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Introduction to the Special Section: What Do We Know About the Psychophysiology of Child Psychopathy and Conduct Problems?

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Abstract
Various imaging techniques as well as parasympathetic and sympathetic nervous system measurement methods have allowed for the increasingly sophisticated investigation of the psychophysiology that underlies the psychopathic personality and its dimensions including Conduct Disorder. With this special section, we were interested in whether the dimensions separately tell us anything different regarding the underlying mechanisms or processes involved in the specific phenotypic expression(s) of psychopathy. Seven empirical articles address this question by examining the psychobiology of psychopathy from a multicomponent perspective. Four articles examined the heart functioning and/or skin conductance of those with elevated psychopathic traits and two studies used EEG to index and image the brain. A single study tested heart functioning in relation to the environment. Findings from the papers indicate differences with respect to psychophysiology across the dimensions and thus signal benefits to examining the broader construct of psychopathy as well as its underpinning dimensions. Those with elevated GM traits appear to have aberrations with respect to self-referential processing and fealessness in adulthood but limited impairments otherwise, whereas those with elevated CU and DI traits show impairment in associative learning and potentially fear processing and arousal. Findings from the special section articles may have implications for the etiology, treatment, and eventually diagnostic manuals (i.e., DSM-5, ICD-11). We hope that these studies in this special section lead to additional multicomponent investigations that ultimately improve our understanding of the psychobiological mechanisms of psychopathy.

Keywords Psychopathy · GM traits · CU traits · DI traits · Psychophysiology · HR · EEG

Introduction

Child psychopathy is a severe personality disorder that has been shown to have links to Conduct Disorder (CD; e.g., López-Romero et al., 2019; Salekin, 2016). Factor analytic work on the psychopathic personality has demonstrated that the disorder is multi-componential (e.g., Colins et al., 2014; Dong et al., 2014; Frick et al., 2000; Luo et al., 2021). Initially, Harpur et al. (1989) established that the condition was separable into two broad factors including an interpersonal/affective factor and lifestyle/antisocial factor. The Harpur et al. (1989) study was the first to show differences between the separate components of psychopathy in terms of their external correlates, which were rarely investigated prior to this study. Later, the two-factor model was further articulated as three- and four-factor models including an interpersonal, affective, lifestyle and antisocial factor (Hare, 2003). At the child level, these factors have been referred to as grandiose-manipulative (GM), callous-unemotional (CU), daring-impulsive (DI), and conduct disorder (CD) (Salekin, 2017). They similarly have been referred to as grandiose-deceitful (GD), callous-unemotional (CU), and impulsive-need for stimulation (INS) (see e.g., Andershed et al., 2018). Lilienfeld (2018) remarked that the Harpur et al. (1989) factor structure paper was one of the most influential and important

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in the psychopathy research field because it allowed for a better understanding of the condition and an improved alignment between the individual dimensions and respective psychological and biological correlates. Factor analytic studies have continued to demonstrate that the condition is multidimensional in nature with unique correlates (e.g., Colins et al., 2018; Dong et al., 2014; Frick et al., 2000; López-Romero et al., 2019; Luo et al., 2021; Ribeiro da Silva et al., 2021). For consistency, we primarily use the terms grandiose-manipulative (GM), callous-unemotional (CU), daring-impulsive (DI), and Conduct Disorder (CD) traits in this introduction paper.

The promise that the multidimensional model holds for understanding psychopathy may be substantial. Specifically, the multicomponent model may allow for a more complete clinical picture of psychopathy that can be anchored to Cleckley (1941/1976) and Hare (1991). Tethering the work to the most prominent theory and research in the field could be important to more fully encapsulate relevant and representative trait items (Salekin et al., 2018). Equally and relatedly important, the multicomponent model may facilitate our understanding of the manifold psychobiological mechanisms of psychopathy. Further, the multicomponent model may help us better predict negative outcomes, prognosis, and treatment effects of children with various psychopathic traits and CD (e.g., Lahey, 2014; Ribeiro da Silva et al., 2021; Salekin, 2016). Thus, the authors contend that if the multidimensional model of psychopathy is more fully incorporated into research, the information garnered could lead to relative improvements in the development of etiological models, the prediction of conduct problems, the creation of efficacious treatment programs, and potentially the refinement of diagnostic and statistical manuals including the DSM-5 and ICD-11 (APA, 2013; WHO, 2018). Thus far, the DSM-5 and ICD-11 only include CU traits in the diagnostic criteria for CD, Conduct-Dissocial, and Oppositional-Defiant Disorder (ODD) diagnoses. Yet, the specifier varies in its ability to capture, or predict, severe CD (e.g., Déry et al., 2019).

An aim of this special section, therefore, was to begin the process of increasing research on investigating potential underlying psychobiological mechanisms for the child psychopathy concept from a multidimensional perspective. The current special section contains seven articles that address child and adolescent psychopathy and its underpinning components as well as their potential psychophysiological correlates. Four papers investigate psychopathy and its relation to heart rate and/or skin conductance and startle reflex. An additional two studies investigate psychopathic traits and their relation to EEG measured brain activity and one study examines psychopathy and HR, and the biological response to the environment. We describe each of these studies briefly below before providing some concluding thoughts and directions for future research. We break the studies into 1) heart functioning and/or SCR and startle studies, 2) EEG studies, and 3) heart rate (HR) by environment study.

Heart Rate, Skin Conductance, and Startle Studies

Ivanova-Serokhvostova et al. (2022) examined the heart and skin conductance functioning of children with psychopathic traits in a conditioning paradigm. With this study, Ivanova-Serokhvostova et al. (2022) aimed to extend knowledge regarding fear conditioning in psychopathy and its dimensions in child and early adolescent clinical populations. Participants were 45 outpatient boys (age = 6–14 years) from two psychiatric clinics in Spain who were assessed with the Child Problematic Traits Inventory (CPTI; Colins et al., 2014). The fear conditioning stimuli (CS + and CS-) were geometric shapes and the unconditional stimulus (US) was an unpleasant sound (metal scraping on slate; 83 dB). In this study, the authors employed difference scores (CS + — CS-) in skin conductance responses (SCR) and self-reported cognitive and affective measures as indices of fear conditioning. This design, to include self report measures, follows recommendations by Hoppenbrouwers et al. (2016). Their results showed that deficits in fear conditioning were indeed related to several psychopathy dimensions but notably not to psychopathy as a unitary construct (as measured by CPTI total). Specifically, Ivanova-Serokhvostova et al. (2022) found that the impulsivity need for stimulation (INS) dimension was a predictor of impaired fear conditioning at a cognitive level. The interaction of callous-unemotional (CU) and impulsivity need for stimulation (INS) dimensions was a significant predictor of impaired electrodermal fear conditioning. By contrast, and noteworthy, the grandiose-deceitful (GD) dimension was marginally associated with a greater electrodermal fear conditioning. The Ivanova-Serokhvostova et al. (2022) study may support to some extent what Cleckley (1941/1976) suspected, that the broad construct can mask potential emotional and personality problems that can only be seen, and better understood, at the component level. The authors note that their findings indicate that the GD (GM) dimension may be related to a "preserved capacity to form associations between a threat cue and an aversive event at a physiological level." These results align with the findings from a broader review paper on this topic (Salekin, 2017) and other research showing GD (GM) to be related to better perspective-taking, higher intelligence, and physiological functioning that allows for clearer signals from the environment (see also Goa et al., 2018; Wang et al., 2012). Together, as the authors note, the results suggest that GD (GM) dimension of psychopathy may be related to a better predisposition for successful conditioning whereas CU and INS (DI) together may be related to deficits in fear conditioning. The study provides some support for consideration of the multidimensional model of youth psychopathy.

Fanti et al. (2022) investigated the associations between diverse psychophysiological measurement including heart rate, skin conductance, and startle reflex assessed at rest and during an exposure to two modes of emotional stimuli (film and pictures). In this study, participants (age = 5–9 years) were assessed with the CPTI (Colins et al., 2014) for their level of psychopathy. Participants then viewed video scenes and pictures eliciting different emotions while their physiological reactions were recorded. With respect to baseline measures, the Fanti et al. (2022) study showed a negative relation between the impulsive dimension (INS) and baseline skin conductance. Employing hierarchical regression models the authors further discovered that lower heart rate reactivity in response to sad video scenes and fearful pictures was distinctively associated with the CU dimension. Alternately, high startle reactivity in response to fearful emotional stimuli was associated with GD (fearful pictures) and INS (fearful video) dimensions. As the authors note, their findings may well correspond with the stimulus seeking theory, suggesting that individuals with impulsive characteristics (INS or DI) might exhibit low levels of arousal during rest. However, they note that individuals with elevated psychopathic traits may respond with high levels of arousal during emotional stimuli with the aim of setting their arousal at an optimal level (Eysenck, 1997; Quay, 1965). High levels of impulsivity were also associated with elevated levels of startle reactivity during exposure to violent stimuli, which depict individuals exhibiting fear potentially lending further support to the stimulation seeking theory (Quay, 1965) (see also Beauchaine, 2012; Eysenck, 1997). The GD (GM) traits showed preserved orienting to the fear stimuli and may also show increased arousal to such stimuli. Like the Ivanova-Serokhvostova et al. (2022) study, the authors found that GD (GM) and CU dimensions had some unique and potentially opposing physiological responses mirroring also, to some extent, other past research on the topic (e.g., MacDougall et al., 2019). These differential relations between the psychopathy factors and psychophysiology provide additional support pertaining to the bio-distinctness of the psychopathy dimensions.

Muñoz Centifanti et al. (2022) contend that few studies have taken into account the moderating effects of anxiety on the relationship of distinct psychopathic traits with SCR to fear inducing stimuli. In the Muñoz Centifanti et al. (2022) study, the authors utilized a virtual reality task (rollercoaster drop) and skin conductance response (SCR) in a sample of 75 young individuals (age 11–16 years) enrolled in an alternative, non-mainstream, school. The roller coaster drop was used to examine the specific event related response to what is referred to as a discrete threat, rather than examining SCR throughout the entire rollercoaster ride. The authors used the teacher version of the Antisocial Process Screening Device (APSD; Frick & Hare, 2001) to test the relations of separable psychopathic traits with SCR and self-reported anxiety. Muñoz Centifanti et al. (2022) found that lower anxiety was associated with higher CU traits, but only in youths with low SCR to the discrete threat (the rollercoaster drop). Their findings showed that fear and anxiety exhibit complex interactive relations with CU traits. Interestingly, Narcissism (GM) and Impulsivity (DI) traits did not show the same effect. This study, similar to the Ivanova-Serokhvostova et al. (2022) and Fanti et al. (2022) investigations, also showed, to some extent, differential findings for the components of psychopathy. While the findings may provide information related to threat, the findings may also be considered relevant to thrill-seeking as youth in this study may find the rollercoaster drop, at least to some extent, exciting lending some potential support to Quay's theory (1965). This might be especially true for narcissism (GM) and impulsivity (DI) traits, a finding that is similar to, and in line with, the findings in the Fanti et al. (2022) investigation. The study also offers an examination of psychopathy in a sample of youth with high co-occurring psychopathology (1/2 with ADHD) and moderately high abuse history (1/3 with abuse history) and therefore offers information pertaining to psychophysiology of a sample with a higher rate of multi-health problems.

Thomson (2022), likewise, used a virtual reality fear induction task (a horror game) to examine whether the interpersonal (GM), affective (CU), lifestyle (DI) and antisocial factors of psychopathy were differentially related to physiological fear reactivity profiles in a young adult sample (age = 18–21 years). Thomson (2022) used the Self Report Psychopathy 4th edition (SRP-4; Paulhus et al., 2016) short form to measure psychopathy and indexed sympathetic nervous system and parasympathetic nervous system functioning via skin conductance and respiratory sinus arrhythmia (RSA). The virtual reality task used in the Thomson study was referred to as a horror game task that included giving participants a battery operated flashlight to use in a dark room. When the battery depleted, the participant would be left sitting centrally located in a horror experience until the battery could be recharged. According to Thomson, the horror experience included jump scares, intimidating music, and unsettling visual cues. Thomson (2022) found that the affective (CU) and antisocial facets were associated with a lower SNS fear reactivity while the lifestyle facet was associated with a greater PNS fear reactivity. Notably, the author observed that the interpersonal facet (GM) was related to co-inhibition of the ANS (low SNS and PNS activity). Thomson (2022) suggests that the finding of co-inhibition may be a physiological profile that enables the manipulative, coercive, and "cold blooded" behaviors linked with psychopathy. Further, Thomson states that the co-inhibition evidenced with the interpersonal facet (GM) could be the "biological profile for fearlessness" (see also Wagner et al., 2015). Further considerations may be that the co-inhibition (under-arousal) might also be considered an uncomfortable state that encourages a person to engage in risky behavior to

increase their physiological state to normal or optimal levels coinciding with earlier theories of under-arousal that pertain to psychopathy (Quay, 1965). Thomson (2022) aptly notes that theory will be important in understanding treatment, and further contends that whichever theory is valid may drastically alter treatment approaches. In line with Ivanova-Serokhvostova et al. (2022), Fanti et al. (2022), and Munoz Centifant et al. (2022), the Thomson (2022) findings indicate that the correct theory may vary by dimension.

EEG Studies

Two studies in the special section used EEG measurement to examine the psychophysiology of psychopathy and its components. Clark et al. (2022) tested the neural functioning of 40 adolescent offenders (age = 13–18 years) with varying degrees of psychopathic traits using EEG spectra analysis. The vast majority of youth in their study (detained for a minimum of three months) met criteria for CD. The authors used the self-report APSD (Frick & Hare, 2001) to assess psychopathy in this sample and also examined brain functioning via theta/beta EEG bands. As the authors note, theta/beta has been frequently examined in ADHD studies and found to show aberrations in youth with ADHD. In the Clark et al. (2022) study, theta/beta ratio was examined in an 8-min resting state during which participants had their eyes open (4 min) and eyes closed (4 min). Clark et al. (2022) hypothesized that if the Impulsivity (DI) component of psychopathy is somewhat similar to ADHD that (1) the total psychopathy scores and Impulsivity (DI) subscale scores would be positively correlated with theta/beta ratio and that (2) Narcissism (GM) and callous-unemotional (CU) traits subscale scores would be negligibly correlated (unrelated) with theta/beta. The authors discovered that those individuals with elevated psychopathic traits did not differ from those with low levels of psychopathic traits on theta/beta. Clark et al. (2022) suggest that their research shows an important point of departure from the research on ADHD that has more commonly shown this psychophysiological correlate. These findings also indicate that suggestions to use ADHD as a proxy for the daring-impulsive (DI) psychopathy component may not be appropriate. This argument of using ADHD as an indicator of impulsivity/need for stimulation is often made in fledgling psychopathy models, although as Clark et al. (2022) note the research support for this contention or methodology as a way of accounting for psychopathy is not well supported by the research (e.g., Smith & Hung, 2012). The Clark et al. (2022) findings may also indicate then that the "impulsivity" that is associated with psychopathy may manifest differently than the impulsivity associated with ADHD. Interestingly, however, the exploratory sLORETA, did show differences in beta band activity between the dimensions with those with elevated GM traits appearing to demonstrate low levels of beta activity (in the rest period) whereas those with CU and DI traits had higher levels of beta activity during rest. A few studies have suggested that excess beta at rest may correlate with delinquency (Meier et al., 2014). The Clark et al. (2022) findings may suggest differences in cognitive control at the dimensional level, (when using sLORETA) given these noted beta differences, although more research is needed on this topic.

In a second EEG imaging study, Bontemps et al. (2022) examined the self-referential processing of 39 adolescent offenders (age = 15.79; SD = 1.36) with psychopathic traits and conduct problems. This study was conducted at a detention center where most youth (detained for an average of 14 days) met criteria for CD. Bontemps et al. (2022) utilized the self-report Proposed Specifiers for Conduct Disorder scale (PSCD; Salekin & Hare, 2016) to assess psychopathy. In the Bontemps et al. (2022) study participants were asked to view words and statements that were descriptive of the psychopathic personality ("charm," "manipulative," "callous"), to rate whether the trait applied to them, and to contemplate the trait itself while their neuronal functioning was being recorded. According to Bontemps et al. (2022), the findings for their study showed that frontal alpha asymmetry was reversed from the expected and hypothesized approach motivation direction (based on the approach-withdrawal motivation hypothesis; Davidson, 1992). The authors concluded that their findings may indicate that those with elevated psychopathic traits do not affectively approach the traits, but rather are affectively neutral or even withdrawn (detached) from the self-descriptive information. In addition, the authors note that the expected correlations are not seen for alpha power when individuals with elevated psychopathic traits view self-referential information. While these latter findings did not align with expectations, the right lateralized activity for those individuals highest in GM traits did however fit with past research on self-referential processing given that some neuroscience and cognitive neuropsychology researchers believe that the right hemisphere is associated with self-referential thought (Decety & Sommerville, 2003). Clinical cases also have supported the privileged role of the right hemisphere in representing the self. Additionally, personal confabulation (fictitious stories about the self) may be associated with aberrations to the right frontal lobe (e.g., Feinburg, 2001). Neuroimaging studies with healthy subjects have also provided converging evidence for right hemisphere involvement in self-other processing, (Fink et al., 1996; Gallagher & Frith, 2003; Keenan et al., 2001) and patient studies (Happé et al., 1999) have demonstrated that the right medial prefrontal cortex is involved in various forms of self and other mental state reasoning. However, much research is still needed on the location of self-referential processing as other studies suggest that the medial prefrontal cortex more broadly may also be most related to self-referential thought. Regardless of these

specific regions (and circuits), the Bontemps et al. (2022) study highlights the potential psychophysiological differences exhibited at the psychopathy dimension level. The Bontemps et al. (2022) study also highlights the important issue of additional theory development.

Resting Heart Rate x Environment

One study examined psychophysiology (heart rate) and its relation to the environment. Specifically, Kofler et al. (2022) suggested that the biology of children may be differentially affected by the environment which can then differentially impact negative outcomes. Kofler et al. (2022) tested the moderating effects of resting heart rate (which the authors use as a measure of biological sensitivity) and sex on the relationships between neighborhood collective efficacy. The sample for their study included 245 boys and girls (age = 8–11 years) recruited from the community. The authors used a combined parent and child APSD (Frick & Hare, 2001) rating to assess psychopathic traits. Employing hierarchical regressions, Kofler et al. (2022) found that both GM and CU traits were associated with neighborhood processes, but that the relationship varied by the child's sex and heart rate level. Daring impulsive (DI) traits were not associated with either social processes or heart rate. In addition, aggression and delinquency were associated with social control, and the relationship was moderated by heart rate and sex. The Kofler et al. (2022) findings suggest that neighborhood social processes are distinctly associated with the three dimensions of childhood psychopathy and with conduct problems in children with a specific psychophysiological profile, and that these relationships according to the authors' findings are further differentiated by sex. The Kofler et al. (2022) study highlights the importance of considering the environment in relation to examining biological correlates of psychopathy (see also Gao & Zhang, 2021). Additionally, the Kofler et al. (2022) study underscores the complexity of these various relations.

Conclusion and Future Directions

Child psychopathy is a construct that has received increased attention over the past few decades. History shows, however, that child psychopathy was discussed much earlier as is revealed by the initial writings of Hervey Cleckley (1941/1976) and Benjamin Karpman (1949, 1950). This may not be particularly surprising given that there has always been an interest in curbing severe disorders like the psychopathic personality early in their development. Similarly, the study of the psychophysiology of psychopathy can be traced to earlier years with studies using fear and classical conditioning paradigms such as the countdown paradigm and mental maze shock paradigm (e.g., Hare, 1965; Lykken, 1957). And, at the adult level, researchers have increasingly examined psychopathy factor level differences with respect to psychophysiology (e.g., Brislin et al., 2018). The multicomponent model for psychopathy holds much promise and we suspect it will likely increase what can be learned regarding the underlying psychobiological mechanisms of psychopathy and its affiliated CD. The articles in this special section although preliminary in nature emphasize this point by elucidating several issues including that, together, they: i) shed light on the potentially separable psychobiology of the psychopathy dimensions, ii) underscore the prospect of multiple theoretical models for psychopathy, and iii) highlight how the findings, if replicated, may have implications for diagnostic manuals including the DSM and ICD. We elaborate on each of these issues below and also provide some guidance for future research.

Psychopathy and Psychobiological Correlates

Collectively, the set of papers included in the special section underscore that there may well be psychophysiological differences between the psychopathy dimensions. Specifically, the special section articles suggest that GM traits may be linked to deficits in the mPFC but otherwise the traits do not appear to be hampered with severe deficits in other areas such as fear conditioning or fear processing, at least at the child level. Several of the studies in the special section thematically demonstrate that those with elevated GM traits show increased startle reactivity, increased arousal, and preserved electrodermal fear conditioning (i.e., Ivanova-Serokhvostova et al., 2022; Fanti et al., 2022; Kofler et al., 2022; Muñoz Centifanti et al., 2022), and later in adulthood, fearlessness (Thomson, 2022). Another study suggests potential right hemisphere processing for self-referential traits (Bontemps et al., 2022). These findings are consistent with past research that has shown GM traits to be associated with somewhat higher and intact cognitive abilities (Lasko et al., 2019; Salekin, 2017; Salekin et al., 2004) and with enhanced attention to novel stimuli (e.g., Gao et al., 2018).

Alternately, CU traits appeared to be linked to fear processing deficits and/or potentially low levels of arousal as several studies in the special section show reduced electrodermal fear conditioning (when considered in interaction with DI traits; Ivanova-Serokhvostova et al., 2022), reduced heart rate to fearful pictures (Fanti et al., 2022), reduced SCR to a rollercoaster drop (Muñoz Centifanti et al., 2022) and reduced SNS to a fear induction task (Thomas, 2022). Additionally, CU traits were found to be unrelated to theta beta ratio and unrelated to alpha asymmetry although sLORETA did show excess beta for CU traits, reflecting increased activity when participants were requested to be at rest. These special section findings for CU traits align

with some of the studies that have suggested structural and functional abnormalities in fear processing areas and fear circuitry such as the amygdala and the orbitofrontal regions (Blair et al., 2014; Marsh et al., 2008; Patrick, 1994). Still, further research is needed to address the distinctions between fear processing and threat signaling (Hoppenbrouwers et al., 2016; LeDoux, 2014). These distinctions can be important to understand because, as Ivanova-Serokhvostova et al. (2022) elucidate, it could be the case that children and adolescents with elevated psychopathic traits may be consciously aware of the CS-US association, but do not process the emotional significance of that information as a result of reduced physiological responsiveness. This may be more salient when the broader configuration of traits are present, posing an important question for future research.

DI traits also appeared to show differences in psychophysiology from GM but not necessarily CU traits. Research has shown DI traits are likely linked to striatal aberrations (Glenn & Yang, 2012) but as shown by Clark et al. (2022) are not similarly linked to ADHD and its affiliated biology in terms of the theta/beta brain wave activity. The articles in the special section show that DI traits (in interaction with CU traits) are also related to reduced fear conditioning (Ivanova-Serokhvostova et al., 2022), reduced skin conductance to emotional stimuli (Fanti et al., 2022), increased startle to fear, perhaps being linked to arousal in seeing others in distress (Fanti et al., 2022), increased PNS to a fear induction task (in young adulthood), and no differences from the other dimensons in theta beta wave, or alpha wave activity. However, at rest, similar to what was found for CU traits, sLORETA showed that the beta waves may be higher than expected in those individuals with high DI traits, potentially expressing unrest.

Jointly, then, the findings from the special section studies indicate that the psychopathic traits and their underpinning dimensions may be affiliated with differing psychophysiology. These findings may not be overly surprising in that they align with other research studies demonstrating the somewhat distinct psychobiology for the separate dimensions (e.g., Aghajani et al., 2016; Oskarsson et al., 2021). Thus, the articles in the special section give support to the notion that the psychopathy dimensions could be "rooted in distinct underlying etiologic-dimensional factors" as noted by Ivanova-Serokhvostova et al. (2022). Clinically, this may signify that the interventions designed for treating psychopathy may necessarily need to differ based on the configuration of psychopathic traits exhibited.

Theoretical Models for Child Psychopathy

Studies in the special section also tested their study hypotheses within a theoretical context. Four studies tested the fearlessness hypothesis (Ivanova-Serokhvostova et al., 2022; Muñoz Centifanti et al., 2022; Thomson, 2022 [plus dual process theory]; Kofler et al., 2022 [plus enviroment]), three studies tested aspects of the arousal theory (Fanti et al., 2022; Clark et al., 2022; Thomson, 2022), and one study (Bontemps et al., 2022) tested ideas about self-concept. As can be seen from these special section articles, the multidimensional approach allowed for the consideration of a broader set of etiological models to account for the condition. Lilienfeld et al. (2016) has previously criticized the extent to which past psychopathy research has focused on singular causes for the multifactorial condition of psychopathy. Similarly, Miller and Lynam (2015) have stated that it is likely that "different elements [of psychopathy] are related to different deficits" (p. 233). With regard to GM, the low-fear models did not seem to apply, based on the analyses in the special section studies, to any large extent in the child studies. However, Thomson (2022), with a sample of emerging adults, nevertheless showed individuals with elevated GM traits to have a fearless profile. CU traits seemingly did to a much greater extent align with fearlessness theories and the special section studies suggested that there would be reduced fear and reduced signaling (i.e., conditioning) and perhaps less representation regarding potential threats in the environment. DI traits were primarily tested in the context of, and with respect to, the low arousal theory (Quay, 1965). One study in the special section showed that DI traits were related to lower skin conductance (SC) at rest (Fanti et al., 2022) and another by Clark et al. (2022) showed that the theta beta brain activity did not vary across the sub-dimensions. Although the Clark et al. (2022) study can be related to the low arousal theory and may provide indirect information regarding other theories such as the response modulation hypothesis, it may also indirectly address propositions that psychopathy can be located within DSM existing disorders such as ADHD, ODD, and CD (i.e., the fledgling psychopathy hypothesis). The Clark et al. (2022) investigation, notably, shows that DI traits do not appear to have equivalent brain aberrations as ADHD youth, at least in terms of theta/beta processing. This may suggest that ADHD does not capture psychopathy, or a component of psychopathy, as suggested by some. Two key take-away messages form the special section articles pertaining to theory are that: i) the proposed and tested theoretical models do not appear to be supported at the total score level, but instead, appear to gather support at the dimensional level, and, ii) while the special section articles primarily center on two dominant theories (Lykken, 1957; Quay, 1965), they simultaneously raise questions as to whether additional theories may be worth further investigation (e.g., Arieti, 1953; Hare, 2013; Patterson, 1976).

Innovative task development and novel physiological measurement, as was seen in this special section, may be needed to further test novel theoretical models.

Diagnostic Considerations and Psychobiological Dysfunction

The present set of studies show some preliminary evidence that the dimensions appear to have psychobiological distinctness to them suggesting that the use of biologically influenced indicators may be an informative approach in understanding conduct problems and CD. With respect to diagnostic considerations, future research may wish to further contemplate classical validators suggested by Robins and Guze (1970) and Cantwell (1996) to determine if psychophysiological measurement may be helpful in understanding psychopathy and conduct problems (CD). With the special section articles in this issue, the first two phases of Robins and Guze's (1970) validators appear to be addressed including: i) clinical description (the multi-componential model of psychopathy) and ii) laboratory tests (psychophysiology studies). Although the findings are preliminary, the special section articles underscore how psychophysiology may be an important consideration in clinical diagnostics and treatment matching. This is in line with Wakefield et al.'s (2003) definition of mental disorders as including a psychophysiological or physiological dysfunction and recent efforts to understand the psychobiology of other relevant constructs like fear conditioning and extinction (i.e., Insel et al., 2010). If these bio-distinctive dimension variances continue to hold it will mean that they may signify the need for their inclusion in nosological criteria. It is far too early for such an implementation at this time. However, such a notion may eventually be tractable and biologically meaningful. A next step is to continue to examine the psychophysiology of the various psychopathy dimensions and CD as well as to also investigate the extent to which the differing subdimensions predict somewhat differing outcomes. Lasko and Chester (2021) recently performed such an analysis when they showed that GM traits, as opposed to CU or DI traits, were affiliated with greater levels of conscientiousness, better educational attainment, and less self-reported crime in follow-up years of the Pathways to Desistance study (see also Goulter et al. 2021). Lasko and Chester (2021) suggest that the GM trait youth may represent a version of successful psychopathy showing in another study that GM traits in adults are associated with greater levels of gray matter in the lateral prefrontal cortex (Lasko et al., 2019). These findings, both in terms of predcition and psychobiology, may help the field further map important psychobiological and predictive differences between the dimensions as is also seen in the special section papers. Lastly, research is also needed to determine if having the complete constellation of traits is likely to signify a clinically larger set of problems for youth than CD alone, or CD with a single component of psychopathy. Some research is beginning to address this important conceptual issue (e.g., Andershed et al., 2018; Christian et al., 1997; Colins et al., 2018; López-Romero et al., 2021; Somma et al., 2018; see also Kendler, 2018).

Final Conclusion

In closing, it should be noted that psychopathy with CD is a complex condition. Cleckley (1941/1976) and Hare (1991/2003) provided a referent point and guide posts for understanding the psychopathic personality which included interpersonal (GM traits), affective (CU traits), lifestyle (DI traits), and antisocial characteristics (CD traits). Each of the traits differ in their expression and psychobiology but each individually, and as a constellation, are linked to significant antisocial outcomes (e.g., Asscher et al., 2011; Leistico et al., 2008). If future studies continue to examine the total psychopathy score along with dimension scores, and take into consideration peripheral and central physiology (Karalunas et al., 2014), it will help to build our understanding of how the configuration of these dimensions contribute to the full clinical picture of psychopathy (Lilienfeld, 2018; Lilienfeld et al., 2018; Mullins-Sweatt et al., 2010). Although the articles in the section clearly advance knowledge and show the promise of considering the multiple dimensions of psychopathy, they do not definitively answer the many questions that still remain regarding the underlying mechanisms of psychopathic traits and conduct problems. Thus, although they provide an interesting starting point, they simultaneously indicate that much more research is needed on this topic. Hopefully, the current special section articles help to identify important directions for future research. In closing and in lieu of obtaining commentary for this special section, and in honor of Scott Lilienfeld, we decided to leave readers with a quote from his previous writings (Lilienfeld, 2018). We believe that this quote, is pertinent here again (Lilienfeld, 2018). Specifically, as stated by Lilienfeld (2018) "The examination of [psychopathy dimensions] should become *de rigueur* in the psychopathy literature, including research on youth psychopathy, to allow for more compelling corroboration or refutation of configural models of psychopathy, which bear important implications for this condition's conceptualization, measurement, and etiology" (p. 83).

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Declarations

Ethical Approval IRB approval was not sought for this introduction paper as it is not required. All procedures performed were consistent with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent There were no participants as this is an introduction paper. Therefore, informed consent was not needed or sought or obtained. No human participants.

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