S3 Table. Studies on the association of psychopathy and facial emotion recognition performance and functional central and peripheral nervous system correlates

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
Behavior (accuracy)				
Beussink et al., 2020	N total = 145 M offenders; age = 26.26±6.86	PCL-R total and subscales (whole sample)	Explicit recognition of emotions: Matching of emotions (angry, disgustful, sad, surprised, fearful and happy faces)	↑ accuracy for fearful faces (Affective facet) ↓ accuracy for happy faces (Lifestyle facet)
Brislin & Patrick, 2019	N total = 127; M (n = 62); F (n = 65); age = 19.5±3.7	TriPM total and subscales (whole sample)	Explicit recognition of emotions (angry, disgustful, fearful, happy, sad and surprised faces, with different intensities)	↓ accuracy for middle-intensity fearful faces (Meanness subscale) ↓ accuracy for low-intensity disgustful faces (Disinhibition subscale)
Contreras-rodríguez et al., 2014	N=44 M; criminal offenders (n=22; age=39.8±9.2); healthy nonoffenders (n=22; age=40.6±9.5)	PCL-R total and subscales (whole sample)	Implicit emotional face-matching task (happy, fearful and angry faces)	Accuracy: n.s.
Dargis et al., 2018	N = 198 M inmates; age = 18-55	PCL-R total and subscales (whole sample)	Explicit recognition of emotions (happy, sad, angry, fearful, disgustful, and neutral faces) and viewing of emotions (happy, angry, fearful, and neutral faces)	↓ accuracy for fearful faces (Affective facet) ↑ accuracy for fearful faces (Lifestyle facet)
Deeley et al., 2006	N total = 15 M; offenders (n = 6; age = 36.0±9.0); HC (n = 9, age = 27.0±5.0)	PCL-R total (offenders)	Implicit emotion recognition task (fearful, happy and neutral faces)	Accuracy: n.s.

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
Dolan & Fullam, 2006	N total = 98 M; offenders (n = 49, age = 35.2±10.3); HC (n = 49, ag e =35.3±9.1)	PCL:SV total and subscales (offenders)	Explicit recognition of emotions (morphed angry, disgustful, fearful, happy, sad and surprised faces, with different intensities)	↓ accuracy for sad faces (total score) ↓ accuracy for happy faces (Antisocial facet) Response time: n.s
Dolan & Fullam, 2004	N total = 109 M; antisocial inmates (n = 89; age = 36.7±9.9); HC (n = 20; age = 33.6±4.9)	PCL:SV total (anti-social inmates)	Explicit recognition of emotions (happy, sad, angry, fearful, surprised, disgustful and distressed faces, with covered or uncovered eyes)	↑ accuracy for all emotion expressions (antisocial inmates)
Eisenbarth et al., 2008	N total = 44 F; forensic patients (n = 28) + community people (n = 16); age = 41.7±11.5	PCL-R total (forensic patients)	Explicit recognition of emotions (anxious, angry, disgustful, happy, neutral, sad and surprised)	↓ accuracy for short presentation of sad faces
Faith et al., 2023	N total = 139 M; inmates; age = 26.3±6.9	PCL-R total and subscales (whole sample)	Explicit recognition of emotions (morphed happy, sad, angry, fearful, surprised and disgusted faces)	↑ response time for angry faces (Antisocial facet)
Faith et al., 2022	N total = 288 M; inmates; age = 26.7±6.8	PCL-R total (whole sample)	Explicit recognition of emotions (morphed happy, sad, angry, fearful, surprised and disgusted faces)	↓ accuracy for fearful faces
Gehrer et al., 2019	N total = 36 M; psychopathic (n = 19, age = 40.3±11.1); non-psychopathic offenders (n = 17, age = 37.4±9.0)	PCL-R total (whole sample)	Explicit recognition of emotions & gender (angry, disgustful, happy, fearful, sad, surprised and neutral faces)	Accuracy: n.s.
Gillespie et al., 2019	N total = 73 M violent offenders; age = 38.7±11.7	TriPM total and subscales (whole sample)	Explicit recognition of emotions (morphed neutral, angry, disgustful, fearful, happy, sad, and surprised faces with different levels of intensity)	↓ accuracy for fearful faces ↑ accuracy for sad faces

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
Gillespie et al., 2017	N total = 55 M; violent offenders (n=30; age = 35.1±11.8; community people (n = 25; age = 37.9±18.3	TriPM subscales (whole sample)	Explicit recognition of emotions (morphed angry, disgustful, fearful, happy, sad and surprised faces, with different intensities)	Accuracy: n.s.
Gillespie et al., 2015	N = 38 community M; age = 23.2±4.9	LSRP subscales (whole sample)	Explicit recognition of emotions (morphed angry, disgustful, fearful, happy, sad and surprised faces, with different intensities)	Accuracy: n.s.
Glass & Newman, 2006	N total = 111 M; psychopathic inmates (n = 50, age = 32.58±7.08); non-psychopathic inmates (n = 61, age = 32.0±7.0)	PCL-R total score (whole sample)	Explicit recognition of emotions (angry, fearful, happy and sad faces): Identify condition & Locate condition (congruent with attentional set)	↑ accuracy for fearful faces (Identify condition)
Gordon et al., 2004	N total = 20 community M; age = 23.5±4.1	PPI total and subscales (whole sample)	Explicit recognition of emotions (angry, fearful, sad, and joyful faces) Emotion recognition condition and identity condition (which emotion is vs. who the person is)	Accuracy: n.s. Response time: n.s.
Hansen et al., 2008	N total = 43 M offenders; age = 31.6	PCL-R total and subscales (whole sample)	Explicit recognition of emotions (sad, fearful, disgustful, angry, surprised, happy, and neutral)	↑ accuracy for disgustful faces (Lifestyle and Antisocial facets) ↓ accuracy for neutral faces (Affective facet) ↓ accuracy for female disgustful faces (Interpersonal facet)

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
Igoumenou et al., 2017	N total = 1353 M ex-inmates; age = 29.9±0.4	PCL-R total and subscales (whole sample)	Explicit recognition of emotions (morphed happy, surprised, sad, fearful, angry and disgustful faces, with different intensities)	↑ accuracy for angry faces (Interpersonal facet) ↓ accuracy for fearful and disgustful faces (Affective facet) ↓ accuracy for surprised faces (Lifestyle facet) ↓ accuracy for fearful, disgustful and surprised faces (Antisocial facets)
Jusyte & Schönenberg, 2017	N total = 69 M; violent offenders (n = 34; age = 37.8±10.84); HC (n = 35; age = 30.5±11.8)	SRP-III total and subscales (whole sample)	Implicit recognition of emotions Experiment 1: Emotion sensitivity (angry, happy, fearful and neutral faces, with different intensities); Experiment 2: Ambiguous expressions task (blended happy-fearful, happy-angry and fearful-angry faces)	Experiment 1: n.s. Experiment 2: ↓ accuracy for ambiguous fearful faces (violent offenders' total score, Callous Affect and Antisocial Behavior subscales)
Khvatskaya & Lenzenweger, 2016	N total = 47 community; M (n = 16); F (n = 31); age = 18.9±1.6	PPI-R total (whole sample)	Explicit recognition of emotions (angry, contempted, disgustful, fearful, joyful, sad, surprised, or neutral faces)	n.s.
Kosson et al., 2002	N total = 67 M; psychopath inmates (n = 34, age = 27.0±2.8); non-psychopath inmates (n = 33, age=27.0±6.5)	PCL-R total (whole sample)	Explicit recognition of emotions (happy, sad, angry, fearful and disgustful)	↓ recognition accuracy for disgustful faces
Kranefeld & Blickle, 2022	N total = 477 community; M (n = 305); F (n = 272); age = 40.3±12.3	TriPM, PPI-R and LSRP total and	Implicit emotional face-matching task	Accuracy: n.s.

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
		subscales (whole sample)		
Kuin et al., 2017	N total = 117 M; violent offenders (n=71; age = 36.6±11.8); nonviolent offenders (n = 14; age = 37.4±10.4); HC (n = 32; age = 41.8±11.2)	PPI-R total (violent offenders and nonviolent offenders)	Explicit recognition of emotions (morphed sequences from unambiguous happy to unambiguous angry faces)	n.s.
Künecke et al., 2018	N total = 266 M; inmates (n = 179) and HC (n = 87); age = 35.9±11.0	PCL:SV total (whole sample)	Explicit recognition of emotions (morphed dynamic angry, happy, sad and neutral faces)	↑ response time for neutral faces
Mier et al., 2014	N total = 29 M; inmates (n = 11, age = 44.6±9.0); HC (n = 18, age = 44.0±10.4)	PCL-R total (inmates); PPI-R total (HC)	Explicit recognition of emotions (happy, angry, fearful and neutral faces): Affective Theory of Mind (ToM), Emotion recognition & Neutral face conditions	Accuracy: n.s. Response time: n.s
Mowle et al., 2019	N total = 110 community; M (n = 36); F (n = 74); age 18-19	TriPM total and subscales (whole sample)	Explicit recognition of emotions (fearful, happy, sad, angry, surprised, calm, neutral, and disgustful faces)	↓ accuracy for fearful faces (Meanness subscale in high traits)
Munro et al., 2007	N total = 30 M; violent offenders (n = 15, age = 45.9±3.5); HC (n = 15, age = 46.6±1.8)	PCL-R total (violent offenders)	Explicit emotion recognition: Face flanker task (angry and fearful faces) and letter flanker task	Response time: n.s. ↓ fearful-face flanker accuracy (in violent offenders)

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
Olderbak et al., 2018	N total = 339 M; forensic patients + inmates (n = 226) HC group (n = 113); age = 18-65	PCL:SV total (whole sample)	Explicit recognition of emotions (angry, disgustful, fearful, happy, sad and surprised faces): Task 1: Different intensity from upright and inverted dynamic faces; Task 2: Composite faces; Task 3: Facially expressed emotions	Task 1: ↓ accuracy for upright inverted disgustful, fearful, happy and surprised faces (forensic) Task 2: ↓ accuracy for happy expressions in composite (forensic) Task 3: ↓ accuracy for angry faces in inmates and happy (community)
Oliver et al., 2015	N total = 40 community; M (n = 16); F (n = 24); age = 21.6±3.7	PPI-R total and subscales (whole sample)	Implicit recognition of emotions: Continuous flash suppression/presentation (disgustful, fearful and neutral faces); Objective index (emotion localization) & Subjective index (confidence rating)	↓ accuracy for fearful faces (Objective index, Coldheartedness subscale)
Pera-Guardiola et al., 2016	N total = 39 M; criminal offenders (n = 19; age = 39.2±8.9); healthy non-offenders (n = 20; age = 40.6±9.9)	PCL-R total and subscales (whole sample)	Explicit facial emotion expression recognition task (gradually morphed happy, surprised, fearful, sad, disgustful and angry faces)	↓ accuracy for sad, happy and fearful faces ↑ accuracy for sad faces and fearful faces (Antisocial facet)
Pham & Philippot, 2010	N total = 68 M; psychopathic inmates (n = 20, age = 34.0±10.1); non-psychopathic inmates (n = 23, age = 34.6±8.8); HC (n = 25, age = 35.4±7.9)	PCL-R total and subscales (inmates)	Explicit recognition of emotions (morphed happy, angry, sad, fearful, or disgustful faces, varied in intensity)	↓ accuracy for happy, angry and disgustful faces

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
Philipp-Wiegmann et al., 2017	N = 70 M; reactive violent offenders (n = 17, age = 34.9±14.6); proactive violent offenders (n = 24, age = 34.0±14.5); community people (n = 29, age = 31.6±12.3)	PCL:SV total (whole sample)	Explicit recognition of emotions (angry, fearful, surprised, sad, happy, and disgustful)	↓ accuracy overall (both violent offenders' groups)
Schönenberg & Jusyte, 2014	N total = 110 M; violent offenders (n = 55; age = 33.4±9.8); HC (n = 55; age = 30.4±10.2)	PPI-R total and subscales (violent offenders)	Implicit recognition of emotions: Ambivalence task (morphed sequences happy–fearful, happy–angry and fearful–angry faces)	n.s.
fMRI				
Carré et al., 2013	N total = 200; M (n = 83); F (n = 117); community; age = 19.7±1.3	SRP-SF subscales (whole sample)	Implicit emotion perceptual face-matching task (fearful, angry, surprised, and neutral faces)	↓ R dorsal AMY to fearful faces (Interpersonal facet) ↑ R dorsal AMY to angry faces (Lifestyle facet)
Contreras-rodríguez et al., 2014	N = 44 M; criminal offenders (n = 22; age = 39.8±9.2); healthy nonoffenders (n = 22; age = 40.6±9.5)	PCL-R total and subscales (whole sample)	Implicit emotional face-matching task (happy, fearful and angry faces)	↑ frontal cortex for all emotions (F1) ↓ frontoparietal cortex, visual areas, and diencephalic–mesencephalic structures for all emotions (F2) Connectivity: n.s. (total score, F1 and F2)
Decety et al., 2014	N total = 80 M inmates; age = 18-50	PCL-R total and subscales (whole sample)	Implicit recognition of dynamic emotions (fearful, sad, happy, and painful faces)	F1 and 2: ↓ bilateral FG, R IFG, R OFC,R dmPFC, L inferior temporal pole, and bilateral middle frontal gyrus for happy; ↓ bilateral middle occipital

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
				gyrus ,R IFG, and R supramarginal gyrus for fearful faces; ↓ L pSTS, R IFG, bilateral dmPFC, and R SMA for sad; ↓ middle cingulate cortex, IFG, dmPFC and L angular gyrus to painful faces; ↑ aINS for painful faces Factor 1:↓right middle occipital gyrus, bilateral IFG,R vmPFC, L OFC and R inferior temporal pole for happy faces; ↓ L insula, R vmPFC, OFC and R SMA for fearful faces; ↓ L IFG and R middle frontal gyrus for sad faces; ↓ R angular gyrus and L pSTS for painful faces; ↑ L postcentral gyrus and R precentral gyrus for painful faces Factor 2: ↓ right supramarginal gyrus and R SMA for happy faces; ↓R INS, L IFG, L middle frontal gyrus, and L SMA for fearful faces; ↓ L FG, left IFG and L inferior temporal pole for sad; ↓R STS, dorsal ACC, and striatum for painful faces;

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
				Total high vs. low: ↓ bilateral FG, dmPFC, inferior temporal pole, and R middle frontal gyrus for fearful faces Factor 1 high vs. low: ↑R INS for fearful faces; ↑left aINS and L middle cingulate gyrus to sad faces
Deeley et al., 2006	N total = 15 M; offenders (n = 6; age = 36.0±9.0) HC (n = 9, age = 27.0±5.0)	PCL-R total (offenders)	Implicit emotion recognition task (fearful, happy and neutral faces)	↓ bilateral cerebellum and FG, L postcentral gyrus for fearful faces (vs. HC) ↑ R INS and precuneus, ↓ cerebellum and FG for fearful faces (vs. neutral) ↓ R FG, L lingual gyrus, cerebellum and precentral gyrus for happy faces (vs. HC) ↑ R cerebellum, bilateral FG and middle occipital gyrus, R precuneus, anterior cingulate gyrus, medial frontal gyrus, L superior parietal lobule and precuneus for fearful faces (vs. neutral)
Gordon et al., 2004	N total = 20 community M; age = 23.5±4.1	PPI total and subscales (whole sample)	Explicit affect recognition task (angry, fearful, sad, and joyful faces) Emotion recognition condition and identity condition (which emotion is vs. who the person is)	↓ R inferior frontal córtex, R AMY and mPFC ↑ visual cortex (Emotional Interpersonal subscale) ↑ R AMY in emotion recognition condition (Social Deviance subscale)

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
				↓ mPFC in emotion recognition condition (total score)
Mier et al., 2014	N total = 29 M; inmates (n = 11, age = 44.6±9.0); HC (n = 18, age = 44.0±10.4)	PCL-R total (inmates); PPI-R total (HC)	Explicit recognition of emotions (happy, angry, fearful and neutral faces): Affective Theory of Mind (ToM), Emotion recognition & Neutral face conditions	↓ R FG for all faces ↓ R FG and L AMY (affective ToM task)
Pera-Guardiola et al., 2016	N total = 39 M; criminal offenders (n = 19; age = 39.2±8.9); healthy non-offenders (n = 20; age = 40.6±9.9)	PCL-R total and subscales (whole sample)	Explicit facial emotion expression recognition task (gradually morphed happy, surprised, fearful, sad, disgustful and angry faces)	↑ volume of dmPFC for better sad faces recognition; and middle ACC, aINS, IFG, OFC and anterior cerebellum for better happy faces recognition; and somatosensory cortex for better fearful faces recognition ↑volume of dmPFC for better recognition of all faces (Lifestyle facet)
EEG				
Almeida et al., 2014	N total = 54 community M; age = 23.2±3.8	PPI-R total and subscales (whole sample)	Explicit recognition of emotions (angry, fearful, disgustful, happy, neutral and calm faces, varying spatial frequency content)	↓ N170 amplitude for facial expressions (Fearless dominance subscale) ↑ N170 amplitude for fearful and happy faces (Coldheartedness subscale)
Brislin & Patrick, 2019	N total = 127; M (n = 62); F (n = 65); age = 19.5±3.7	TriPM total and subscales (whole sample)	Explicit recognition of emotions (angry, disgustful, fearful, happy, sad and surprised faces, with different intensities)	↓ L and R N170 amplitude for fearful faces; ↓ P200 amplitude for fearful faces; and ↓ LPP amplitude to fearful and sad faces (Meanness subscale)

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
				↑ L N170 amplitude for fearful faces (Disinhibition subscale)
Eisenbarth et al., 2013	N total = 23 F forensic patients; M = 37.0±8.8	PCL-R total and subscales (whole sample)	Implicit recognition of emotions (fearful, angry, and happy faces); Viewing of emotions (positive, negative and neutral)	N170, P3 and LPP amplitudes: n.s. ↓ N2 amplitude for angry and fearful faces (F2)
Munro et al., 2007	N total = 30 M; violent offenders (n = 15, age = 45.9±3.5); HC (n = 15, age = 46.6±1.8)	PCL-R total (violent offenders)	Explicit emotion recognition: Face flanker task (angry and fearful faces) and letter flanker task	↓ ERN negative amplitude during face flanker task (in violent offenders)
Eye-gazing				
Dargis et al., 2018	N = 198 M inmates; age = 18-55	PCL-R total and subscales (whole sample)	Explicit recognition of emotions (happy, sad, angry, fearful, disgustful, and neutral faces) and viewing of emotions (happy, angry, fearful, and neutral faces)	↓ fixations on eyes of fearful faces (Interpersonal facet) ↑ fixations on eyes of fearful faces (Antisocial facet) ↓ fixations on eyes of fearful faces during free viewing (total score)
Gehrer et al., 2019	N total = 36 M; psychopathic (n = 19, age = 40.3±11.1); non-psychopathic offenders (n = 17, age = 37.4±9.0)	PCL-R total (whole sample)	Explicit recognition of emotions & gender (angry, disgustful, happy, fearful, sad, surprised and neutral faces)	↓ dwell time on eyes overall (in psychopathic offenders)
Gillespie et al., 2017	N total = 55 M; violent offenders (n = 30; age =	TriPM subscales (whole sample)	Explicit recognition of emotions (morphed angry, disgustful, fearful,	↓ dwell time and fixations on the eyes overall (Boldness subscale)

Study	Sample	Psychopathy measure/scores	Task/Emotional stimuli	Association with psychopathy
	35.1±11.8; community people (n = 25; age = 37.9±18.3		happy, sad and surprised faces, with different intensities)	
Gillespie et al., 2015	N = 38 community M; age = 23.2±4.9	LSRP subscales (whole sample)	Explicit recognition of emotions (morphed angry, disgustful, fearful, happy, sad and surprised faces, with different intensities)	↓ dwell time and fixations on the eyes of angry and fearful faces (Primary psychopathy scale)
Mowle et al., 2019	N total = 110 community; M (n = 36); F (n = 74); age 18-19	TriPM total and subscales (whole sample)	Explicit recognition of emotions (fearful, happy, sad, angry, surprised, calm, neutral, and disgustful faces)	Fixation on facial features: n.s.
Pupillometry				
Burley et al., 2017	N total = 102 community M (n = 50); F (n = 52); age = 21.1±3.6	TriPM total and subscales (whole sample)	Implicit recognition of emotions (unpleasant, pleasant and neutral); Static & dynamic expressions viewing (fearful, happy, neutral, disgustful, angry and sad faces)	n.s.
Burley et al., 2019	N total = 82 M forensic psychiatric inpatients; age = 38.6±12.8	PCL-R total and subscales (whole sample)	Implicit emotion recognition of static & dynamic emotional expressions (fearful, happy, neutral, disgustful, angry and sad faces)	↓ dilation for angry faces (Interpersonal facet) ↑ dilation for happy faces (Interpersonal and Affective facets)
Gillespie et al., 2019	N total = 73 M violent offenders; age = 38.7±11.7	TriPM total and subscales (whole sample)	Explicit recognition of emotions (morphed neutral, angry, disgustful, fearful, happy, sad, and surprised faces with different levels of intensity)	↓ pupil dilation for fearful, happy and sad faces (Meanness subscale)

Note. PCL-R = Psychopathy Checklist – Revised; PCL:SV = Psychopathy Checklist: Screening Version; PPI = Psychopathic Personality Inventory; PPI-R = Psychopathic Personality Inventory – Revised TriPM = Triarchic Psychopathy Measure; LSRP = Levenson's Self-Report Psychopathy Scale; SRP = Self-Report Psychopathy Scale; SRP-III = Self-Report Psychopathy Scale – Third Version; SRP-SF = Self-Report Psychopathy Scale – Short Form; F1 = PCL-R's Factor 1; F2 = PCL-R's Factor 2; FG = fusiform gyrus; IFG = inferior frontal gyrus; OFC = orbitofrontal cortex; PFC = prefrontal cortex; mPFC = medial PFC; dmPFC = dorsomedial PFC; vmPFC = ventromedial PFC; SMA = supplementary motor area; INS = insula; aINS = anterior INS; STS = superior temporal sulcus; pSTS = posterior STS; ACC = anterior cingulate cortex; AMY = amygdala; GM = grey matter; ERN=error-related negativity; Pe = error positivity; LPP = late-positive potential; fMRI = functional magnetic imaging; EEG = electroencephalography; ERP = event-related potentials; M age=mean age; ↓ = lower; ↑ = higher; n.s. = non-significant; M = males; F = females; HC = healthy controls; R = right; L = left.