



Antisocial behaviour in children with and without callous-unemotional traits

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This is the third in a series of three articles on a new clinical concept called violence adapting syndrome

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Summary

More than 15 years of research have documented behavioural differences between callous-unemotional and non-callous subtypes of children with antisocial behaviour. Recent studies also suggest that children with callous-unemotional traits may be genetically vulnerable to antisocial behaviour, while those without callous-unemotional traits appear to have primarily environmental aetiology to their antisocial behaviour. Furthermore neurocognitive profiles differ between antisocial children with and without callous-unemotional traits. While the former group appears emotionally under-reactive, particularly to others' distress, the latter group may be emotionally over-reactive, particularly to perceived threat. In this review we provide an overview of the current evidence base with regard to callous-unemotional and non-callous subgroups of children with antisocial behaviour and discuss the implications of the current evidence base for prevention and intervention. This overview selectively focuses on recent advances in this area of research, as well as earlier studies where these help set the research context.

Antisocial behaviour is one of the most common reasons for a childhood referral to mental health and educational services and represents a substantial public health cost.¹ We know that children with early-onset antisocial behaviour are at risk of developing chronic life-course persistent antisocial problems, as well as several other psychiatric and physical health problems.^{2,3} It is also evident from decades of developmental psychopathology research that children with antisocial behaviour are a heterogeneous group and for interventions to be successful it is critical that distinct subgroups of children receive services that best match their profile of vulnerabilities and strengths.⁴

Callous-unemotional (CU) traits (lack of guilt and empathy, as well as shallow affect) can be

used to distinguish between children who are capable of premeditated antisocial behaviour and violence (CU-subtype; AB/CU+) and children whose antisocial behaviour and violence are primarily impulsive and threat reactive (non-CU subtype; AB/CU-). Adults with a combination of CU traits and antisocial behaviour are labelled psychopaths within the criminal justice system. While it would be entirely inappropriate to suggest that children are psychopaths, it is the case that there is a subset of children with severe conduct problems (please note that the terms antisocial behaviour and conduct problems will be used interchangeably in this review) and CU traits that place them at heightened risk for developing adult psychopathy.⁵

Methods

This review was based on a selection of peer-reviewed articles in English obtained from PubMed that were published from 1994 to present day. Articles related to the study of antisocial behaviour with and without CU subtyping, with a focus on brain imaging and genetically informative study designs.

Behavioural outcomes associated with antisocial behaviour with/without callous-unemotional traits

Longitudinal data show that children with AB/CU+ present with more severe behavioural profile and more long-term problems than their AB/CU- counterparts.^{4,6} Moreover, in line with the adult psychopathy literature, findings have highlighted the asymmetrical relationship between CU traits and conduct problems in children.⁶ Children with high levels of CU traits have been found to be highly likely to display high levels of conduct problems; however, children with high levels of conduct problems have been found to be only moderately likely to

display high levels of CU traits (Figure 1). Children with AB/CU+ may also be resistant to some forms of traditional strategies prescribed for conduct problems, for instance, time-out disciplinary strategies within a parenting programme.⁷ The inclusion of CU traits as a specifier to the next edition of the Diagnostic and Statistical Manual of Mental Disorder (American Psychiatry Association) is currently being considered.⁸

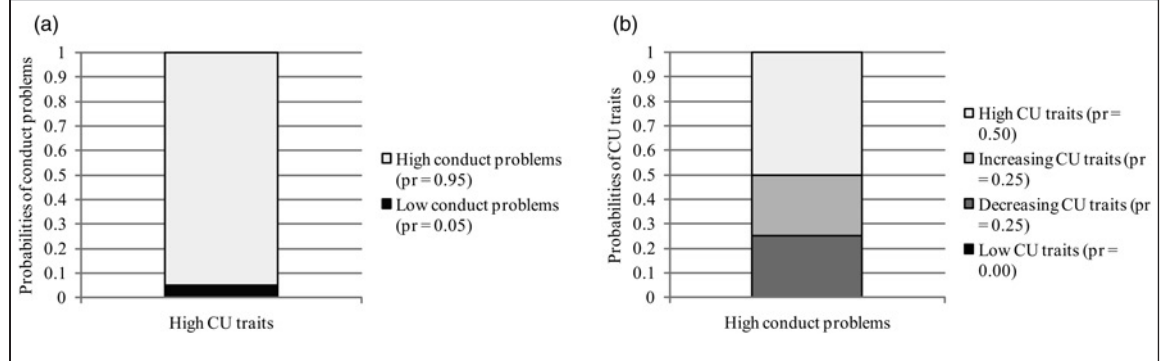
Different emotion processing profiles associated with antisocial behaviour with and without callous-unemotional traits

Cognitive experimental data suggest that children with AB/CU+ are poor at modulating their behaviour in response to punishment in conditioning paradigms.⁴ In addition they have difficulties in processing others' fearful and sad facial expressions and vocal tones.⁹ In contrast, AB/CU- is associated with an exaggerated affective response to perceived social threat, such as anger or in some cases even ambiguous, neutral expressions.^{4,10}

Recent findings suggest that children with AB/CU+ may also have an impoverished personal

Figure 1

Probabilities of high and low levels of conduct problems conditional on high levels of CU traits (a) and probabilities of high, increasing, decreasing and low levels of CU traits conditional on high levels of conduct problems (b). Fontaine *et al.*⁶ identified groups of children with different levels of CU traits (stable high, increasing, decreasing and stable low) and conduct problems (high and low). They examined the relationships between the different levels of CU traits and conduct problems, notably the probabilities of having high or low levels of conduct problems given high levels of CU traits, and the converse set of probabilities, i.e. the probabilities of having high, increasing, decreasing and low levels of CU traits given high levels of conduct problems. They found that children with high levels of CU traits were highly likely to display high levels of conduct problems (probability = 0.95) (Figure 1a), but children with high levels of conduct problems had only a 0.50 probability to display high levels of CU traits (Figure 1b)



experience of fear and guilt, which could in part explain why they have such difficulty perceiving others' distress.^{11,12} Children with AB/CU- report comparable experiences of fear and guilt to typically developing children. Interestingly, Jones *et al.*¹¹ found that neither group of children with antisocial behaviour has difficulties in 'mentalising' (perceiving the thoughts and intentions of other people). It is possible therefore that the difficulties that children with AB/CU+ exhibit are limited to 'feeling what others feel' and do not extend to difficulties commonly seen in children with autism spectrum disorders, i.e. 'knowing what others think'. This pattern of difficulties and strengths may explain why children with AB/CU+ are good at manipulating others to their own advantage, even if such behaviour will cause distress to somebody else. Theoretical accounts of AB/CU+ propose that normal socialisation is disrupted in these children because they do not form adequate associations between their transgressions and punishment outcome and because they do not find other people's distress aversive and consequently fail to develop empathy.⁹ By contrast, children with AB/CU- are proposed to form 'hostile attribution biases' and to exhibit aggression as a result of living in unstable and threatening environments.^{4,9}

Aetiology of antisocial behaviour in children with and without callous-unemotional traits

Findings from twin studies suggest that CU traits are highly heritable, particularly for boys with elevated and persistent levels of CU traits (e.g. Fontaine *et al.*¹³). We know less about aetiology of CU traits in girls, but preliminary evidence suggests a larger contribution of environmental influences for girls with a high and stable pattern of these traits.¹³ Antisocial behaviour is strongly heritable in children with AB/CU+, while the presence of antisocial behaviour in AB/CU- children appears to be driven primarily by environmental influences.^{14,15} For example, harsh and inadequate parenting is strongly associated with antisocial behaviour, but only in children without CU traits.⁴

Our recent data suggest that the genetic vulnerability to AB/CU+ is conferred by multiple genes of small effect size probabilistically increasing the

risk for poor behavioural outcome and that some of these genes may be important for neurodevelopment.¹⁶ Based on data from candidate gene and imaging genetic studies, it is also possible to speculate that the risk genes for AB/CU+ may confer low reactivity to emotional stimuli (see for example Glenn,¹⁷ Sadeh *et al.*,¹⁸ Viding and Jones¹⁹) while gene variants linked with high emotional reactivity, perhaps in combination with environmental risk (e.g. Caspi *et al.*²⁰) could be particularly relevant for AB/CU-. However, molecular genetic research into different subtypes of antisocial behaviour is in its infancy and it is likely that there will be significant advances in the coming decades, including the application of novel epigenetic approaches.

Neurocognitive profiles of antisocial children with and without callous-unemotional traits

A handful of studies now exist investigating the brain function and structure in children with antisocial behaviour. To date no studies have directly compared AB/CU+ and AB/CU- groups; the research has either concentrated on the AB/CU+ specifically or children with antisocial behaviour more generally.

Functional magnetic resonance imaging (fMRI) studies of adolescents with AB/CU+ suggest a functional neural 'signature' of the prominent features of AB/CU+, namely lack empathy for others' distress, poor behavioural choices and difficulty learning from mistakes. The key brain regions associated with perception of distress and reinforcement learning show atypical functional neural response in AB/CU+. Children with AB/CU+ exhibit lower amygdala activity to others' distress (fearful facial expressions) as compared with typically developing children and children with attention deficit-hyperactivity symptoms.^{21,22} Other studies have reported abnormal ventromedial prefrontal cortex response to punishment, and disrupted integration of amygdala, OFC and caudate functioning during reinforcement learning in adolescents with CU traits.^{23,24}

Another set of fMRI studies have focused on children with antisocial behaviour more generally, without subtyping the participants on the basis of CU traits. These studies have reported

reduced anterior cingulate activity to threatening emotional scenes under passive viewing conditions in adolescents with antisocial behaviour, possibly reflecting poor emotional regulation.^{25,26} Another study using an almost identical passive viewing paradigm found increased amygdala activation, partly related to co-morbid anxiety, in children with antisocial behaviour.²⁷ Because of the association between increased amygdala activity to threatening emotional stimuli and anxiety, Sterzer *et al.*²⁶ co-varied anxiety ratings in their analyses and found that antisocial behaviour independent of anxiety was associated with reduced amygdala reactivity. A recent study reported that, compared with typically developing adolescents, adolescents with conduct problems showed amygdala hyper-reactivity to neutral faces.²⁸ Higher amygdala reactivity to emotional stimuli and reduced activity in the emotion regulation regions of the brain in those children with antisocial behaviour and anxiety symptoms suggest functional neural bases for why some children with antisocial behaviour (perhaps those with AB/CU-) may react aggressively even in the face of minimal provocation. Given that AB/CU- are more prone to manifest elevated levels of anxiety as compared with AB/CU+ one interpretation of these findings is that different patterns of amygdala activity in children with antisocial behaviour may simply reflect different emotional vulnerabilities in those with and without CU traits. Research is currently underway by our research unit to directly compare children with and without CU traits in an fMRI setting while doing informative tasks that can highlight differences in emotional reactivity and regulation.

Structural MRI (sMRI) studies indicate that compared with typically developing boys, those with AB/CU+ have increased grey matter and decreased white matter concentration (possibly indicative of aberrant brain maturation) in fronto-temporal circuitry critical for emotion processing, moral judgments and decision-making.^{29,30} Brain-imaging data with twins suggest that some of the observed grey matter differences represent potential intermediate phenotypes for AB/CU+.³¹ In other words, heritable influences that are important for AB/CU+ are also important in explaining the grey matter anomalies observed in AB/CU+.

sMRI studies of children with antisocial behaviour (without subtyping on CU traits) using automated imaging analysis techniques have found decreased instead of increased grey matter in several fronto-temporal brain areas.^{32,33} It is possible that these findings diverge from the findings of De Brito and colleagues both because the samples have not been subtyped on CU traits, but also because of the different age groups being studied. The existing sMRI results further highlight the importance of being careful in how children with antisocial behaviour are categorized. It is increasingly evident that the broad grouping of children with antisocial behaviour is problematic given that data may conceal contrasting patterns of abnormality within different subgroups.

Implications of subtyping research for prevention and treatment of antisocial behaviour in children

If it is the case that children with and without CU traits are characterized by different patterns of neurocognitive vulnerability it follows that they are likely to be responsive to different forms of intervention. In other words differentiating children on the basis of CU traits (AB/CU+ and AB/CU-) may allow the development of more targeted and effective interventions for both subgroups.

In relation to children with AB/CU+ it is important to emphasize that although high heritability of antisocial behaviour in this group denotes vulnerability, it does not equate to lack of responsiveness to intervention. A growing evidence base indicates that treatment is effective in both reducing levels of antisocial behaviour and levels of CU traits in children with AB/CU+.^{34,35} However, it remains unclear what specific components of the interventions to date are driving the improvement across these domains. It appears likely that punishment-related strategies are ineffective with this subgroup, consistent with the findings from experimental and neuroimaging studies of reinforcement learning.^{6,8,23} Interventions designed for youth with AB/CU+ may more usefully focus on using positive reinforcement or reward-oriented response strategies to encourage prosocial behaviour, instead

of using punishment-oriented methods or disciplinary strategies such as time-out. A pressing task for future clinical research is to determine which 'active ingredients' within any treatment programme are primarily driving the observed behavioural change in AB/CU+.

By contrast children with AB/CU- are likely to be sensitive to traditional disciplinary strategies that revoke privileges or focus on anger management/emotion regulation (e.g. Fontaine *et al.*⁶). Given that environmental adversity is likely to be over-represented in this group, any intervention should include a consideration of systemic factors such as parenting and broader social functioning. Such systemic approaches have been shown to be particularly effective in treating conduct problems generally.³⁶

One implication of the existence of two subtypes of antisocial behaviour responding to different kinds of intervention is that treatment effect sizes reported in the current literature may be diluted. If a particular treatment approach is more or less effective depending on the presence of CU traits then it makes sense to evaluate treatment outcome by subgroup.

Conclusions

There is a growing consensus that children with antisocial behaviour are a heterogeneous group. One promising approach to subtyping these children is to index their level of CU traits. Children with AB/CU+ appear genetically vulnerable to antisocial behaviour and present with a more severe and enduring set behavioural problems than their AB/CU-. The two subtypes also present with different profiles of emotional reactivity. Children with AB/CU+ appear relatively insensitive to punishment, threat and others' distress. Children with AB/CU- appear over-sensitive to emotional cues, particularly threat. Emerging brain imaging findings are consistent with different patterns of emotional reactivity across subgroups. These substantial differences between children with antisocial behaviour have yet to influence treatment approaches. However, it is increasingly evident that children across CU subgroups are likely to respond differentially to various forms of intervention.

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