementary cross-modal emotional cues, such as facial expressions or body postures, to overcome this uncertainty. Studies report higher accuracy or sensitivity scores in congruent cross-modal (including context) than unimodal tasks (Bänziger et al., 2011; Laukka et al., 2021). Conversely, we could have expected a less conservative response toward anger, as found in facial expressions by Gillespie et al. (2015), suggesting alertness to aggressive signals, even when these signals are ambiguous (hostile attribution bias).

Emotion labeling reflection time

Analysis showed that emotion labeling reflection times for anger, happiness and fear were longer for forensic inpatients who had committed sexual offenses compared to community members. This result aligns with previous research and meta-analyses that reported age's effect on speed processing (Cronje et al., 2024; Dillien et al., 2020; Joyal et al., 2014; Turner & Rettenberger, 2020). However, easiness reflection time did not differ between groups. We assume that the process's nature, respectively, emotion categories labeling and subjective easiness, do not involve the same underlying cognitive functions. According to psychological Constructionism, semantic knowledge shapes individuals' perception and recognition of emotions (Lindquist & Gendron, 2013). Following this premise, semantic knowledge or representation must also influence speed processing, as was highlighted in Baglione et al. (2023) meta-analysis. Recently, Cosgrove et al. (2023) showed that age impacts the semantic network structure, where conceptual knowledge, such as emotion categories, is stored. Older people may require longer processing time to access the semantic representation of an emotion category. Therefore, such longer processing may not be attributable to the nature of the group but rather to its age.

Task easiness

The two forensic inpatient groups considered disgust, surprise and sadness easier to recognize than the community members. Except for disgust, we found a discrepancy between performance and perceived task easiness in the two forensic inpatient groups. This discrepancy between one's competency and self-perception refers to metacognition, or cognition about cognition (Flavell, 1979). It can be broken down into phases, including self-reflection, defined as the competency to assess one's performance (Schunk, 2001).

Literature showed that metacognitive skills are impaired in community members with psychiatric symptoms (Hoven et al., 2019; Rouault et al., 2018) and psychiatric inpatients (Hoven et al., 2019; Sun et al., 2017), including those with aggressive behavior (Candini et al., 2020). However, the nature of this impairment is uncertain. Some reported impairment in cognitive confidence in psychiatric patients (Sun et al., 2017), while others suggested a nuanced view (Hoven et al., 2019; Rouault et al., 2018). Individuals with anxious-depressive symptoms (e.g. OCD) exhibited under-confident metacognitive skills, whereas individuals with compulsive behaviors and intrusive thought symptoms (e.g. schizophrenia spectrum disorders) presented overconfidence in their performances.

As the prevalence of psychiatric disorders, especially psychosis, is high in our forensic inpatient groups, we hypothesize that decreased metacognitive skills may lead them to an overconfident self-assessment in their competency to recognize affective prosody. We would expect a significantly higher impairment in the forensic inpatients who have committed non-sexual offenses in comparison to their sexual offenses counterparts as they exhibit significantly more mental disorders and Axis I-Axis II comorbidity. Although the forensic inpatients who had committed sexual offenses in our study were older and had been hospitalized longer than their non-sexual offenses counterparts, previous research suggested that age does not impact local metacognition, defined as the trial-by-trial performance self-assessment, in a cross-sectional healthy sample (McWilliams et al., 2023).

Limitations

This study has limitations. Collected groups are unmatched in sociodemographic variables such as age and years of education. In addition, we initially sought to control the influence of age, years of education and length of stay on the dependent variables using ANCOVAs. However, carrying out these analyses based on our data distribution was unsuitable. We then addressed this limitation by running zero-order bivariate correlations between these variables. Finally, despite being validated with French-speaking locutors, the GEMEP has not been validated on forensic inpatients who had committed sexual or non-sexual offenses, or on psychiatric inpatients.

Study contributions and future directions

To date, this study is the first to assess affective prosody recognition in forensic inpatients who have committed sexual offenses, providing critical insights into this population's emotional processing of prosodic social cues. Furthermore, one of the main criticisms addressed to emotion recognition studies, especially but not exclusively to affective prosody, is the use of unnatural expressions, which exhibit dissimilar acoustical patterns compared to natural expressions (Jürgens et al., 2011). These play-acted expressions are generally assessed as less natural by naïve raters. This study handles this limitation, as the GEMEP stimuli set has been created while maximizing believability (audio-only modality: plausibility = .55 and authenticity = .56) (Bänziger et al., 2011).

Future research is needed in the emotional processing field of forensic inpatients who have committed sexual offenses. A first approach would be the constitution of a more homogeneous group. The mere concept of 'sexual offenders,' referred to in this study as forensic inpatients who have committed sexual offenses for ethical reasons (see (Willis, 2018)), is a widely

heterogeneous group (Link & Lösel, 2021). Resorting to more evidence-based or idiosyncratic sampling is thus essential to highlight specific patterns of emotional processing. In this regard, future studies could compare forensic inpatients with and without a pedophilic disorder, as Suchy et al. (2009) only assessed interest rather than diagnosis. Such a study should also consider idiopathic or acquired pedophilia, as meta-analytical results suggested social cognition deficits only in the latter (Scarpazza et al., 2021).

Another suggestion would be to resort to typologies or taxonomies in sexual offending (e.g. rapist vs. regressed child molester vs. fixed child molester, see (Robertiello & Terry, 2007) for a review) or underlying emotional/cognitive processes (e.g. emotion regulation), closer to transdiagnostic current consideration in psychopathology. For example, Link and Lösel (2021) showed that another group should be considered in the analyses: the offenders who have committed sexual offenses against mixed-age victims. This category tends to fall between the two others: individuals who have committed sexual offenses against children and those against adults. They exhibit less impulsive driven but more opportunistic behaviors than those who offended exclusively adults. Conversely, they have a later onset of delinquency than those who offended children who start at a young age (e.g. 10 years old) (Link & Lösel, 2021; Rice & Knight, 2019).

Similarly, using stimuli voiced by children (natural or computerized) would address the question of age-specific emotional processing of models. We could expect higher scores in sensitivity toward child stimuli than adult stimuli by forensic inpatients who have committed sexual offenses against children. Indeed, the literature suggests that these individuals, especially those who sexually abused an extrafamilial child, exhibit emotional congruence, which is defined as a preferential way to relate to children rather than to adults and is seen as threatening (McPhail et al., 2013). Moreover, as speaker's gender influences affective prosody recognition, with a higher recognition rate when pseudo-sentences are uttered by women (Lausen & Schacht, 2018), following studies should compare the recognition performances of forensic inpatients taking gender into account.

A second approach would be to deepen the underlying process of affective prosody recognition, which remains unclear even in healthy community members (Cowen et al., 2019; Wright et al., 2018). Findings show that affective prosody recognition is mainly driven by underlying emotion categories rather than acoustical features such as arousal and valence (Cowen et al., 2019). These emotion categories are conceptualized inside a semantic space, a dimensional 3D framework in which emotions are recognized in relation to each other and organized by three properties: conceptualization, dimensionality and structure (Cowen & Keltner, 2017; Cowen et al., 2019). Conceptualization is defined as '*how categories and affective scales describe the space, and whether each are separately sufficient to infer the emotional state*' (p.4) (Cowen & Keltner, 2018). Dimensionality refers to

the number of vectors inside this 3D space, while structure conveys the emotional distribution (e.g. gradient or cluster) (Cowen & Keltner, 2018). Conceptualized as ARACCE (Wright et al., 2018) or semantic space (Cowen et al., 2019), future work in affective prosody with forensic inpatients who have committed sexual offenses could investigate their representations of discrete emotions and how it may impact their recognition accuracy or sensitivity.

Acknowledgements

The authors thank Mrs. Lucie Audra, psychologist at the CRP "Les Marronniers". The authors also thank Mrs. Charlotte Jacquemyn, Mr. Elian Vermeulen, Mr. Raphaël Jaur, Mrs. Amélie Bourlée, Mrs. Célia Hanquet, Mrs. Manon Leveugle, Mrs. Margaux Mancini, Mrs. Margaux Gossiaux, and Mr. Florian Cornez, current or former students from the Forensic Psychology Department for their assistance in the data collection.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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