Neuroscience and Biobehavioral Reviews 131 (2021) 1116–1126

Contents lists available at ScienceDirect

Neuroscience and Biobehavioral Reviews

journal homepage: www.elsevier.com/locate/neubiorev

Unzipping empathy in psychopathy: Empathy and facial affect processing in psychopaths

Ronald J.P. Rijnders [a,b,*], David Terburg [b,c], Peter A. Bos [d], Maaike M. Kempes [d,e,1], Jack van Honk [c,f,1]

[a] Netherlands Institute of Forensic Psychiatry and Psychology, Forensic Observation Clinic "Pieter Baan Centrum", Carl Barksweg 3, 1336 ZL, Almere, the Netherlands
[b] Utrecht University, Faculty of Social Sciences, Department of Psychology, Heidelberglaan 8, 3584 CS, Utrecht, the Netherlands
[c] University of Cape Town, Department of Psychiatry and Mental Health, J-Block, Groote Schuur Hospital, Observatory, 7925, Cape Town, South Africa
[d] Leiden University, Faculty of Social and Behavioural Sciences, Institute of Education and Child Studies, Wassenaarseweg 52, 2333 AK, Leiden, the Netherlands
[e] Netherlands Institute of Forensic Psychiatry and Psychology, Department of Science and Education, Herman Gorterstraat 5, 3511 EW, Utrecht, the Netherlands
[f] University of Cape Town, Institute of Infectious Diseases and Molecular Medicine, Anzio Rd, Observatory, 7925, Cape Town, South Africa

ARTICLE INFO

Keywords:
Psychopathy
PCL-R
Empathy
Zipper model of empathy
Amygdala
Facial affect processing

ABSTRACT

Psychopathy is a neurodevelopmental disorder that has a highly deleterious effect upon both individuals and society at large. Psychopaths grossly neglect and disrespect the interests of others. Their antisocial behavior is thought to originate from a lack of empathy. However, empathy is multidimensional in nature, as evidenced by the considerable heterogeneity in extant theorizing on the subject. Here, we present the "Zipper model of empathy" that reconsiders how both its affective and cognitive components converge in mature empathic behavior. Furthermore, the Zipper model of empathy is expedient for explaining the empathy deficits in psychopathy, insofar as it brings together current theories on the dysfunctional affective components of empathy, violence inhibition, and automatic versus goal-directed attention. According to the literature, the neurobiological underpinnings of these theories are amygdala-centered; however, this article traces this specifically to the basolateral and central amygdala subregions. When viewed together, the cognitive and affective components of empathy are zipped together in a natural fashion in healthy empathic behavior, whereas psychopaths leave the zipper substantially unzipped in pursuit of their purely self-centered goals.

1. Introduction

Psychopathy is a personality disorder characterized by disturbances in the emotional, interpersonal, and behavioral domains. Psychopaths grossly take advantage of other people by both neglecting and disrespecting their interests. They behave like predators insofar as they do not care about the pain they inflict upon the persons they consider as prey. The estimated lifetime prevalence of psychopathy worldwide in the general population ranges from 0.5 % to 1%, whereas psychopaths are overrepresented in the North-American correctional populations with prevalence figures as high as 15–25 % (Hare, 1996). Coid et al. (2009) found in a representative national sample of English and Welsh prisoners that the psychopathy prevalence figures were 7.7 % (95 % CI 5.2–10.9) in men and 1.9 % (95 % CI 0.2–6.9) in women. There are strong indications that psychopathic traits in males are associated with psychopathic traits in their male and female offspring (Auty et al., 2015). This warrants serious attention considering the significant annual healthcare costs for children with antisocial behavior (Romeo et al., 2006). Reducing the disruptive actions of psychopaths in society might be cost-effective, insofar as psychopathy is a risk factor for perpetration of violence (odds ratio = 5–10, in relation to other offenders and psychiatric patients; Hart and Storey, 2013). Based on a study by Anderson (1999); Kiehl and Hoffman (2011) calculated that psychopaths were responsible for around $460 billion of criminal social costs each year in the United States alone (US dollars in 2009). This figure did not include the costs of psychiatric treatment for psychopaths themselves, nor did it account for various indirect costs, such as, for example, treatment for victims and their non-quantifiable emotional

* Corresponding author at: Netherlands Institute of Forensic Psychiatry and Psychology, Forensic Observation Clinic "Pieter Baan Centrum", Carl Barksweg 3, 1336 ZL, Almere, the Netherlands.
E-mail address: r.rijnders@dji.minjus.nl (R.J.P. Rijnders).
[1] Kempes and Van Honk report an equal contribution.

https://doi.org/10.1016/j.neubiorev.2021.10.020
Received 5 November 2020; Received in revised form 15 October 2021; Accepted 17 October 2021
Available online 22 October 2021

suffering. These astronomical costs led Kiehl and Sinnot-Armstrong to conclude that "psychopathy is likely the most expensive mental health disorder known to man" (2013, p. 1).

The lay public's assumptions about what constitutes prototypical psychopathic behavior rarely corresponds to the clinical reality. Due to both the diversity and varying intensities of the symptoms in the emotional, interpersonal, and behavioral domains that determine the diagnosis of psychopathy (Hare, 1996, 2003; Brinkley et al., 2004), heterogeneity is the rule in the clinical expression of psychopathy. Notwithstanding this heterogeneity, some core characteristics are invariably present (Martens, 1997), most notably, severe empathy deficits that are considered to be pivotal to the construct of psychopathy (Cleckley, 1976; Blair, 2007; Patrick et al., 2009; Verschuere et al., 2018; Verschuere and te Kaat, 2020). Indeed, Soderstrom (2003) has even argued that psychopathy should in fact be classified as an empathy disorder, based on the fact that psychopathic predators' high involvement in violent criminality reflects either a lack of or ineffective empathic functioning on their behalf. Although we certainly believe that empathy deficits do play a central role in the construct of psychopathy, we will not argue that empathy deficits are identical to the entire clinical presentation of psychopathy. As described in § 2, psychopathy is characterized by behavioral, cognitive, and affective problems (Brinkley et al., 2004; Hare, 1996) that go beyond empathy deficits alone. However, in this contribution, we will focus primarily on empathy deficits in the construct of psychopathy.

Basically, empathic processes can be understood as the social glue in society (Chakrabarti & Baron-Cohen, 2011) that binds human beings. The capacity to communicate expressed emotions is essential for the establishment of social understanding and social relationships (Kraaijenvanger et al., 2017), and is primarily based on both the transmission and decoding of facial emotional expressions (Smith et al., 2005). Contextual appraisal of emotional states and group variables allied with attentional and motivational factors are all important sunderpinnings of the empathy construct. Therefore, one can assume that healthy functioning people will display dynamic alterations in their empathy processing in a variety of different circumstances. The question as to what precise mechanism accounts for the empathic malfunctioning observed in psychopathy remains unanswered, yet. It is not known whether it should be considered as either a defective trait, and thus by definition difficult to change or perhaps even resistant to therapeutic interventions, or as a state-dependent, dynamic process, which might be altered by psychotherapy or pharmacotherapy. If the latter is the case, then one could assume that therapeutic interventions, for example those focused on attentional and motivational processes, could contribute toward improving the psychopath's disturbed empathic functioning. Indirect support for this assumption comes from a study that demonstrated how psychosocial interventions and high-quality foster care positively influenced both the development and impact of callous-unemotional traits in boys with a history of severe early deprivation (Humphreys et al., 2015).

The present article focuses on empathy processing in psychopathy as well as its relationship to the difficulties psychopaths have with facial emotional information processing. After giving a brief introduction to the Psychopathy Checklist, that is, the gold standard for psychopathy diagnosis, the multidimensional construct of empathy with its cognitive and affective components is discussed, followed by a proposal for an integrative model (the Zipper model of empathy). Within the Zipper model, cognitive and affective processes conjointly interact to build up ("zipping up") to mature empathic behavior, whereas the "unzipping" of these processes results in either hindered empathic behavior or its disappearance entirely. Psychopaths are known to have little or no empathy-related affective responses, while, simultaneously, they are not necessarily being disturbed in their cognitive processing (Richell et al., 2003; Blair, 2007). Their poor empathic behavior might be due, in part, to deficits in facial emotional information processing, although there are debates over whether these deficits stem from either innate deficient amygdala processing (Blair, 2005a, b) or the failure to allocate attention to stimuli that are considered of secondary importance (response modulation theory of psychopathy; see: Newman and Lorenz, 2003; Baskin-Sommers et al., 2009).

2. Psychopathy checklist

Psychopathy is assumed to be a personality disorder that persists throughout life (Hare, 1996), and is operationally defined by the Psychopathy Checklist-Revised (PCL-R; Hare, 1991, 2003). This 20-item checklist with scores of 0, 1 or 2 for each item has a maximum score of 40, which represents the extreme end of the psychopathy scale. As it seems that various etiological pathways might produce high scores on the PCL-R, psychopathy should thus be considered as an etiologically heterogeneous entity (Brinkley et al., 2004). Numerous studies have tried to identify PCL-R sub-scores in the search for these heterogeneous components. Harpur et al. (1988), for instance, demonstrated that the PCL-R consists of two major factors: interpersonal/affective and impulsive/antisocial lifestyle items. Using confirmatory factor analysis of North American and Scottish PCL-R data, Cooke and Michie (2001) presented a three-factor hierarchical model of psychopathy, comprising 1) an arrogant and deceitful interpersonal style, 2) a deficient affective experience, and 3) an impulsive and irresponsible behavioral style. In their model, antisocial criminality was hardly emphasized, as the authors did not consider this to be a constitutive feature of psychopathy, although they did acknowledge that it was certainly a correlate (see also Cooke et al., 2004; Skeem and Cooke, 2010). Hare (2003) then proposed a four-factor model (also referred to as a four-facet model), comprising 1) an interpersonal factor (with PCL-R items: glib/superficial, grandiose self-worth, pathological lying, conning/manipulative), 2) an affective factor (lack of remorse or guilt, shallow affect, callousness or lack of empathy, failure to accept responsibility), 3) a behavioral lifestyle factor (stimulation seeking, impulsivity, irresponsibility, parasitic orientation, lack of realistic goals), and 4) an antisocial factor (poor behavioral controls, early behavioral problems, juvenile delinquency, revocation of conditional release, criminal versatility). Two PCL-R items (promiscuous sexual behavior, and many short-term marital relationships) are left separately as they do not load under these four factors (facets).

Cooke et al. (2005) examined the generalizability of the PCL-R from North America to continental Europe, concluding that psychopathy appears to have a syndromic structure that is stable across cultures. Although no evidence of cross-cultural structural bias in PCL-R ratings was found, cross-cultural metric bias in ratings of psychopathic symptoms were found to be statistically significant and clinically meaningful. According to these authors, this should prompt the implementation of a lower diagnostic cut-off score in Europe. Although Bolt et al. (2007) stated that a PCL-R cut-off score of 30 provided the best global clinical assessment of psychopathy, Cooke et al. (2005) suggested that in Europe a PCL-R cut-off score of 28 points was equivalent to the North American cut-off score of 30 points, based on the fact that lower cut-off scores (even 25 and higher) were used in research and treatment programs in different European countries (Grann et al., 1998; Cooke, 1998; Rasmussen et al., 1999; Cooke and Michie, 1999; Mokros et al., 2013).

In all these three aforementioned models, factor analysis resulted in a distinct factor, namely disturbed affective processing (e.g., empathy dysfunction), being an important underpinning of psychopathy. Therefore, we will first discuss the concept of empathy and its mutually interacting affective and cognitive components.

3. Empathy construct

The literature galore on the construct of empathy provides a wide variety of definitions and nuanced interpretations from a broad range of academic fields, such as, for example, neurology, developmental psychology, neuro-economics, psychiatry, social psychology and primatology (Batson, 2009; see Hanson (2003) for a brief historical overview of

the development of the concept of empathy, who also cited a model of eight different types of sympathy developed by Scheler in the 1920s). Indeed, the complicated and elusive character of empathy leads one to conclude that it is an "essentially contested concept" (Gallie, 1956).

Empathy is a multidimensional construct that results from conjointly operating cognitive and affective processes. Before unpacking empathy further, it is first important to emphasize that while the construct of empathy comprises cognitive and affective components, these components themselves are not synonymous with the end result, that is, empathic behavior. Considering this, and despite the frequent usage of these terms in extant literature and daily life, "cognitive empathy" and "affective empathy" should thus be considered as underlying factors that contribute to the expression of empathic behavior. Therefore, we recommend using terms such as "components" or "parts" when describing the cognitive or affective aspects of the empathy construct.

Empathy is thought to emerge during early developmental stages (Decety, 2015) and can serve as a powerful resource in personal adjustment during stressful circumstances (Feshbach, 1997). There is considerable evidence that empathy has deep evolutionary, neuroendocrine, and neurophysiological underpinnings (Decety et al., 2012). As such, empathy plays a pivotal role in social understanding and social relationships. Cohen and Strayer (1996) defined empathy as the ability to understand and share in another person's emotional state. Klimecki and Singer (2013) added to this definition by stating that there should be no confusion with one's own emotional state. This is in line with Hoffman's (2008) point that mature empathy is metacognitive, that is, one is cognizant of the fact that the emotion felt is a response to the emotional state of another person. According to Feshbach (1997), in her integrative cognitive-affective model of empathy, "the affective empathy reaction is postulated to be a function of three component factors: (a) the cognitive ability to discriminate affective cues in others; (b) the more mature cognitive skill involved in assuming the perspective and role of another person; and (c) emotional responsiveness, that is, the affective ability to experience emotions" (p. 36). She stressed that in both her own and other models of empathy, the ability to differentiate oneself from another is a critical requirement. It is instructive to note here that this integrative cognitive-affective model implies that the emergence of mature empathy (i.e., empathic behavior) is dependent on the interaction between both the affective and cognitive components.

Both Walter (2012) and Adriaense et al. (2020) provided an overview of the various components of the broader construct of empathy, including affective behavior, affective experience, affective isomorphism, perspective taking, self-other distinction, orientation toward the other, and prosocial motivation. When reflecting on empathy, one might easily overlook the fact that rather than consisting of a unidirectional operation in which someone perceives and processes the emotional signals of another person, empathy in fact results from a mutually driven process between persons. That is to say, the self and the other are simultaneously both the "sender" and "receiver" (see also Main et al., 2017). In this reciprocal interplay, empathy processing takes place via ongoing adjustments in the transmission of one's own emotional signals and the perception of those of the other person.

A phenomenon called mimicry precedes empathy processing. Mimicry is an automatically elicited motor muscle response that mirrors another person's emotional expression, including his or her emotional postures, gestures, or facial expressions (Chartrand and van Baaren, 2009; Lipps, 1903). Although direct contact with others is of great importance in the empathy-inducing process, it is theoretically possible that empathy for non-present others is generated through semantic processing and the construction of visual or auditory images of others (of them suffering, for example), which, in turn, may induce mimicry processing and, consequently, empathic responses (Hoffman, 2008). Mimicking facially expressed emotions forms part of a highly dynamic interpersonal process (Chartrand et al., 2005) that eventually can elicit the corresponding emotional state in the perceiver (Söderkvist et al., 2018; Olszanowski et al., 2019). Bird and Viding (2014) posited that this can induce a process called emotional contagion, that is, an affectively resonant and similar (isomorphic) reaction in the self (perceiver) when observing another person's emotion. They argued in their self to other model of empathy (SOME) that emotional contagion is at the root of the empathy construct. The basic premise of SOME is that the perceiver's own emotional state might be activated and shaped by the sender's expression of their emotional state. This isomorphic reaction is strictly self-oriented. Mimicry is also referred to as motor empathy (Blair, 2005a, b). However, this term is perhaps confusing, since mimicry and emotional contagion are preceding components of the emerging empathy construct and, as such, should be regarded as precursors of empathy (Klimecki & Singer, 2013). Ultimately, mimicking induced emotional contagion can facilitate the processing of affective forms of empathy (Hermans et al., 2006; Hoffman, 2000; de Wied et al., 2006; Sonnby-Borgström, 2002; Scheffer et al., 2011). In emotional contagion, the self-other distinction is not present, while in the evolving process toward empathic behavior the cognitive notion arises that the emotion one is resonating with is the emotion of the other (Singer and Klimecki, 2014; Bird and Viding, 2014). Consequently, one should conclude that the boundaries of the perceiver's capacity to experience his or her own emotions restrict both the kind and degree of empathy that can be felt. In their perception-action model of empathy, de Waal and Preston (2017) stated that motor mimicry and emotional contagion are the most basic expressions of their model in which the emotional states of the other are processed and synchronized through one's own embodied representations. This provides the opportunity for empathic behavior to emerge, albeit in the light of and depending on one's own history with the associated personal and contextual factors.

Another component of the broader empathy construct is personal distress (Batson, 1991), which is adjacent to the concept of emotional contagion. Personal distress is "a self-focused, aversive, affective reaction to the apprehension of another's emotion (e.g., discomfort or anxiety), such as the distress of a person feeling anxious when viewing someone who is sad" (Eisenberg, 2000, p. 762). In contrast to emotional contagion, in personal distress, the self-other distinction will be present. Moreover, with emotional contagion, the observer experiences the same ("isomorphic") emotions as the sender, while this is not necessarily the case with personal distress.

Finally, the most mature form of empathy is arguably empathic concern, that is, an other-oriented response that is congruent with the perceived welfare of someone in need (Decety et al., 2012). Empathic concern is also known as sympathy or compassion and thus should be understood as primarily unselfish in nature. Eisenberg (2000) defined sympathy as "an emotional response stemming from the apprehension or comprehension of another's emotional state or condition, which is not the same as what the other person is feeling (or is expected to feel) but consists of feelings of sorrow or concern for the other" (p. 671–672).

According to de Wied et al. (2010), empathy processing starts with a matching of emotions between the self and the other ('feeling with the other'), before then proceeding to turn via further cognitive processing into either sympathy ('feeling for the other') or personal distress ('feeling by the other'). These reactions are not dichotomous: some combination of sympathy and personal distress may well occur. Eisenberg (2000) noted in her overview of markers of empathy and prosocial behavior that in normal children and adults, observing another person's distress is associated with the incitement of prosocial behavior, either via sympathy induced altruism or, in contrast, personal distress-related attempts to reduce one's own aversive emotional state (such as, for example, in a situation in which one is unable to escape having to deal with the person causing one's distress).

Jolliffe and Farrington (2004) stated that numerous studies support the view that empathy facilitates prosocial behavior, which includes altruistic behavior, and, moreover, that a lack of empathy encourages antisocial or aggressive behavior, insofar as such actions may reflect an inability to appreciate the feelings of others. However, the cognitive components of the empathy construct should not be seen as prerequisites

of prosocial or altruistic behavior, as can be inferred from animal-based research. Although humans show greater variation in prosocial or altruistic behavior than other animals, there is compelling empirical evidence for unselfishly motivated prosocial behavior in non-human primates and other mammals (Yamamoto and Takimoto, 2012; de Waal and Suchak, 2010). Moreover, with respect to psychopaths, we will argue that their deficiency in the affective aspects of empathy does not derive from disturbed cognitive functioning per se (see, for example, Blair, 2008). This will be discussed in detail below.

4. Contextual factors in empathy

A key question in extant literature concerns whether the capacity to experience one's own emotions while perceiving another's is basically context- or state-dependent, that is, whether it is static in nature or, conversely, dynamic and situationally induced? Moreover, are personal characteristics of importance for enhancing both the kind and degree of empathy? Decety (2015), in response to Batson's earlier work, implied that this was indeed the case. Ultimately, he distinguished three dissociable facets of the empathy construct, based on the fact that a motivational facet is dissociable from affective sharing on the one hand and perspective taking on the other, with the latter being regarded as a cognitive component of empathy. This motivational facet is also accepted, at least to some extent, by Fischer and Hess (2017). Despite the aforementioned automatism of mimicking the emotional expression of others, they assumed that there is at least a minimal potential for affiliation between the sender ("expresser") and observer ("mimicker") that is dependent on the shared emotional meaning of the situation. Consequently, this implies that there is an inclination to focus on the other if that is appropriate and preferred in the situation. This tendency is likely to be stronger when an in-group member is involved. However, this does not imply that there is an unrestricted channel involved in processing the components of the empathy construct, as assessments, filters, and inhibitions can all serve to block the expression of empathy if it were maladaptive (de Waal and Preston, 2017). The authors pointed to observations consistent with evolutionary theory that "empathic response is increased by similarity, familiarity, and social closeness" (2017, p. 503). Regarding this theme, we will further use the terms in-groups versus out-groups. To cite an example of in-group versus out-group differences in empathy: contagious yawning that is thought to be related to precursors of the empathy construct is more common in chimpanzees who look at yawning in-group members than when they observe yawning individuals who are unknown to them (Campbell and de Waal, 2011). So-called in-group preferences include the tendency to exhibit more (facial) mimicry toward an in-group member than toward a person from the out-group (Bourgeois and Hess, 2008; van der Schalk et al., 2011). This might prove beneficial from an evolutionary perspective, insofar as belonging to a social group and being accepted by group members have proven to be fundamental to human life (Kraaijenvanger et al., 2017). In their transcranial magnetic stimulation study, Avenanti et al. (2010) showed that Italian-Caucasian and black-African participants (living in Italy) who watched clips in which pain was being evoked upon the hands of either black or white models exhibited decreased sensorimotor resonance (i.e., a lack of empathic brain response) when the pain was being inflicted upon a model from the other race, compared to when pain was being inflicted upon their own racial group or when violet-colored models were used. The authors concluded that although empathic responses to pain in non-stereotypical strangers can be triggered, this is not the case when observing pain in either members of other races than one's own or in stereotypical out-group members. While racial in-group bias in empathy toward pain was also found by Han (2018), this research showed that despite being mediated by distinct neurological systems, empathic brain activity for same-race or other-race pain appeared to also be related to sociocultural and physical environment factors.

In the field of social conflict management, between-group empathy is paramount, insofar as its impediment or absence is strongly related to indifference toward out-group suffering, diminished helping responses, or even out-group "Schadenfreude" (a German term for taking pleasure in the failure or misfortune of others), which, ultimately, could result in a risk of intergroup aggression (Cikara et al., 2011). From an evolutionary point of view, individuals living in social groups in harsh environments who are experiencing insecure food supplies will develop a flexible empathic neural circuit related to sharing and responding to the suffering of in-group and even out-group members, which is likely to be based more on culturally acquired prejudices than on strictly racial grounds (Chiao and Mathur, 2010). Vanman (2016) pointed toward the reverse relationship between out-group empathy and strong prejudice. That is to say, effective out-group empathic changes can be achieved if participants are trained to adopt a multicultural perspective (i.e., recognizing group differences) as well as when in-group norms regarding out-group empathy become salient. In addition, intergroup communication centered on the expression of empathy, anger, or, for instance, victim-centered apologies can induce and/or improve out-group empathy, and therefore reduce prejudice. Inducing empathy in children (aged 8–13 years), irrespective of how advanced their social perspective skills were, resulted in equally helpful behavior being shown toward both in-group and out-group members, while in-group preferences prevailed when empathy was not induced (Sierksma et al., 2015). Although there is a relative dearth of knowledge about gender differences in empathy processing, there are some indications that compared to women, men who participated in research in which an economic game was played, showed less empathy toward unfair opponents receiving pain stimuli (Singer et al., 2006).

Given that empathy processing appears to be dynamic in nature, the emergence of both the cognitive and affective components of empathy thus significantly depend on psychological factors (such as, for example, attention and motivation) as well as contextual appraisal of state-, group- and context-variables. This notion was endorsed by Singer and Lamm (2009), who stated in their review that flexible interpersonal and contextual factors are important pillars underlying the dynamics of empathy processing. As explained above, these factors and appraisals are by definition not static in and of themselves, which is to say that dynamic fluctuations in empathic functioning are part of everyday life. In some instances, this is also due to biological conditions, as is the case, for example, with motivation-driven empathy processing, which is temporarily reduced by fatigue or results from the consequences of sleep deprivation or obstructive sleep apnea syndrome (Nelson et al., 2003; Guadagni et al., 2014, 2018; Tempesta et al., 2018; Kheirandish-Gozal et al., 2014). Similarly, external, or environmental stressors, such as cold temperatures, can also mediate empathic responses (Luo et al., 2017). Therefore, the dynamically interacting cognitive and affective components of the empathy construct will be described below against the backdrop of these psychological and context variables.

5. Zipping of empathy components: the Zipper model of empathy

Based on our review of extant literature on empathy, we propose the Zipper model of empathy. The purpose of this heuristic model is to shed light on the dynamic and temporal interactive process that drives empathic behavior. Ultimately, it can provide guidance into clinical and scientific practice.

Mature empathy can be regarded as a balanced state resulting from conjointly operating cognitive and affective processes. Since this equilibrium appears to be dynamic, a mature empathic state can thus be said to be sustained temporarily depending on various influencing forces. Both contextual factors and diverse psychological states (such as, for example, motivation and attention) act as "zipping" forces that direct the bidirectional alterations of the empathy construct. This process is presented in Fig. 1.

Facial emotional processing (see below) precedes the precursors of

Fig. 1. Zipper model of empathy.
Conjointly interacting cognitive and affective components in bidirectional dynamic empathy processing, including mimicry and emotional contagion as precursors of the empathy process. The term emotional responsiveness stems from the work of Feshbach (1997). Fully "zipping up" leads to mature empathic behavior while "unzipping" results in either the hampering of empathic behavior or its disappearance altogether. Both the direction and strength of the zipper forces are dependent on both psychological states (hand 1) and contextual factors (hand 2).

cognitive and affective components, such as the aforementioned mimicry and emotional contagion. Note that "zipping up" stands for approaching mature empathy and the expression of empathic behavior, while unzipping entails a looser collaboration between cognitive and affective processes and, as such, symbolizes either a reduction in empathy or its loss altogether.

This zipping process of the empathy components is dependent on the sound development of the neurological apparatus, not to mention personal features and the appraisal of contextual factors. For instance, fatigue or stress-inducing circumstances that alter mood states or cause demoralization might reverse both the direction and strength of the zipping forces, ultimately inducing a significant reduction (by unzipping) in the way that one empathizes with the other. Conversely, one can assume that high intrinsic motivation regarding the other easily paves the way by zipping up toward a mature empathic state. This might be even more the case for in-group members than it is for out-group members, insofar as the latter encounter more barriers to overcome in this zipping empathy process. With respect to psychopaths, we argue below that the zipper teeth that symbolize cognitive processing are present and relatively intact (see also Blair, 2008), whereas psychopaths are known to fall short when it comes to zipping up to mature empathy.

6. Empathy, aggression, and psychopathy

6.1. Aggression and psychopathy

In normal circumstances, aggression is context-dependent wherein species-specific communicative aspects between the aggressor and the opponent play a key role (Haller and Kruk, 2006). On the one hand, aggression can be conceptualized as a hostile reaction to a perceived threat or dangerous situation (Berkowitz, 1983), thus suggesting that it is an impulsive, reactive form of aggression that is relatively unplanned. On the other hand, aggression might also include intentional, goal-directed, premeditated, purposeful, instrumental behavior (Cornell et al., 1996), which is why this latter form of aggression is also referred to as instrumental or proactive aggression. However, both impulsive/reactive and instrumental aggressive elements are not mutually exclusive, as demonstrated by Barratt et al. (1999) who found that only 20–25 % of aggressive acts could be accounted for by either impulsive/reactive or instrumental aggression alone. Psychopathy is strongly related to engagement in both the impulsive-reactive and instrumental forms of aggression, whereas violent non-psychopaths are unlikely to engage in instrumental violence (Porter and Woodworth, 2006). Moreover, it appears that psychopaths' involvement in instrumental violence and aggression decreases very little with age (Hare, 1999).

There is a vast body of literature pinpointing the links between psychopathic traits and aggressive behavior, such as violent crimes (see Porter and Woodworth, 2006). However, the question of why psychopaths are more likely to engage in instrumental violence is hitherto unresolved. Blair (2001) argued that psychopaths fail to interpret cues of emotional distress in their victims, which could indicate an abnormal cognitive processing. Marsh et al. (2013) concluded that adolescents with disruptive behavior disorders and psychopathic (callous-unemotional (CU)) traits experience dysfunction in responding to other's pain, which, in turn, may contribute to their behavioral deficits as observing the pain of others should normally trigger empathic distress in the observer and, consequently, dampen aggression. Similar results were found in children with conduct problems who showed reduced fMRI responses to other people's pain. Those with high CU traits exhibited anterior insula and anterior cingulate cortex responses, which potentially reflects a neurobiological marker for empathy deficits (Lockwood et al., 2013). These results are of paramount importance, insofar as CU traits in adolescence predispose someone to psychopathy in adulthood (Lynam et al., 2007).

6.2. Are empathy components necessary intermediaries between aggression and psychopathy?

Notwithstanding the defective affective processing in psychopaths, little is known about their processing of precursors of the empathy construct (i.e., mimicry and emotional contagion). Testimonies of victims describing perpetrators as displaying a cold gaze and unemotional facial expressions during the course of committing their criminal acts are indicative of absent emotional mimicry and hampered emotional contagion, which, consequently (see Bird and Viding, 2014), may lead to a failure of empathy processing to mature empathy, as also presented in our aforementioned Zipper model (see Fig. 1).

Mullins-Nelson et al. (2006) found a negative relationship between the affective components of empathy and psychopathy in their community sample, whereas the perspective-taking ability (that is, a cognitive part of empathy) was found to be no different in either psychopaths or non-psychopaths. In contrast with these findings, Fonagy (2003) postulated in adults who lacked the ability to inhibit violent behavior due to either a disturbed or absent mentalization, that is, the capacity to both recognize and attribute mental states to others in different situations by using contextual information that may have evolved from a brain system representing actions that lead to successful social adaptation (Frith and Frith, 1999; Achim et al., 2011). Although mentalizing includes cognitive parts of empathy, it could not be established that psychopathic individuals present a generalized impairment in the cognitive components of empathy (Richell et al., 2003). Several other studies of this kind led Blair (2007) to conclude that there is no evidence-base to suggest that psychopathic individuals are impaired in their Theory of Mind, that is, the cognitive ability to conceive of the mental states of others (Baron Cohen et al., 1985). These mental states

include inferences related to "purpose or intention, as well as knowledge, belief, thinking, doubt, guessing, pretending, liking, and so forth" (Premack and Woodruff, 1978, p.515).

According to Dawel et al. (2012), impaired empathic functioning in psychopaths stems from pervasive emotion recognition deficits, while Blair (2008) and Blair et al. (2001, 2004) highlighted psychopaths' inability to process specific (i.e., negative) emotions. In their fMRI study of psychopaths, Meffert et al. (2013) suggested that reduced empathy in psychopaths results from impaired stimulus driven, bottom-up attention to the emotions of others. This biased bottom-up attention could thus be a cofactor in the maldevelopment of moral functioning and social learning seen in psychopaths, as victims' distress will not be automatically detected, thus preventing the incitation of negative emotions that are normally associated with observing distress in others (as is the case in emotional contagion and personal distress; see also §4). This does not necessarily imply a hard-wired neurological defect, but may reflect hypostimulation or the non-stimulation altogether of the zipping forces that lead to empathic behavior (see Fig. 1). These forces are significantly dependent on both psychological states and contextual factors. Simply put, in the absence of either interest or motivation to interact with others, psychopaths have a heightened threshold to sufficiently process other people's emotional stimuli to generate empathy processing toward that person. On the other hand, if psychopaths are genuinely interested in and highly motivated to interact with another person (we assume that this would most likely be a close family member or another in-group member), then the likelihood of building up to empathic behavior increases. This begins with detecting and processing emotional stimuli from the other, which, in turn, will eventually activate the aforementioned precursors of empathy. As demonstrated by our Zipper model of empathy, psychological and contextual factors are paramount to the induction of empathy processing. Notwithstanding this, one should not be blind to the possibility that through exhibiting false interest and antisocial motivations, psychopaths may exclude the affective parts and instead only use the cognitive parts of the empathy process, such as, for example, by displaying emotional awareness, to attain what they want. Obviously, in these instances, mature empathy can never be achieved. Ordinarily, simulating the mental states of others within our own mental mechanisms brings about an intuitive understanding of that other person's mind. According to Blair (2007), in normal circumstances this association is critical for preventing instrumental aggression from evolving, which is in line with his violence inhibition mechanism model (VIM; Blair, 1995). Hence, activating these circuits in a different way might explain, at least in part, the lack of empathy in psychopaths.

Although several studies point to a link between aggression and empathy, it is important to note that what this exact link is remains vague, not least because the aspects of empathy that are studied are not always clearly defined. However, along with impulse control and either prosocial or antisocial tendencies, the cognitive aspects of empathy appear to be a cofactor in behavioral control and, hence, in controlling aggression. While one can also hypothesize that the affective components of empathy play a protective role, its relationship with aggression induction also remains unclear. Furthermore, it is not known whether, and if so to what extent, empathic functions potentially influence either the inhibition or induction of aggressive behavior toward both in-group and out-group members, respectively. According to Blair (2008), the recognition of emotional facial expression is critically important, if not in fact a precondition, for the development of affective components in the empathy construct. This seems to especially be true for psychopaths who "fail to recognize cues that would otherwise lead them to inhibit aggressive behavior by activating the neural networks involved in empathic processing" (Brook et al., 2013, p. 980). In the Zipper model of empathy, this recognition underlies the precursors of empathy, namely mimicry and emotional contagion. Under normal circumstances of genuine interest and motivation and adequate contextual factors, detecting and processing cues from other people's emotional states will induce these root processes of empathy and, in turn, initiate the processing of cognitive and affective aspects. Given that psychopaths' failure to "build up" mature empathy may derive from either the lack of or incorrect detection of emotional stress signals in their victims, the processing of emotional facial information in psychopaths will thus be discussed in the next two sections.

6.3. *Facial affect information processing in psychopaths*

Patterson and Newman (1993) argued that during their instrumental actions, psychopaths have severe difficulties in switching their attention to initially less salient aversive contingencies as they manifest. These observations formed the basis of the response modulation theory of psychopathy (Newman and Lorenz, 2003). In addition, Baskin-Sommers et al. (2009) found that the PCL-R factor 1 was associated with superior attentional control, that is, a tendency to focus superiorly on primary goals with less attention being paid to secondary stimuli. They concluded that their findings advocated for the response modulation theory of psychopathy, which they eloquently summarized by underlining "that the inhibitory and affective deficits associated with psychopathy reflect a failure to allocate attention to such information rather than a core inhibitory or affective deficit. According to the response modulation model, psychopathic offenders are less likely to suspend an established focus of attention to process peripheral information. Consequently, they are less responsive to affective, inhibitory, and even motivationally-neutral information unless it is an integral aspect of their pre-potent focus of attention. Though this insensitivity to peripheral information is associated with inhibitory deficits, paradoxically a deficit in response modulation may be associated with superior attention control because it entails less responsivity to peripheral information once a person is engaged in goal-directed behavior" (2009, p. 628). Similarly, Zeier and Newman (2013) found that incarcerated psychopathic men showed selective attention abnormalities when carrying out a modified flanker task, which was in line with the response modulation theory. Hence, psychopaths' actions lack inhibition causing deficient self-regulation in their social interplay with others and society at large.

Given that difficulties in switching attention appear to be important for psychopaths' goal-directed behavior, this raises the question of whether attention deficits form the basis of facial recognition deficits in psychopathy, and if so, to what extent. As stated by Blair (2001), several studies with psychopaths have shown selective deficits in interpreting emotional stress signals from their victims, thus meaning that they are impaired in processing fearful, sad and, possibly even, disgusted facial expressions. No impairment in the processing of angry, happy, or surprised expressions was reported. Blair et al. (2004) found a lower overall affect recognition in highly psychopathic prisoners compared to those with lower levels of psychopathy, but, most notably, significant group differences in recognizing fearful expressions. Harris and Picchioni (2013) agreed that Blair's findings do indeed lend some support to the aforementioned VIM model (Blair, 1995), wherein a disturbance in recognizing distress cues fear and sadness is associated with disruptive social cognition and reduced violence inhibition. In accordance with Blair's previous findings, Marsh and Blair (2008) found in their meta-analysis robust impairments in recognizing fearful, sad, and surprised expressions, but not in terms of recognizing happiness, anger, or disgust. In his integrated emotion systems model, Blair (2005a, b) postulated that these significant recognition deficits arise from amygdala dysfunction. The latter prevents psychopaths from associative learning in the conditioning process of conditioned stimuli interacting with unconditioned stimuli like fearful and sad expressions. This results in empathy deficiencies and socially inappropriate behavior toward the other (we discuss amygdala dysfunction further in the next section). The meta-analysis by Dawel et al. (2012), however, partially contradicted Blair's conclusion regarding selective deficits of psychopaths in emotion signaling, as they described pervasive emotion recognition deficiencies related to all six basic emotional expressions (fear, anger, happiness, sadness, disgust, and surprise). Further evidence for a possible relation

between psychopathic traits and emotional recognition deficits came from both Habel et al. (2002) and Cigna et al. (2017), who found that impaired facial emotion discrimination was related to PCL-R factor 2, whereas PCL-R factor 1 was positively correlated with increased performance in facial emotion discrimination. According to both groups of authors, this positive correlation could be explained in terms of heightened desire and the ability of psychopaths to manipulate those around them by correctly interpreting the emotional expressions in their faces. The Zipper model of empathy explains that although psychopaths may correctly interpret emotional expressions of other people and, as such, have the cognitive zipper teeth available, the problem is that the affective zipper teeth do not (fully) interact, as no emotional contagion is processed. As described above, it is also imperative that empathy-building forces such as motivation are present (see the dissociable motivational facet as bescribed by Decety, 2015 and the minimal potential of connection and shared emotional meaning mentioned by Fischer and Hess, 2017). In other words, the Zipper model's cognitive teeth do not falter, but the affective teeth do, and, moreover, the psychological state is too weak as a driving force to eventually build up to mature empathetic behavior.

All the above mentioned studies showed evidence for a relation between (either general or specific) emotion recognition deficits and psychopathic traits. However, not all of the results from these studies are wholly convincing. Harris and Picchioni (2013) mentioned in their review three studies that showed impaired facial emotion recognition in psychopathic patients (Munro et al., 2007; Hastings et al., 2008; Blair et al., 2004). On the contrary, in three other studies that they reviewed (Richell et al., 2003; Dolan and Fullam, 2004; Glass and Newman, 2006), no differences in emotion recognition accuracy could be established between high and low psychopathy ratings. Harris and Picchioni (2013) also noted that some of the methodological inconsistencies between the studies cited also prompted cautious interpretation of the findings. Pham and Philippot (2010) found that criminal non-psychopaths showed greater accuracy in terms of decoding happiness, anger, and disgust in comparison to criminal psychopaths, while no group differences were established for sadness and fear. According to these authors, these results were in contradistinction to Blair's hypothesis regarding amygdala dysfunction (Blair et al., 2001). Rather, they suggested that distinct research findings related to decoding facial expressions of sadness and fear in psychopathy could be explained by the different populations that were studied.

Brook et al. (2013) reviewed eleven facial recognition studies in psychopathy and concluded that there was no consistent evidence for either the general emotional processing deficit perspective or the specific emotional processing perspective. The general emotional processing deficit implies an overall reduced capacity to process emotional expressions across the emotional spectrum, which in fact parallels the above conclusions of Dawel et al. (2012). In contrast, the specific emotional processing deficit only involves a reduced capacity for specific types of emotions. The latter perspective is consistent with the aforementioned VIM model that describes recognition deficits for sadness and fear (Blair, 1995). Moreover, Brook et al. (2013) noted that most of the studies addressing emotion processing ignored anxiety as a co-factor. They supported Newman's argument that research on cognitive deficits in psychopathy should include a measure of trait anxiety, because low-anxiety vs. high-anxiety traits may well be important in disentangling mechanisms of emotional deficits in psychopaths.

As aforementioned, extant literature on facial recognition in psychopathy presents rather contradictory results, not least due to the multitude of methodological issues in the various study designs. For example, Koenigs et al. (2011) emphasized the heterogeneity of the research data of the different populations studied, which often consisted of difficult-to-compare groups of psychopathic patients, psychopathic non-patients, and persons with psychopathic characteristics who do not fully meet the criteria for a psychopathy diagnosis. Furthermore, significant discrepancies in diagnostic procedures between the study groups might also lead to diagnostic bias in the level of estimated psychopathy. The authors also warned that because of such variations in the research data, the brain regions associated with these characteristics could be easily misidentified as dysfunctional brain regions thought to be involved in psychopathy. Moreover, research data on emotional deficits cannot be automatically generalized outside of Caucasian psychopathic male offender samples to, for example, African American psychopathic offenders, or even to female samples (Brook et al., 2013). Both level of intelligence and duration of educational training also often remain underexplored in different studies, despite research showing that they are clearly associated with emotion recognition results (Pham and Philippot, 2010; Igoumenou et al., 2017). It should also be noted that the picture complexity of the presented stimuli is another complicating factor (Sadeh and Verona, 2012) that might lead to difficulties in comparing the different studies. Using difficult-to-compare stimuli (be it facial expressions or non-facial expressions) in the different studies can also serve as a methodological barrier, while the emotional intensity of the triggers portrayed also differs across the studies. For example, artificially morphed expressions of different facial emotions can result in fake emotional expressions of the faces displayed (Krumhuber et al., 2013). Calvo et al. (2018) advocated for the use of dynamic facial expressions rather than static expressions, as the former have more of an impact upon those brain regions believed to be related to the processing of social-relevant and emotion-relevant information. Furthermore, the use of colored facial expressions instead of non-colored expressions influences emotion recognition, while there are also different detection thresholds for different emotions (Calvo et al., 2016). Moreover, Brook et al. (2013) suggested that psychometric artefacts of tests with diverse discriminating power might yield different results when assessing positive and negative facial emotions; for example, good performances in identifying facial happiness may be related to lower test sensitivity rather than a normal capacity in identifying positive emotions.

6.4. *Amygdala functioning and facial affect information processing in psychopaths*

According to Dadds et al. (2011), amygdala dysfunction is associated with psychopaths' impaired ability to detect and attend to the human eye region. However, despite various neuropsychological and neuroimaging studies (see, for example, Blair's overview, 2005a, b and 2008), extant literature on psychopaths' amygdala anatomy and dysfunctionality remains inconclusive. The general idea is that a psychopath's amygdala is less reactive to emotional events, in turn, leading to emotionally callous behavior, and thus blocking the "building up" to mature empathic behavior. From this perspective, the amygdala directs attention automatically toward emotional stimuli, like facial expressions, especially in the eye region, thereby providing emotionality to one's behavior. However, this perspective fails to explain why the blunted emotional reactivity of psychopaths (Baskin-Sommers et al., 2011; Newman et al., 2010) and their blunted empathy (Meffert et al., 2013) can be resolved when the emotional stimuli lines up with their own self-interest. In accordance with our Zipper model of empathy, this suggests that a motivational component might be at work here. Indeed, a lack of automatic attention due to motivational factors may very well result in a "downstream" face recognition deficit. The response modulation theory of psychopathy (Newman and Lorenz, 2003) predicts that even when psychopaths are remotely aware of peripheral information, they nevertheless tend to ignore this information that is of secondary interest to them, while, simultaneously, being overwhelmingly attracted to achieving their primary goal. This tendency to ignore contextual information might thus reflect that emotional processing deficits are preceded by a motivational impairment (Baskin-Sommers et al., 2009). Interestingly, recent theories of amygdala functioning are beginning to emphasize its role in motivation as well as in psychopathy (Moul et al., 2012).

Importantly, the amygdala is not a single brain structure, but rather a

heterogeneous collection of nuclei, with animal models showing that an interplay of the basolateral (BLA) and central (CeA) subregions of the amygdala not only determines the level of emotional reactivity (Terburg et al., 2018), but also influences goal-directed motivation at the level of the striatum and prefrontal cortex (Balleine and Killcross, 2006). Simply put, while the CeA promotes automatic emotional reactivity and general motivation, these tendencies can be modulated by the BLA in favor of more instrumental goal-directed motivation and behavior. In other words, when the current goal does not align with the automatic emotion reactivity, then the BLA can reduce the latter to promote instrumental action.

Although research in humans has only recently started to investigate this mechanism, studies confirm that the integrity of the BLA is necessary to control emotional reactivity in favor of goal-directed escape (Terburg et al., 2018). Furthermore, the BLA is necessary for both learning and expressing calculative actions to yield maximum rewards at the expense of others (Rosenberger et al., 2019; van Honk et al., 2013). In line with this, psychopaths' BLA shares increased functional connectivity with frontolimbic structures like the striatum, anterior cingulate cortex, and prefrontal cortices, while the psychopaths' functional connection between the CeA and such frontolimbic structures is reduced (Aghajani et al., 2017; Yoder et al., 2015). When viewed together, this suggests that the goal-directed behavior of psychopaths is relatively more strongly driven by instrumental motivation from the BLA and less affected by the automatic affective processing from the CeA. When the goal and emotion align, however, psychopaths might be perfectly capable of utilizing the CeA's emotionality. This motivational interpretation of amygdala functioning in psychopathy can therefore explain why psychopaths have blunted emotional reactivity and empathy in general, but not when these emotions are in alignment with their own self-interest. This is consistent with the findings of Meffert et al. (2013) that showed that there is no hardware problem in this respect, but rather that the problem is largely motivational, and, as such, can be manipulated by instruction or rewarding circumstances. It is also in line with the response modulation theory of psychopathy (Newman and Lorenz, 2003), which explains why psychopaths with their superior attentional control are less responsive to affective facial information unless it is an integral aspect of their pre-potent focus of attention. In terms of our Zipper model of empathy, then, if it helps psychopaths to achieve their goals, they can "zip up" parts of the empathy concept and thus come across as charming and empathic toward others. However, due to their assumed lack of experience of regularly "building up" mature empathic behavior, they will likely do this in a clumsy and not entirely credible way, as the "use it or lose it" paradigm implies.

7. Conclusions

Empathy is a multidimensional construct with cognitive, affective, and behavioral characteristics and can be symbolically interpreted as the social glue in society that binds human beings. Empathy processing is primarily shaped and maintained by constant mutual communication between the perceiver and the outside world and is based on the combination of appraisal of contextual variables and intrapsychic aspects, such as attentional and motivational factors. We propose a Zipper model of empathy in which mature empathic behavior can be regarded as a dynamically balanced state resulting from conjointly operating cognitive and affective processes that "zip up" toward empathic behavior. Against the background of neurodevelopmental underpinnings, both zipper direction and zipper strength depend on intrapsychic conditions and contextual factors (see Fig. 1). This balance, by definition, persists only temporarily and can be reversed by "unzipping," resulting in reduced expression of empathic behavior.

The purpose of this article was to shed light on the empathy components in psychopathy and, subsequently, how facial affect processing substantiates empathy deficits in psychopathy. Although not exclusive, one of the main channels of communication between conspecifics involves the processing of facial affect information. In this respect, extant literature on facial recognition in psychopathy shows rather contradictory results, namely because the research of different groups is difficult to compare due to manifold methodological issues in the various study designs. Despite these methodological problems and often conflicting results (see also Chapman et al., 2018), there are nevertheless strong indications that facial emotion recognition deficits in psychopaths exist. Whether these consist of general deficits or specific deficits is not yet proven, but we argue that psychopaths' drive to reach their own goals comes at the cost of the automatic emotional processing needed for efficient facial affect processing. This concept furthermore touches upon the idea of psychopaths' preferential unwillingness to engage with or attach to other people, especially when they are out-group members. In such a state of basic disinterest and lacking motivation, psychopaths tend to ignore people and thereby fail to explore people's emotional facial expressions, as can be deduced from the study by Boll and Gamer (2016), who found reduced face exploration and reduced gaze bias for the eye region in participants with high psychopathic traits, while the accuracy of emotion classification was not linked to psychopathic features. Consequently, psychopaths will also fall short in inducing the precursors of the empathy construct (mimicry and emotional contagion) and, therefore, in "zipping up" parts of the empathy concept as they do not automatically share an understanding or emotional meaning with other people whom they deem to be of secondary interest. Indeed, psychopaths' primary interest lies in pursuing their own goals, thus effectively reducing their automatic emotional reactivity in favor of goal-directed motivation, a process that is heavily supported by BLA preponderance over the CeA subregion of the amygdala. In contrast, variables related to in-group members or other important contextual information can motivate psychopaths to deliberately focus on certain people, which, in turn, increases the attention paid by psychopaths to the emotional expressions of others. This might increase the likelihood of mimicry and emotional contagion occurring, which are known to be precursors of the cognitive and affective empathy components that "zip up" in the direction of empathic behavior. In this sense, we believe no substantiated arguments exist as to why amygdala dysfunction and superior attentional control (as predicted by the response modulation theory of psychopathy; Newman and Lorenz, 2003) should mutually exclude each other.

As argued above, according to the Zipper model of empathy, the zipper teeth that symbolize cognitive processing are present and relatively intact, whereas psychopaths are known to fail in "zipping up" to mature empathic behavior. This should come as no surprise, as affective components (symbolized by affective zipper teeth) are equally important in achieving mature empathic behavior, and thus it is very likely that this is where psychopaths' empathy deficits mainly lie, even when they pursue it: namely, a downregulated or even absent affective capacity.

Based on the abovementioned methodological, diagnostic, and procedural limitations of emotion recognition research, we believe that future research into psychopathy should include well-defined groups of PCL-R confirmed psychopaths. Clear descriptions of their ethnic and educational background, assessments of their intellectual functioning and state measures of stress (anxiety and mood), alongside clarification over either their non-forensic or forensic status (e.g., type of offenses, patient versus non-patient detainee) should be provided. Preferably, PCL-R assessed psychopathic women would also be included in future research. Test procedures should at the very least also include dynamic expressions of emotional expressions from protagonists from different ethnicities and genders. In particular, we welcome emotion recognition research in psychopaths that is using stimuli from both in-group and out-group protagonists. As we argued in Sections 4 and 5 regarding the Zipper model of empathy, intrapsychic factors such as attention and motivation are of great importance in the zipping process that builds up to mature empathy. The same considerations also apply to emotional stimuli that are related to psychopaths' current and prior living

environments, as the Zipper model also defines contextual factors as being of significance.

Funding

We report no biomedical financial interests or potential conflicts of interest. JvH received a grant from the Dutch Research Council's (NWO) National Initiative Brain & Cognition - social innovation in healthcare, education and safety.

Acknowledgements

We thank Thomas Rinne, M.D., PhD, Prof. P. Michiel Westenberg, MSc, PhD, and Minet de Wied, MSc, PhD, for their comments on earlier drafts of the manuscript, and Daniel Dittmar (www.dittmar.co) for designing Fig. 1.

References

Achim, M.A., Ouellet, R., Roy, M.-A., Jackson, P.L., 2011. Assessment of empathy in first-episode psychosis and meta-analytic comparison with previous studies in schizophrenia. Psychiatry Res. 190 (1), 3–8. https://doi.org/10.1016/j.psychres.2010.10.030.

Adriaense, J.E.C., Koski, S.E., Huber, L., Lamm, C., 2020. Challenges in the comparative study of empathy and related phenomena in animals. Neurosci. Biobehav. Rev. 112, 62–82. https://doi.org/10.1016/j.neubiorev.2020.01.021.

Aghajani, M., Klapwijk, E.T., van der Wee, N.J., Veer, I.M., Rombouts, S., Boon, A.E., et al., 2017. Disorganized amygdala networks in conduct-disordered juvenile offenders with callous-unemotional traits. Biol. Psychiatry 82 (4), 283–293. https://doi.org/10.1016/j.biopsych.2016.05.017.

Anderson, D.A., 1999. The aggregate burden of crime. J. Law Econ. 42 (2), 611–642. https://doi.org/10.1086/467436.

Auty, K.M., Farrington, D.P., Coid, J.W., 2015. Intergenerational transmission of psychopathy and mediation via psychosocial risk factors. Br. J. Psychiatry 206, 26–31. https://doi.org/10.1192/bjp.bp.114.151050.

Avenanti, A., Sirigu, A., Aglioti, S.M., 2010. Racial bias reduces empathic sensorimotor resonance with other-race pain. Curr. Biol. 20, 1018–1022. https://doi.org/10.1016/j.cub.2010.03.071.

Balleine, B.W., Killcross, S., 2006. Parallel incentive processing: an integrated view of amygdala function. Trends Neurosci. 29 (5), 272–279. https://doi.org/10.1016/j.tins.2006.03.002.

Baron-Cohen, S., Leslie, A.M., Frith, U., 1985. Does the autistic child have a 'theory of mind'? Cognition 21, 37–46. https://doi.org/10.1016/0010-0277(85)90022-8.

Barratt, E.S., Stanford, M.S., Dowdy, L., Liebman, M.J., Kent, T.A., 1999. Impulsive and premeditated aggression: a factor analysis of self-reported acts. Psychiatry Res. 86, 163–173. https://doi.org/10.1016/S0165-1781(99)00024-4.

Baskin-Sommers, A.R., Zeier, J.D., Newman, J.P., 2009. Self-reported attentional control differentiates the major factors of psychopathy. Pers. Individ. Dif. 47, 626–630. https://doi.org/10.1016/j.paid.2009.05.027.

Baskin-Sommers, A.R., Curtin, J.J., Newman, J.P., 2011. Specifying the attentional selection that moderates the fearlessness of psychopathic offenders. Psychol. Sci. 22 (2), 226–234. https://doi.org/10.1177/0956797610396227.

Batson, C.D., 1991. The Altruism Question: Toward a Social-Psychological Answer. Erlbaum, Hillsdale, NJ.

Batson, C.D., 2009. These things called empathy: eight related but distinct phenomena. In: Decety, J., Ickes, W.J. (Eds.), The Social Neuroscience of Empathy. MIT Press, Cambridge, MA, pp. 3–15.

Berkowitz, L., 1983. The experience of anger as a parallel process in the display of impulsive, "angry" aggression. In: Green, R.G., Donnerstein, E.I. (Eds.), Aggression: Theoretical and Empirical Views. Academic Press, New York, pp. 103–134.

Bird, G., Viding, E., 2014. The self to other model of empathy: providing a new framework for understanding empathy impairments in psychopathy, autism, and alexithymia. Neurosci. Biobehav. Rev. 47, 520–532. https://doi.org/10.1016/j.neubiorev.2014.09.021.

Blair, R.J.R., 1995. A cognitive developmental approach to morality: investigating the psychopath. Cognition 57, 1–29. https://doi.org/10.1016/0010-0277(95)00676-p.

Blair, R., 2001. Neurocognitive models of aggression, the antisocial personality disorders, and psychopathy. J. Neurol. Neurosurg. Psychiatry 71, 727–731. https://doi.org/10.1136/jnnp.71.6.727.

Blair, R.J.R., 2007. Empathic dysfunction in psychopathic individuals. In: Farrow, T.F.D., Woodruff, P.W.R. (Eds.), Empathy in Mental Illness. Cambridge University Press, New York, pp. 3–16.

Blair, R.J.R., 2008. Fine cuts of empathy and the amygdala: dissociable deficits in psychopathy and autism. Q. J. Exp. Psychol. 61, 157–170. https://doi.org/10.1080/17470210701508855.

Blair, R.J.R., Colledge, E., Murray, L., Mitchell, D.G.V., 2001. A selective impairment in the processing of sad and fearful expressions in children with psychopathic tendencies. J. Abnorm. Child Psychol. 29, 491–498. https://doi.org/10.1023/A:1012225108281.

Blair, R.J.R., Mitchell, D.G.V., Peschardt, K.S., Colledge, E., Leonard, R.A., Shine, J.H., et al., 2004. Reduced sensitivity to others' fearful expressions in psychopathic individuals. Pers. Individ. Dif. 37, 1111–1122. https://doi.org/10.1016/j.paid.2003.10.008.

Boll, S., Gamer, M., 2016. Psychopathic traits affect the visual exploration of facial expressions. Biol. Psychiatry 117, 194–201. https://doi.org/10.1016/j.biopsycho.2016.03.010.

Bolt, D.M., Hare, R.D., Neumann, C.S., 2007. Score metric equivalence of the PCL-R across North American and UK criminal offenders: a critique of Cooke et al. (2005) and new analyses. Assessment 14, 44–56. https://doi.org/10.1177/1073191106293505.

Bourgeois, P., Hess, U., 2008. The impact of social context on mimicry. Biol. Psychol. 77 (3), 343–352. https://doi.org/10.1016/j.biopsycho.2007.11.008.

Brinkley, C.A., Newman, J.P., Widiger, T.A., 2004. Two approaches to parsing the heterogeneity of psychopathy. Clin. Psychol. Sci. Pract. 11 (1), 69–94. https://doi.org/10.1093/clipsy/bph054.

Brook, M., Brieman, C.L., Kosson, D.S., 2013. Emotion processing in Psychopathy Checklist-assessed psychopathy: a review of the literature. Clin. Psychol. Rev. 33, 979–995. https://doi.org/10.1016/j.cpr.2013.07.008.

Calvo, M.G., Avero, P., Fernández-Martin, A., Recio, G., 2016. Recognition thresholds for static and dynamic emotional faces. Emotion 16 (8), 1186–1200. https://doi.org/10.1037/emo0000192.

Calvo, M.G., Fernández-Martín, A., Gutiérrz-Garcá, A., Lundqvist, D., 2018. Selective eye fixations on diagnostic face regions of dynamic emotional expressions: KDEF-dyn database. Sci. Rep. 8, 17039. https://doi.org/10.1038/s41598-018-35259-w.

Campbell, M.W., de Waal, F.B.M., 2011. Ingroup-outgroup bias in contagious yawning by chimpanzees supports link to empathy. PLoS One 6 (4), e18283. https://doi.org/10.1371/journal.pone.0018283.

Chakrabarti, B., Baron-Cohen, S., 2011. Genes related to autistic traits and empathy. In: Ebstein, R., Shamay-Tsoory, S., Hong Chew, S. (Eds.), From DNA to Social Cognition, 1th ed. Wiley-Blackwell, Hoboken, New Jersey.

Chapman, H., Gillespie, S.M., Mitchell, I.J., 2018. Facial affect processing in incarcerated violent males: a systematic review. Aggress. Violent Behav. 38, 123–138. https://doi.org/10.1016/j.avb.2017.10.006.

Chartrand, T.L., van Baaren, R., 2009. Human mimicry. In: Zanna, M.P. (Ed.), Advances in Experimental Social Psychology, Vol. 41. Elsevier Academic Press, pp. 219–274. https://doi.org/10.1016/S0065-2601(08)00405-X.

Chartrand, T.L., Maddux, W.W., Lakin, J.L., 2005. Beyond the perception–behavior link: the ubiquitous utility and motivational moderators of nonconscious mimicry. In: Hassin, R.R., Uleman, J.S., Bargh, J.A. (Eds.), The New Unconscious. Oxford University Press, New York, pp. 334–361.

Chiao, J.Y., Mathur, V.A., 2010. Intergroup empathy: how does race affect empathy neural responses? Curr. Biol. 20, R478–R480. https://doi.org/10.1016/j.cub.2010.04.001.

Cigna, M.-H., Guay, J.-P., Renaud, P., 2017. Psychopathic traits and their relation to facial affect recognition. Pers. Individ. Dif. 117, 210–215. https://doi.org/10.1016/j.paid.2017.06.014.

Cikara, M., Bruneau, E.G., Saxe, R.R., 2011. Us and them: intergroup failures of empathy. Curr. Dir. Psychol. Sci. 20 (3), 149–153. https://doi.org/10.1177/0963721411408713.

Cleckley, H., 1976. The Mask of Sanity, 5th ed. Mosby, St. Louis, MO https://www.gwern.net/docs/psychology/1941-cleckley-maskofsanity.pdf.

Cohen, D., Strayer, J., 1996. Empathy in conduct-disordered and comparison youth. Dev. Psychol. 32 (6), 988–998. https://doi.org/10.1037/0012-1649.32.6.988.

Coid, J., Yang, M., Ullrich, S., Roberts, A., Moran, P., Bebbington, P., et al., 2009. Psychopathy among prisoners in England and Wales. Int. J. Law Psychiatry 32, 134–141. https://doi.org/10.1016/j.ijlp.2009.02.008.

Cooke, D.J., Michie, C., 1999. Psychopathy across cultures: North America and Scotland compared. J. Abnorm. Psychol. 108, 58–68. https://doi.org/10.1037/0021-843X.108.1.58.

Cooke, D.J., Michie, C., 2001. Refining the construct of psychopathy: toward a hierarchical model. Psychol. Assess. 13 (2), 171–188. https://doi.org/10.1037/1040-3590.13.2.171.

Cooke, D.J., 1998. Psychopathy across cultures. In: Cooke, D.J., Forth, A.E., Hare, R.D. (Eds.), Psychopathy: Theory, Research and Implications for Society. Kluwer Academic, Amsterdam, pp. 13–45.

Cooke, D.J., Michie, C., Hart, S.D., Clark, D.A., 2004. Reconstructing psychopathy: clarifying the significance of antisocial and socially deviant behavior in the diagnosis of psychopathic personality disorder. J. Pers. Disord. 18 (4), 337–357. https://doi.org/10.1521/pedi.2004.18.4.337.

Cooke, D.J., Michie, C., Hart, S.D., Clark, D.A., 2005. Searching for the pan-cultural core of psychopathic personality disorder. Pers. Individ. Dif. 39, 283–295. https://doi.org/10.1016/j.paid.2005.01.004.

Cornell, D.G., Warren, J., Hawk, G., Stafford, E., Oram, G., Pine, D., 1996. Psychopathy in instrumental and reactive violent offenders. J. Consult. Clin. Psychol. 64, 783–790. https://doi.org/10.1037//0022-006x.64.4.783.

Dadds, M.R., Jambrak, J., Pasalich, D., Hawes, D.J., Brennan, J., 2011. Impaired attention to the eyes of attachment figures and the developmental origins of psychopathy. J. Child Psychol. Psychiatry 52 (3), 238–245. https://doi.org/10.1111/j.1469-7610.2010.02323.x.

Dawel, A., O'Kearny, R., McKone, E., Palermo, R., 2012. Not just fear and sadness: meta-analytic evidence of pervasive emotion recognition deficits for facial and vocal expressions in psychopathy. Neurosci. Biobehav. Rev. 36 (10), 2288–2304. https://doi.org/10.1016/j.neubiorev.2012.08.006.

de Waal, F.B.M., Preston, S.D., 2017. Mamaalian empathy: behavioural manifestations and neural basis. Nat. Rev. Neurosci. 18 (8), 498–509. https://doi.org/10.1038/nrn.2017.72.
de Waal, F.B.M., Suchak, M., 2010. Prosocial primates: selfish and unselfish motivations. Philos. Trans. R. Soc. Lond. B Biol. Sci. 365 (1553), 2711–2722. https://doi.org/10.1098/rstb.2010.0119.
de Wied, M., van Boxtel, A., Zaalberg, R., Goudena, P.P., Matthys, W., 2006. Facial EMG responses to dynamic emotional facial expressions in boys with disruptive behavior disorders. J. Psychiatr. Res. 40 (2), 112–121. https://doi.org/10.1016/j.jpsychires.2005.08.003.
de Wied, M., Gispen - de Wied, C., van Boxtel, A., 2010. Empathy dysfunction in children and adolescents with disruptive behavior disorders. Eur. J. Pharmacol. 626, 97–103. https://doi.org/10.1016/j.ejphar.2009.10.016.
Decety, J., 2015. The neural pathways, development and functions of empathy. Curr. Opin. Behav. Sci. 3, 1–6. https://doi.org/10.1016/j.cobeha.2014.12.001.
Decety, J., Norman, G.J., Berntson, G.G., Cacioppo, J.T., 2012. A neurobehavioral evolutionary perspective on the mechanisms underlying empathy. Prog. Neurobiol. 98, 38–48. https://doi.org/10.1016/j.pneurobio.2012.05.001.
Dolan, M., Fullam, R., 2004. Theory of mind and mentalizing ability in antisocial personality disorders with and without psychopathy. Psychol. Med. 34 (6), 1093–1102. https://doi.org/10.1017/S0033291704002028.
Eisenberg, N., 2000. Emotion, regulation, and moral development. Annu. Rev. Psychol. 51, 665–697. https://doi.org/10.1146/annurev.psych.51.1.665.
Feshbach, N.D., 1997. Empathy: the formative years - implications for clinical practice. In: Bohart, A.C., Greenberg, L.S. (Eds.), Empathy Reconsidered: New Directions in Psychotherapy. American Psychological Association, Washington, DC, pp. 33–59. https://doi.org/10.1037/10226-001.
Fischer, A., Hess, U., 2017. Mimicking emotions. Curr. Opin. Psychol. 17, 151–155. https://doi.org/10.1016/j.copsyc.2017.07.008.
Fonagy, P., 2003. Toward a developmental understanding of violence. Br. J. Psychiatry 183 (3), 190–192. https://doi.org/10.1192/bjp.183.3.190.
Frith, C.D., Frith, U., 1999. Interacting minds - a biological basis. Science 286, 1692–1695. https://doi.org/10.1126/science.286.5445.1692.
Gallie, W.B., 1956. Essentially contested concepts. In: Oxford University Press on Behalf of The Aristotelian SocietyProceedings of the Aristotelian Society, New Series, Vol. 56, pp. 167–198, 1955 - 1956. https://www.jstor.org/stable/4544562.
Glass, S.J., Newman, J.P., 2006. Recognition of facial affect in psychopathic offenders. J. Abnorm. Psychol. 115 (4), 815–820. https://doi.org/10.1037/0021-843X.115.4.815.
Grann, M., Langstrom, N., Tengstrom, A., Stalenheim, G., 1998. Reliability of file-based retrospective ratings of psychopathy with the PCL-R. J. Pers. Assess. 70 (3), 416–426. https://doi.org/10.1207/s15327752jpa7003_2.
Guadagni, V., Burles, F., Ferrara, M., Iaria, G., 2014. The effects of sleep deprivation on emotional empathy. J. Sleep Res. 23, 657–663. https://doi.org/10.1111/jsr.12192.
Guadagni, V., Cook, E., Hart, C., Burles, F., Iaria, G., 2018. Poor sleep quality affects empathic responses in experienced Paramedics. Sleep Biol. Rhythms 16, 365–368. https://doi.org/10.1007/s41105-018-0156-8.
Habel, U., Egbert, K., Salloum, J.B., Devos, H., Schneider, F., 2002. Emotional processing in psychopathic personality. Aggress. Behav. 28 (5), 394–400. https://doi.org/10.1002/ab.80015.
Haller, J., Kruk, M.R., 2006. Normal and abnormal aggression: human disorders and novel laboratory models. Neurosci. Biobehav. Rev. 30 (3), 292–303. https://doi.org/10.1016/j.neubiorev.2005.01.005.
Han, S., 2018. Neurocognitive basis of racial in-group bias in empathy. Trends Cogn. Sci. 22 (5), 400–421. https://doi.org/10.1016/j.tics.2018.02.013.
Hanson, R.K., 2003. Empathy deficits of sexual offenders: a conceptual model. J. Sex. Aggress. 9 (1), 13–23. https://doi.org/10.1080/1355260031000137931.
Hare, R.D., 1991. The Hare Psychopathy Checklist Revised. Multi Health Systems, Toronto, Ontario.
Hare, R.D., 1996. Psychopathy: a clinical construct whose time has come. Crim. Justice Behav. 23 (1), 25–54. https://doi.org/10.1177/0093854896023001004.
Hare, R.D., 1999. Psychopathy as a risk factor for violence. Psychiatr. Q. 70, 181–197. https://doi.org/10.1023/A:1022094925150.
Hare, R.D., 2003. The Hare Psychopathy Checklist Revised. Multi Health Systems, Toronto, Ontario.
Harpur, T.J., Hakstian, A.R., Hare, R.D., 1988. Factor structure of the psychopathy checklist. J. Consult. Clin. Psychol. 56 (5), 741–747. https://doi.org/10.1037/0022-006X.56.5.741.
Harris, S.T., Picchioni, M.M., 2013. A review of the role of empathy in violence risk in mental disorders. Aggress. Violent Behav. 18, 335–342. https://doi.org/10.1016/j.avb.2012.12.003.
Hart, S.D., Storey, J.S., 2013. Clinical and forensic issues in the assessment of psychopathy. In: Weiner, I., Otto, R.K. (Eds.), The Handbook of Forensic Psychology, 4th ed. Wiley, New York, pp. 556–578 [ISBN: 978-1-118-34841-3].
Hastings, M.E., Tangney, J.P., Stuewig, J., 2008. Psychopathy and identification of facial expressions of emotion. Pers. Individ. Dif. 44, 1474–1483. https://doi.org/10.1016/j.neuroimage.2010.02.034.
Hermans, E.J., Putman, P., van Honk, J., 2006. Testosterone administration reduces empathetic behavior: a facial mimicry study. Psychoneuroendocrinology 31, 859–866. https://doi.org/10.1016/j.psyneuen.2006.04.002.
Hoffman, M.L., 2000. Empathy and Moral Development. Cambridge University Press, Cambridge.
Hoffman, M.L., 2008. Empathy and prosocial behavior. In: Lewis, M., Haviland-Jones, J. M., Barrett, L.F. (Eds.), Handbook of Emotions. The Guilford Press, New York, pp. 440–455.
Humphreys, K.L., McGoron, L., Sheridan, M.A., McLaughlin, K.A., Fox, N.A., Nelson, C. A., Zeanah, C.A., 2015. High-quality foster care mitigates callous-unemotional traits following early deprivation in boys: a randomized controlled trial. J. Am. Acad. Child Adolesc. Psychiatry 54 (12), 977–983. https://doi.org/10.1016/j.jaac.2015.09.010.
Igoumenou, A., Harmer, C.J., Yang, M., Coid, J.W., Rogers, R.D., 2017. Faces and facets: the variability of emotion recognition in psychopathy reflects its affective and antisocial features. J. Abnorm. Psychol. 126 (8), 1066–1076. https://doi.org/10.1037/abn0000293.
Jolliffe, D., Farrington, D.P., 2004. Empathy and offending: a systematic review and meta-analysis. Aggress. Violent Behav. 9 (5), 441–476. https://doi.org/10.1016/j.avb.2003.03.001.
Kheirandish-Gozal, L., Yoder, K., Kulkarni, R., Gozal, D., Decety, J., 2014. Preliminary functional MRI neural correlates of executive functioning and empathy in children with obstructive sleep apnea. Sleep 37 (3), 587–592. https://doi.org/10.5665/sleep.3504.
Kiehl, K.A., Hoffman, M.B., 2011. The criminal psychopath: history, neuroscience, treatment, and economics. Jurimetrics 51 (4), 355–398.
Kiehl, K.A., Sinnot-Armstrong, W.P., 2013. Introduction. In: Kiehl, K.A., Sinnot-Armstrong, W.P. (Eds.), Handbook on Psychopathy and Law. Oxford University Press, New York, NY.
Klimecki, O.M., Singer, T., 2013. Empathy from the perspective of social neuroscience. In: Armony, J., Vuilleumier, P. (Eds.), The Cambridge Handbook of Human Affective Neuroscience. Cambridge University Press. http://hdl.handle.net/21.11116/0000-0003-F2D6-A.
Koenigs, M., Baskin-Sommers, A., Zeier, J., Newman, J.P., 2011. Investigating the neural correlates of psychopathy: a critical review. Mol. Psychiatry 16 (8), 792–799. https://doi.org/10.1038/mp.2010.124.
Kraaijenvanger, E.J., Hofman, D., Bos, P.A., 2017. A neuroendocrine account of facial mimicry and its dynamic modulation. Neurosci. Biobehav. Rev. 77, 98–106. https://doi.org/10.1016/j.neubiorev.2017.03.006.
Krumhuber, E.G., Kappas, A., Manstead, A.S.R., 2013. Effects of dynamic aspects of facial expressions: a review. Emot. Rev. 5, 41–46. https://doi.org/10.1177/1754073912451349.
Lipps, T., 1903. Einfühlung, innere Nachahmung und Organempfindungen [German]. Archiv für die gesamte Psychologie 1, 185–204.
Lockwood, P.L., Sebastian, C.L., McCrory, E.J., Hyde, Z.H., Gu, X., De Brito, S.A., Viding, E., 2013. Association of callous traits with reduced neural response to others' pain in children with conduct problems. Curr. Biol. 23 (10), 901–905. https://doi.org/10.1016/j.cub.2013.04.018.
Luo, S., Han, X., Du, N., Han, S., 2017. Physical coldness enhances racial in-group bias in empathy: electrophysiological evidence. Neuropsychologia 116, 117–125. https://doi.org/10.1016/j.neuropsychologia.2017.05.002.
Lynam, D.R., Caspi, A., Moffitt, T.E., Loeber, R., Stouthamer-Loeber, M., 2007. Longitudinal evidence that psychopathy scores in early adolescence predict adult psychopathy. J. Abnorm. Psychol. 116, 155–165. https://doi.org/10.1037/0021-843X.116.1.155.
Main, A., Walle, E.A., Kho, C., Halpern, J., 2017. The interpersonal functions of empathy: a relational perspective. Emot. Rev. 9 (4), 358–366. https://doi.org/10.1177/1754073916669440.
Marsh, A.A., Blair, R.J.R., 2008. Deficits in facial affect recognition among antisocial populations: a meta-analysis. Neurosci. Biobehav. Rev. 32 (3) https://doi.org/10.1016/j.neubiorev.2007.08.003, 545-465.
Marsh, A.A., Finger, E.C., Fowler, K.A., Adalio, C.J., Jurkowitz, I.T.N., Schechter, J.C., et al., 2013. Empathic responsiveness in amygdala and anterior cingulate cortex in youths with psychopathic traits. J. Child Psychol. Psychiatry 54 (8), 900–910. https://doi.org/10.1111/jcpp.12063.
Martens, W.H.J., 1997. Psychopathy and Maturation [PhD-thesis]. Shaker Publishing, Maastricht.
Meffert, H., Gazzola, V., den Boer, J.A., Bartels, A.A.J., Keysers, C., 2013. Reduced spontaneous but relatively normal deliberate vicarious representations in psychopathy. Brain 136 (8), 2550–2562. https://doi.org/10.1093/brain/awt190.
Mokros, A., Hollerbach, P., Vohs, K., Nitschke, J., Eher, R., Habermeyer, E., 2013. Normative data for the Psychopathy Checklist - revised in German-speaking countries: a meta-analysis. Crim. Justice Behav. 40, 1397–1412. https://doi.org/10.1177/0093854813492519.
Moul, C., Killcross, S., Dadds, M.R., 2012. A model of differential amygdala activation in psychopathy. Psychol. Rev. 119 (4), 789–806. https://doi.org/10.1037/a0029342.
Mullins-Nelson, J.L., Salekin, R.T., Leistico, A.M.R., 2006. Psychopathy, empathy, and perspective-taking ability in a community sample: implications for the successful psychopathy concept. Int. J. Forensic Ment. Health 5 (2), 133–149. https://doi.org/10.1080/14999013.2006.10471238.
Munro, G.E.S., Dywan, J., Harris, G.T., McKee, S., Unsal, A., Segalowitz, S.J., 2007. ERN varies with degree of psychopathy in an emotion discrimination task. Biol. Psychol. 76 (1), 31–42. https://doi.org/10.1016/j.biopsycho.2007.05.004.
Nelson, D.W., Klein, C.T.W., Irvin, J.E., 2003. Motivational antecedents of empathy: inhibiting effects of fatigue. Basic Appl. Soc. Psychol. 25 (1), 37–50. https://doi.org/10.1207/S15324834BASP2501_3.
Newman, J.P., Lorenz, A.R., 2003. Response modulation and emotion processing: implications for psychopathy and other dysregulatory psychopathology. In: Davidson, R.J., Scherer, K., Goldsmith, H.H. (Eds.), Handbook of Affective Sciences. Oxford University Press, New York, NY, pp. 904–929.
Newman, J.P., Curtin, J.J., Bertsch, J.D., Baskin-Sommers, A.R., 2010. Attention moderates the fearlessness of psychopathic offenders. Biol. Psychiatry 67 (1), 66–70. https://doi.org/10.1016/j.biopsych.2009.07.035.

Olszanowski, M., Wróbel, M., Hess, U., 2019. Mimicking and sharing emotions: a re-examination of the link between facial mimicry and emotional contagion. Cogn. Emot. 34 (2), 367–376. https://doi.org/10.1080/02699931.2019.1611543.
Patrick, C.J., Fowles, D.C., Krueger, R.F., 2009. Triarchic conceptualization of psychopathy: developmental origins of disinhibition, boldness, and meanness. Dev. Psychopathol. 21, 913–938. https://doi.org/10.1017/S0954579409000492.
Patterson, C.M., Newman, J.P., 1993. Reflectivity and learning from aversive events: toward a psychological mechanism for the syndromes of disinhibition. Psychol. Rev. 100 (4), 716–736. https://doi.org/10.1037/0033-295X.100.4.716.
Pham, T.H., Philippot, P., 2010. Decoding of facial expression of emotion in criminal psychopaths. J. Pers. Disord. 24 (4), 445–459. https://doi.org/10.1521/pedi.2010.24.4.445.
Porter, S., Woodworth, M., 2006. Psychopathy and aggression. In: Patrick, C.J. (Ed.), Handbook of Psychopathy. Guilford Press, New York, pp. 481–494.
Premack, D., Woodruff, G., 1978. Does the chimpanzee have a theory of mind? Behav. Brain Sci. 1 (4), 515–526. https://doi.org/10.1017/S0140525X00076512.
Blair, R., 2005a. Applying a cognitive neuroscience perspective to the disorder of psychopathy. Dev. Psychopathol. 17 (3), 865–891. https://doi.org/10.1017/S0954579405050418.
Blair, R.J., 2005b. Responding to the emotions of others: dissociating forms of empathy through the study of typical and psychiatric populations. Conscious. Cogn. 14, 698–718. https://doi.org/10.1016/j.concog.2005.06.004.
Rasmussen, K., Storsæter, O., Levander, S., 1999. Personality disorders, psychopathy, and crime in a Norwegian prison population. Int. J. Law Psychiatry 22 (1), 91–97. https://doi.org/10.1016/s0160-2527(98)00031-4.
Richell, R.A., Mitchell, D.G., Newman, C., Leonard, A., Baron-Cohen, S., Blair, R.J., 2003. Theory of mind and psychopathy: can psychopathic individuals read the 'language of the eyes'? Neuropsychologia 41 (5), 523–526. https://doi.org/10.1016/s0028-3932(02)00175-6.
Romeo, R., Knapp, M., Scott, S., 2006. Economic cost of severe antisocial behaviour in children - and who pays it. Br. J. Psychiatry 188, 547–553. https://doi.org/10.1192/bjp.bp.104.007625.
Rosenberger, L.A., Eisenegger, C., Naef, M., Terburg, D., Fourie, J., Stein, D.J., van Honk, J., 2019. The human basolateral amygdala is indispensable for social experiential learning. Curr. Biol. 29 (20), 3532–3537. https://doi.org/10.1016/j.cub.2019.08.078 e3533.
Sadeh, N., Verona, E., 2012. Visual complexity attenuates emotional processing in psychopathy: implications for fear-potentiated startle deficits. Cogn. Affect. Behav. Neurosci. 12, 346–360. https://doi.org/10.3758/s13415-011-0079-1.
Scheffer, I., Wilson, S., Baird, A., 2011. Mirror neuron system involvement in empathy: a critical look at the evidence. Social empathy, emotional intelligence and psychopathy. Neuroscience 6, 327–335. https://doi.org/10.1080/17470919.2010.547085.
Sierksma, J., Thijs, J., Verkuyten, M., 2015. In-group bias in children's intention to help can be overpowered by inducing empathy. Br. J. Dev. Psychol. 33, 45–56. https://doi.org/10.1111/bjdp.12065.
Singer, T., Klimecki, O.M., 2014. Empathy and compassion. Curr. Biol. 24 (18), 875–878. https://doi.org/10.1016/j.cub.2014.06.054.
Singer, T., Lamm, C., 2009. The social neuroscience of empathy. Ann. N. Y. Acad. Sci. 1156, 81–96. https://doi.org/10.1111/j.1749-6632.2009.04418.x.
Singer, T., Seymour, B., O'Doherty, J.P., Stephan, K.E., Frith, C.D., 2006. Empathic neural responses are modulated by the perceived fairness of others. Nature 439, 466–469. https://doi.org/10.1038/nature04271.
Skeem, J.L., Cooke, D.J., 2010. Is criminal behavior a central component of psychopathy? Conceptual directions for resolving the debate. Psychol. Assess. 22, 433–445. https://doi.org/10.1037/a0008512.
Smith, M.L., Cottrell, G.W., Gosselin, A., Schyns, P.G., 2005. Transmitting and decoding facial expressions. Psychol. Sci. 16 (3), 184–189. https://doi.org/10.1111/j.0956-7976.2005.00801.x.
Söderkvist, S., Ohlén, K., Dimberg, U., 2018. How the experience of emotion is modulated by facial feedback. J. Nonverbal Behav. 42 (1), 129–151. https://doi.org/10.1007/s10919-017-0264-1.
Soderstrom, H., 2003. Psychopathy as a disorder of empathy. Eur. Child Adolesc. Psychiatry 12, 249–252. https://doi.org/10.1007/s00787-003-0338-y.
Sonnby-Borgström, M., 2002. Automatic mimicry reactions as related to differences in emotional empathy. Scand. J. Psychol. 43 (5), 433–443. https://doi.org/10.1111/1467-9450.00312.
Tempesta, D., Socci, V., de Gennaro, L., Ferrara, M., 2018. Sleep and emotional processing. Sleep Med. Rev. 40, 183–195. https://doi.org/10.1016/j.smrv.2017.12.005.
Terburg, D., Scheggia, D., Triana Del Rio, R., Klumpers, F., Ciobanu, A.C., Morgan, B., et al., 2018. The basolateral amygdala is essential for rapid escape: a human and rodent study. Cell 175 (3), 723–735. https://doi.org/10.1016/j.cell.2018.09.028 e716.
van der Schalk, J., Fischer, A., Doosje, B., Wigboldus, D., Hawk, S., Rotteveel, M., Hess, U., 2011. Convergent and divergent responses to emotional displays of ingroup and outgroup. Emotion 11 (2), 286–298. https://doi.org/10.1037/a0022582.
van Honk, J., Eisenegger, C., Terburg, D., Stein, D.J., Morgan, B., 2013. Generous economic investments after basolateral amygdala damage. Proc. Natl. Acad. Sci. 110 (7), 2506–2510. https://doi.org/10.1073/pnas.1217316110.
Vanman, E.J., 2016. The role of empathy in intergroup relations. Curr. Opin. Psychol. 11, 59–63. https://doi.org/10.1016/j.copsyc.2016.06.007.
Verschuere, B., te Kaat, L., 2020. What are the core features of psychopathy? A prototypicality analysis using the Psychopathy Checklist-Revised (PCL-R). J. Pers. Disord. 34 (3), 410–419. https://doi.org/10.1521/pedi_2019_33_396.
Verschuere, B., van Ghesel Grothe, S., Waldorp, L., Watts, A.L., Lilienfeld, S.O., Edens, J. F., et al., 2018. What features of psychopathy might be central? A network analysis of the Psychopathy Checklist-Revised (PCL-R) in three large samples. J. Abnorm. Psychol. 127 (1), 51–65. https://doi.org/10.1037/abn0000315.
Walter, H., 2012. Social cognitive neuroscience of empathy: concepts, circuits, and genes. Emot. Rev. 4 (1), 9–17. https://doi.org/10.1177/1754073911421379.
Yamamoto, S., Takimoto, A., 2012. Empathy and fairness: psychological mechanisms for eliciting and maintaining prosociality and cooperation in primates. Soc. Just. Res. 25, 233–255. https://doi.org/10.1007/s11211-012-0160-0.
Yoder, K.J., Porges, E.C., Decety, J., 2015. Amygdala subnuclei connectivity in response to violence reveals unique influences of individual differences in psychopathic traits in a nonforensic sample. Hum. Brain Mapp. 36 (4), 1417–1428. https://doi.org/10.1002/hbm.22712.
Zeier, J.D., Newman, J.P., 2013. Feature-based attention and conflict monitoring in criminal offenders: interactive relations of psychopathy with anxiety and externalizing. J. Abnorm. Psychol. 122 (3), 797–806. https://doi.org/10.1037/a0033873.