

Emotional Stimulation Processing and Empathy  
in Aggressive Adolescents

**Inaugural Dissertation**

Submitted to the Faculty of Psychology at the University of Basel  
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

by

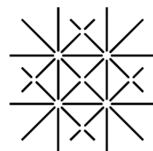
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Basel, 2015

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## Acknowledgments

I would like to express my sincere gratitude to my supervisor Prof. Dr. Christina Stadler. I am grateful for the freedom which you granted me to develop and implement my own research interests throughout this dissertation. Your continuous encouragement and enthusiasm enabled me to push onward with my projects. Your expertise and interest in promoting clinically relevant research has been a constant source of inspiration.

I would like to thank Prof. Dr. Alexander Grob for the supervision of this thesis on behalf of the faculty and for the helpful guidance offered to improve the quality and accuracy of my work. I would also like to express my gratitude to the members of the Department of Personality and Developmental Psychology of the University of Basel for the collegial support extended to me during my PhD. I also thank Prof. Dr. Sakari Lemola for serving in the dissertation committee.

I thank Dr. Doerte Grassman for the introduction to the field of clinical psychiatry and for the inspiration to work with conduct disordered children. Next, I thank Prof. Dr. Philipp Sterzer for the support and creativity during the development of the Stroop experiment. I also thank Célia Steinlin for the enjoyable collaboration during the first half of this dissertation. I would further like to express my gratitude to Dr. Marc Schmid and the MAZ research team for their generosity in offering me the possibility to use their data for my research purposes.

I owe my sincere gratitude to my parents. Without your support I would not have been able to pursue the academic path required to start this dissertation. Special thanks go to my friend Mark Theisen for the valuable and competent remarks and corrections on my manuscripts. Micheline, I thank you so much for your constructive comments on my work and your excellent expertise and guidance in getting things done: fast fast. Having you by my side made everything so much easier. Finally, I thank my brother for his emotional and professional support during the last couple of years. Monday workout and Wednesday lunch have always been a great source of strength.

Last but not least, my sincerest thanks to all the children and adolescents that contributed their time and effort in participating in our studies. My appreciation goes out especially to those kids that are, in their everyday lives, faced with challenges that are out of the ordinary.

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## Declaration by Candidate

I declare that this thesis and the work presented in it are my own. The three research articles have been published or submitted to peer-reviewed journals and were written in collaboration with the listed co-authors. All citations are indicated and only the mentioned sources were used. For the purpose of this cumulative dissertation, the following articles are included and copies of the articles are attached in appendices A, B, and C.

### Article 1

Euler, F., Sterzer, P., & Stadler, C. (2014). Cognitive Control under Distressing Emotional Stimulation in Adolescents with Conduct Disorder. *Aggressive Behavior*, 40(2), 109-119.

### Article 2

Euler, F., Steinlin, C., Stadler, C. (2014) Cognitive and Affective Empathy: Associations with Aggressive and Prosocial Behavior in Adolescents. Manuscript submitted to *Child Psychiatry and Human Development*. Draft of February 25<sup>th</sup>, 2015

### Article 3

Euler, F., Jenkel, N., Stadler, C., Schmeck, K., Fegert, J. M., Kolch, M., & Schmid, M. (2014). Variants of Girls and Boys with Conduct Disorder: Anxiety Symptoms and Callous-Unemotional Traits. *Journal of Abnormal Child Psychology*. doi: 10.1007/s10802-014-9946-x

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## Table of Contents

<b>Table of Contents.....</b>	<b>V</b>
<b>Abstract.....</b>	<b>VII</b>
<b>1 Introduction.....</b>	<b>9</b>
<b>1.1 Research Questions.....</b>	<b>11</b>
<b>2 Theoretical Background.....</b>	<b>12</b>
<b>2.1 Aggressive Behavior in Children and Adolescents.....</b>	<b>12</b>
2.1.1 Dysfunctional Perception and Processing of Emotional Stimulation.....	13
2.1.2 Empathy Deficits.....	14
2.1.3 Callous-Unemotional Traits and Anxiety Symptoms.....	15
<b>3 Methods.....</b>	<b>18</b>
<b>3.1 Article 1: Cognitive Control under Distressing Emotional Stimulation in     Adolescents with Conduct Disorder.....</b>	<b>18</b>
3.1.1 Participants.....	18
3.1.2 Procedure and Measures.....	18
3.1.3 Statistical Analysis.....	18
<b>3.2 Article 2: Cognitive and Affective Empathy: Associations with Aggressive and     Prosocial Behavior in Adolescents.....</b>	<b>19</b>
3.2.1 Participants.....	19
3.2.2 Procedure and Measures.....	19
3.2.3 Statistical Analysis.....	20
<b>3.3 Article 3: Variants of Girls and Boys with Conduct Disorder: Anxiety Symptoms     and Callous-Unemotional Traits.....</b>	<b>20</b>
3.3.1 Participants.....	20
3.3.2 Procedure and Measures.....	20
3.3.3 Statistical Analysis.....	21
<b>4 Summary of the Results.....</b>	<b>22</b>
<b>5 Discussion.....</b>	<b>24</b>
<b>5.1 General Discussion.....</b>	<b>24</b>
<b>5.2 Strengths and Limitations.....</b>	<b>28</b>
<b>5.3 Implications.....</b>	<b>30</b>
5.3.1 Clinical Practice.....	30
5.3.2 Future Research.....	31

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<b>6 References .....</b>	<b>33</b>
<b>Appendix A: Article 1 .....</b>	
<b>Appendix B: Article 2.....</b>	
<b>Appendix C: Article 3 .....</b>	

## Abstract

Dysfunctional emotional processing has a negative impact on human behavior. In children and adolescents, deviant perception and understanding of emotional stimulation and reduced empathic functioning impair the development of important social skills. The present thesis aimed to better understand dysfunctional emotional processing in subgroups of children and adolescents with aggressive and antisocial behavior. We investigated dysfunctions in specific neurocognitive components and their influence on reactive and proactive forms of aggression. Further, characteristics defining subgroups of aggressive and antisocial children and adolescents with distinct dysfunctions in emotional processing were examined. Article 1 addresses the question if cognitive control is more susceptible to the deleterious influence of distressing emotional stimulation in patients with conduct disorder than in healthy controls. In an experimental paradigm we measured performance on a color-word Stroop test under the influence of distressing emotional stimulation. Results indicated that unlike in healthy controls, cognitive control is impaired in reactive aggressive adolescents when subjected to distressing emotional stimulation. In Article 2 we investigated the interrelation of empathy and behavior. In a sample of high-risk adolescent girls and boys we addressed the question whether cognitive and affective facets of empathy are involved in the inhibition of reactive and proactive forms of aggression and the motivation of prosocial behavior. Our data indicated that empathy is only involved in the inhibition of proactive aggression, but not in the inhibition of reactive aggression. Further, results showed that both facets of empathy contribute positively to motivate prosocial behavior. With Article 3, we aimed to identify characteristics which define subgroups of aggressive children and adolescents with specific patterns of dysfunctional emotional processing. Using model-based cluster analysis, we disaggregated variants of adolescents with conduct disorder based on anxiety symptoms and callous-unemotional traits. Variants differed in comorbid psychopathologies and personality development. We also found a gender-specific affiliation to identified variants that supports the assumption of the gender paradox in children and adolescents with conduct disorder. In conclusion, the research presented in this dissertation indicates that reactive and proactive forms of aggression are associated with distinct dysfunctions in emotional processing and supports a better understanding of factors involved in specific phenotypes of aggressive behavior. Based on the results it can be assumed that (1) impaired cognitive control in situations of emotional distress provokes reactive aggression and (2) insufficient understanding of others' emotions enhances the risk for proactive aggression. Variants of aggressive and antisocial adolescents may be identified based on characteristics associated

with these neurocognitive deficits. Findings emphasize the importance of specific treatment approaches tailored to subgroups of aggressive and antisocial children and adolescents with unique characteristics.



# 1 Introduction

From the perspective of evolutionary psychology, aggressive behavior is a collection of behavioral strategies that are useful in specific contextual conditions to enhance survival and reproductive chances (Buss & Shackelford, 1997). Even today, aggressive behavior can have important and adaptive functions during social interactions (Tedeschi & Felson, 1994). However, as humans have developed more sophisticated cultural norms in modern societies, serious forms of aggression are considered as maladaptive behavioral strategies (DeWall, Anderson, & Bushman, 2011). Maladaptive aggression is characterized by a disproportional intensity, frequency, duration, and severity in reference to its situational context (Loeber, 1990). Maladaptive aggression in children and adolescents has become an increasing problem and is one of the most common reasons for referral to child and adolescent mental health services (Maughan, Rowe, Messer, Goodman, & Meltzer, 2004). Associated economic costs to society are extensive (Bonin, Stevens, Beecham, Byford, & Parsonage, 2011; Scott, Knapp, Henderson, & Maughan, 2001). In children and adolescents, aggressive and antisocial behavior is heterogeneous and comprises hot-tempered quarrels as well as purposeful and instrumental acts of cruelty. Psychopathologic manifestations of aggressive and antisocial behavior have a highly negative impact on the affected individual. They are associated with a number of unfavorable consequences throughout development, including problematic peer and familial relationships as well as academic underachievement (Odgers et al., 2007; Odgers et al., 2008).

Current research has uncovered several developmental pathways through which maladaptive forms of aggressive and antisocial behavior develop. Genetic, neurocognitive, and environmental etiological factors have been identified (D. Pardini & Frick, 2013). Empirical research indicates that dysfunctional emotional processing is significantly associated with aggressive and antisocial behavior in children and adolescents (De Wied, Boxtel, Posthumus, Goudena, & Matthys, 2009; Marsh et al., 2013; Sterzer, Stadler, Krebs, Kleinschmidt, & Poustka, 2005). Interestingly, subgroups of aggressive and antisocial children and adolescents show specific patterns of dysfunctional emotional processing (Jones, Happe, Gilbert, Burnett, & Viding, 2010; Kimonis, Frick, Cauffman, Goldweber, & Skeem, 2012a; Sebastian et al., 2014). While some appear emotionally under-reactive, others seem over-reactive especially to cues of threat or provocation (for a review see Viding, Fontaine, & McCrory, 2012). Comorbid anxiety symptoms and the presence of callous-unemotional traits (CU traits) have repeatedly been identified as subgroup characteristics associated with

abnormal emotional processing in aggressive children and adolescents (Angold, Costello, & Erkanli, 1999; Frick, Ray, Thornton, & Kahn, 2014). Hodgins, de Brito, Simonoff, Vloet, and Viding (2009) postulate that the phenotype of aggressive behavior displayed by antisocial individuals depends on the presence and absence of CU traits and anxiety symptoms. Further, empirical evidence shows that varying levels of CU traits and anxiety symptoms are connected to different degrees of experienced childhood abuse and maltreatment, depression symptoms, and anger problems (Kahn et al., 2013; Kimonis, Fanti, Isoma, & Donoghue, 2013; Kimonis, Skeem, Cauffman, & Dmitrieva, 2011; Kimonis, Tatar, & Cauffman, 2012b; Lee, Salekin, & Iselin, 2010). The investigation of characteristic that determine different patterns of dysfunctional emotional processing in subgroups of aggressive children and adolescents represents a substantial challenge to research. The identification of such characteristics will improve the understanding of etiological pathways leading to different phenotypes of aggressive behavior (Hodgins et al., 2009). Moreover, the development of effective treatment programs that match difficulties and strengths of the individuals in these subgroups depend on the findings of such investigations (Stadler, Poustka, & Sterzer, 2010).

The objective of this thesis was to investigate behavioral consequences associated with dysfunctional emotional processing in subgroups of aggressive children and adolescents. We aimed to study neurocognitive concepts involved in emotional processing and associated with the inhibition and motivation of behavior (Decety, 2010). The present work contributes significantly to the current knowledge about deficient neurocognitive processes and associated characteristics of aggressive children and adolescents. The research presented in this dissertation supports a better understanding of etiological factors involved in the development of specific phenotypes of aggressive behavior.

## **1.1 Research Questions**

The objective of this dissertation was addressed by the investigation of the following research questions, for which the relevant literature is summarized in the next chapter.

(1) Is cognitive control in reactive aggressive adolescents more susceptible to the deleterious effects of distressing emotional stimulation than in healthy controls?

(2) Are cognitive and affective facets of empathy involved in the inhibition of aggressive behavior and the motivation of prosocial behavior in adolescents?

(3) Are distinct variants of aggressive adolescents distinguishable based on the presence of limited prosocial emotions and anxiety symptoms? Do identified variants differ in psychopathology and personality development?

## 2 Theoretical Background

### 2.1 Aggressive Behavior in Children and Adolescents

Aggressive behavior in children and adolescents is heterogeneous and varies in a number of aspects. Important attributes are time of onset, stability, severity, comorbidities, and motivational underpinnings of the aggression displayed. In the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013) and the International Classification of Mental and Behavioral Disorders (ICD-10; World Health Organization, 1992) pathological aggressive behavior in children and adolescents is subsumed under the diagnoses oppositional defiant disorder (ODD) and conduct disorder (CD) that form the disruptive behavior disorders (DBDs). Studies in Europe and North America indicate prevalence rates for ODD of 1–3% in girls and 2–6% in boys and for CD of 1–5 % in girls and 3–9 % in boys (Maughan et al., 2004). ODD is characterized by a persistent pattern of negativistic, irritable, and angry mood, as well as defiant, disobedient, and hostile behavior. Problematic behavior is especially elicited towards authority figures. CD is defined by high levels of aggression and rule-breaking behavior that are outside the norm of a developmental stage and that violate the rights of others. CD comprises aggression toward people and animals, destruction of property, deceitfulness or theft, and serious violations of rules. ODD is regarded as a developmental precursor of CD (Moffitt et al. 2008). More precisely, the majority of children who fulfill criteria for CD showed ODD symptoms in the past that are followed by the onset of the more severe CD symptoms. ODD and CD comprise a great variety of symptoms ranging from impulsive hot-tempered quarrels to purposeful and goal-directed acts of cruelty. In both classification systems, symptoms assigned to ODD and CD overlap to a large extent. The most significant differences between the two systems are the classification of six CD subtypes in the ICD-10 system. While in the ICD-10 ODD is a subtype of CD, in the DSM-5 it is a separate diagnosis. ICD-10 and DSM-5 both categorize CD according to age of onset (childhood-onset or adolescence-onset). ICD-10 additionally retains contextual factors related to CD, namely CD confined to the family context, unsocialized CD, and socialized CD. The DSM-5 recently added a CU specifier referred to as ‘specifier for limited prosocial emotions’ to the diagnostic criteria of CD. The specifier designates CD patients that show a significant lack of remorse or guilt, callous lack of empathy, are unconcerned about their performance, and elicit shallow or deficient affect.

While the diagnostic manuals emphasize a phenomenological categorization for the

heterogeneous symptomatology, evolutionary, sociological, and psychological research has tried to identify causal mechanisms underlying the emergence of aggressive and antisocial behavior in children and adolescents. Current developmental models emphasize the interaction of environmental risk factors and genetic predispositions (Dodge, 2009; Dodge & Pettit, 2003). Environmental risk factors such as harsh and inadequate parenting, disrupted family bonds, and traumatization, may exacerbate aggressive and antisocial behavior in children with inherited or acquired neuropsychological dysfunctions or a difficult temperament (Frick & Viding, 2009). Interestingly, the impact of environmental influences and genetic predispositions varies between psychopathological phenotypes of aggressive behavior (Archer, 2009). A seminal theoretical distinction, describing motivational underpinnings of different phenotypes of aggressive behavior, is that of reactive and proactive aggression (Crick & Dodge, 1996). Reactive aggression is defined as an impulsive response to a perceived threat or provocation, often associated with high emotional arousal, anxiety, and anger. Proactive aggression is described as instrumental, organized, cold-blooded, and motivated by the anticipation of reward (Dodge, 1991; Dodge & Coie, 1987; Kempes, Matthys, de Vries, & van Engeland, 2005). Distinct autonomous, behavioral, and emotional correlates have been found in primarily reactive and proactive aggressive individuals (Scarpa, Haden, & Tanaka, 2010).

### **2.1.1 Dysfunctional Perception and Processing of Emotional Stimulation**

In primarily reactive aggressive children and adolescents, aggression of disproportional intensity, duration, and severity can be triggered by minor provocations, or minor threats to the psychological and the physical integrity of oneself and closely related individuals such as family members and friends (Denson, Pedersen, Friese, Hahm, & Roberts, 2011; Waschbusch et al., 2002). During clinical examinations, children and adolescents with conduct problems often report that they react aggressively because they lose control over their actions in situations of high emotional arousal. Research supports this assumption and indicates that the efficacy of self-control depends on the situational context and is related to aggressive behavior (for a review see Denson, DeWall, & Finkel, 2012). It is important to understand the mechanisms that cause insufficient self-control in aggressive individuals in emotionally arousing situations. Self-control is defined as control over one's behavior and describes a class of regulatory processes that enable the inhibition of undesired behavioral tendencies (Hofmann, Schmeichel, & Baddeley, 2012). Self-control is a subcomponent of inhibitory control and is one of the core features of executive functioning (Diamond, 2013). MacDonald (2008) distinguished between two forms of self-control: cognitive control and control of

socio-affective processing. Cognitive control is involved in the control of predominantly cognitive responses and is primarily associated with volitional self-control under affectively neutral conditions. Control of socio-affective processes comprises mechanisms involved in the control of automatic affectively charged responses triggered by affective input. Both types of self-control interact and a load on either one inhibits functionality of the other (MacDonald, 2008; Schmeichel, 2007). A number of behavioral (Blair, Colledge, Murray, & Mitchell, 2001; Loney, Frick, Clements, Ellis, & Kerlin, 2003), psychophysiological (Anastassiou-Hadjicharalambous & Warden, 2008; Fairchild, Stobbe, van Goozen, Calder, & Goodyer, 2010; Herpertz et al., 2005), and neuroimaging (Marsh et al., 2008; White et al., 2012) studies found dysfunctional socio-affective processing in aggressive children and adolescents. Empirical evidence shows that the processing of strong emotional stimulation leads to cognitive control failure (Heatherton & Wagner, 2011). It can be assumed that dysfunctional socio-affective processing increases the impact of distressing emotional stimulation on cognitive control. Support for this assumption comes from previous neuroimaging work. A fMRI study showed reduced activity in the dorsal anterior cingulate cortex during the presentation of distressing emotional stimuli in aggressive adolescents and the abnormal activation pattern was related to poorer executive functions (Sterzer et al., 2005). Further, two studies with healthy adults investigated the impact of emotional stimulation processing on cognitive control (Hart, Green, Casp, & Belger, 2010; Hu, Bauer, Padmala, & Pessoa, 2012). Interestingly, these studies reported that the impact of the emotional stimulation was counteracted if demand for cognitive control increased. Studies investigating the direct impact of temporally extended distressing emotional stimulation on cognitive control in aggressive adolescents are scarce.

In Article 1, we therefore investigated cognitive control under the influence of distressing emotional stimulation in reactive aggressive adolescents and healthy controls. The objective of the study was to gain further insight into the immediate consequences of dysfunctional emotional processing on behavioral outcomes in aggressive children and adolescents. We hypothesized that cognitive control in primarily reactive aggressive CD patients is more susceptible to the deleterious effects of distressing emotional stimulation than in healthy controls.

### **2.1.2 Empathy Deficits**

Empathy is defined as a complex interpersonal phenomenon in which observation, memory, knowledge, and reasoning are united to allow insights into the thoughts and feelings of others (Ickes, 1997). It involves the perception and the understanding of the emotional

conditions of others (Eisenberg, 2000; Hoffman, 2000). Research shows that empathy motivates helping and comforting (Eisenberg & Miller, 1987; Miller & Eisenberg, 1988). Further, it is assumed to inhibit antisocial and aggressive behavior (Decety & Moriguchi, 2007; Jolliffe & Farrington, 2004). Empathy comprises both affective and cognitive components. Jolliffe and Farrington (2006a) define affective empathy as ‘affect congruence’ and cognitive empathy as ‘the understanding of others emotions’. Dadds et al. (2009; 2008) describe affective empathy as ‘feeling the emotions of others’ and cognitive empathy as ‘knowing the how, and the why of other peoples emotions’. Adequate empathic responding is crucial for moral and social development and therefore empathy is an important aspect of reciprocal human relationships (Eisenberg, Eggum, & Di Giunta, 2010). Empirical research indicated that empathy dysfunctions can be a precursor for disruptive behavior disorders (De Wied, Gispens-de Wied, & van Boxtel, 2010). Further, clinicians often notice empathy impairments in aggressive and antisocial children and adolescents. Nevertheless, empirical research over the past years did not consistently support a direct relationship between empathy and aggression (Vachon, Lynam, & Johnson, 2014). It has been argued that it is important to keep in mind the heterogeneous motivational underpinnings of aggressive behavior when the association between empathy facets and aggression is investigated. The experience of empathy seems more likely to inhibit proactive, organized, and cold-blooded aggressive behavior than reactive aggression triggered by perceived provocation or threat (Jolliffe & Farrington, 2006b). It can also be assumed that during reactive aggressive acts, emotional arousal disturbs aggression inhibition mechanisms usually associated with empathy (Lovett & Sheffield, 2007).

In Article 2, we conducted a study aiming to acquire a better understanding of the interrelation of cognitive and affective empathy with reactive and proactive forms of aggressive behavior. The objective of the study was to assess if empathy subcomponents are involved in the inhibition of aggressive behavior with different motivational underpinnings. Further, we investigated whether prosocial behavior is related to cognitive and affective facets of empathy. We expected to find negative associations between proactive aggression and cognitive and affective empathy. Further, we hypothesized that both empathy facets are unrelated to reactive aggression. Finally, we anticipated to find a positive association between prosocial behavior and cognitive and affective empathy.

### **2.1.3 Callous-Unemotional Traits and Anxiety Symptoms**

Integrative frameworks of aggression theories suggest that personal and situational factors determine if individuals show aggressive or antisocial behavior (Anderson & Bushman, 2002;

DeWall et al., 2011). Personal factors represent characteristics an individual brings to a specific situation (e.g., personality traits, attitudes, genetic predispositions, learning experience). Personal factors show consistency across time and across different situations and comprise the preparedness of an individual to show aggressive behavior in different situational contexts. The identification of personal characteristics that define subgroups of aggressive children and adolescents represents an important challenge to research. Improved knowledge about such personal characteristics will foster the development of specific treatment programs, and increase the quality of risk assessment and prediction of future aggressive behavior.

In Article 1 and 2, we investigated specific neurocognitive components involved in dysfunctional emotional processing in aggressive and antisocial children and adolescents. In Article 3, we tested if subgroups of CD patients can be disaggregated based on characteristics related to these neurocognitive components, namely anxiety symptoms and CU traits. CU traits and anxiety symptoms are both associated with more severe symptoms of conduct problems (Angold et al., 1999; Frick & Nigg, 2012). Interestingly, CU traits are negatively correlated with symptoms of anxiety (Frick, Lilienfeld, Ellis, Loney, & Silverthorn, 1999; D. A. Pardini, Lochman, & Powell, 2007). Moreover, CD patients with CU traits show reduced responsivity to emotional stimulation and are characterized by lower levels of empathy, while CD patients with elevated anxiety symptoms are usually hyper-responsive to emotional stimulation (for reviews see Brouns et al., 2013; De Wied et al., 2010). Hence, a complex interplay of dysfunctional emotional processing, CU traits, and anxiety symptoms can be assumed. An interesting approach that describes subgroups of aggressive and antisocial individuals and comprises both anxiety symptoms and CU traits goes back to the taxonomy of primary and secondary psychopathy introduced by Karpman (1941). Recent studies in samples of adolescent offenders (Kimonis et al., 2013; Kimonis et al., 2012a; Kimonis et al., 2011; Lee et al., 2010), clinic-referred (Kahn et al., 2013), and community samples of adolescents (Fanti, Demetriou, & Kimonis, 2013) have applied this taxonomy to identify subgroups of aggressive children and adolescents.

In Article 3 we investigated whether, in a sample of adolescents diagnosed with CD, variants of aggressive adolescents are distinguishable based on the presence of CU traits and anxiety symptoms. Further, we tested if identified variants differ in behavioral characteristics and measures of psychopathology. We expected to find CD variants with and without CU traits and hypothesized that CD patients with CU traits are further specifiable based on the presence of anxiety symptoms. We further assumed that CD variants differ in comorbid



psychopathology namely anger and irritability, externalizing behavior, traumatic experiences and substance abuse. We were also interested if CD variants differ in the personality dimensions described by the psychobiological model of Cloninger, Svrakic, and Przybeck (1993). This conceptual model includes four temperament dimensions (novelty seeking, harm avoidance, reward dependence, persistence) and three character dimensions (self-directedness, cooperativeness, self-transcendence). Based on previous research (Rettew, Copeland, Stanger, & Hudziak, 2004; Schmeck & Poustka, 2001) we expected that the CD variants with elevated CU traits would show deviant personality development in the temperament dimension of novelty seeking and the character dimension of cooperativeness. Additionally, we hypothesized that the CD variant with CU traits and anxiety symptoms indicates abnormal development in the temperament dimension of harm avoidance and the character dimension of self-directedness. We finally addressed gender-specific questions related to the CD variants. We expected to find a gender specific cluster affiliation with girls being overrepresented in the CD variant with elevated anxiety symptoms.

### **3 Methods**

#### **3.1 Article 1: Cognitive Control under Distressing Emotional Stimulation in Adolescents with Conduct Disorder**

##### **3.1.1 Participants**

A total of 44 boys between the ages of 11 and 17 years were included in the study. The patient group consisted of 22 adolescents diagnosed with CD according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000). Twenty-two age matched adolescents were recruited from secondary schools as a nonclinical control group. Exclusion criteria were low intelligence ( $IQ < 80$ ), learning disabilities, and psychotic disorders. Additional exclusion criteria for control group participants were scores above borderline-clinical cut-off in the 'Child Behavior Checklist/4-18' (CBCL; Achenbach, 1991) or a history of any psychiatric disorder.

##### **3.1.2 Procedure and Measures**

All participants were tested in one session starting with the behavioral experiment followed by the psychometric assessment. To assess cognitive control under emotional stimulation we combined a color-word Stroop test (Stroop, 1935) with pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) with either neutral or distressing emotional content. We asked participants to indicate the color of a presented word with a button press. Emotional stimulation and exposition time varied across blocks. Examples of experimental conditions and temporal structure are depicted in Figure 1. The experiment comprised eight blocks, each including 36 Stroop trials and 12 IAPS pictures. Stroop interference was compared in a 2 (study group) x 2 (emotional stimulation) factorial design. Participants filled out the 'Reactive-Proactive Aggression Questionnaire' (RPQ; Raine et al., 2006) and the 'Inventory of Callous Unemotional Traits' (ICU; Essau, Sasagawa, & Frick, 2006). Parents and primary caregivers completed the CBCL. IQ was assessed either with the 'Culture Fair Intelligence Test' (Weiss, 2006) or the German version of the 'Wechsler Intelligence Scale for Children' (Wechsler, 2003).

##### **3.1.3 Statistical Analysis**

To analyze performance on the Stroop test we conducted a two-factor repeated measure analysis of covariance (ANCOVA) with 'study group' as the between-subjects factor and

‘emotional stimulation’ as the within-subjects factor using the IBM-SPSS software package, Version 19 (IBM SPSS Inc., Chicago, USA). The dependent variable ‘Stroop interference’ was calculated by subtracting mean reaction times (RTs) for congruent and from mean RTs for incongruent Stroop trials. Post hoc we conducted univariate ANCOVAs to test for group differences on Stroop interference. We included ‘attention problems’ and ‘IQ’ as covariates.

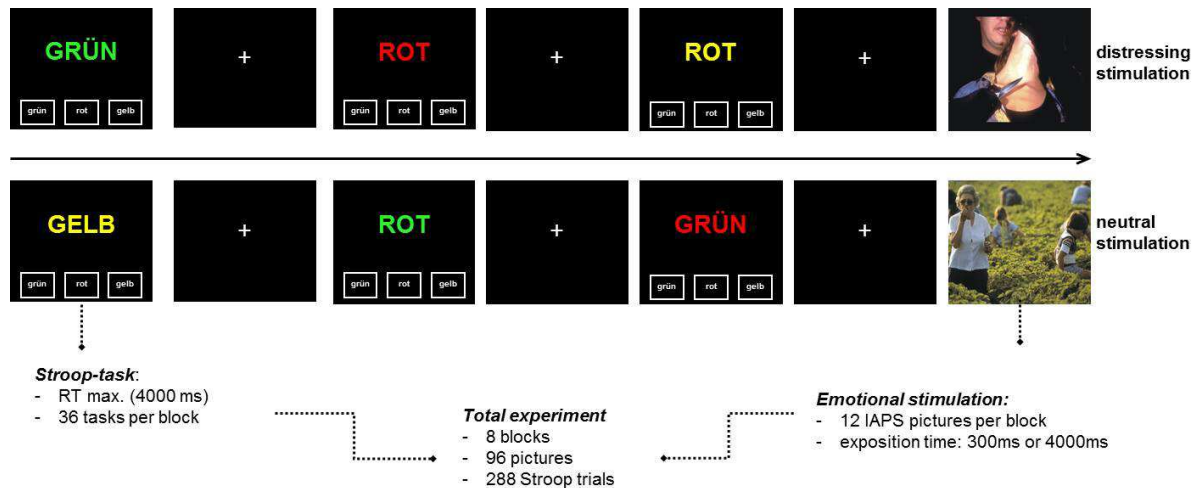


Fig. 1. Experimental structure of manual trial-by-trial Stroop test. Examples of emotional stimulation and Stroop trials. Valence of emotional stimulation and emotional exposition time varied blockwise.

## 3.2 Article 2: Cognitive and Affective Empathy: Associations with Aggressive and Prosocial Behavior in Adolescents

### 3.2.1 Participants

A total of 184 adolescents between the ages of 12 and 22 living in socio-educational institutions in the German-speaking part of Switzerland participated in the survey. Adolescents were admitted to the institutions by criminal (54.0%) or civil (46.0%) law. Adolescents with insufficient German language skills were a priori excluded from the study. Data from 17 adolescents were not applicable for data analysis. The final data set included data from 167 adolescents (64 girls; 103 boys).

### 3.2.2 Procedure and Measures

In a first step, we contacted child welfare and juvenile justice institutions in the German speaking parts of Switzerland. Institutions were visited by the research team and participants filled in questionnaires during group sessions. Other-report assessment was conducted by the

caseworker that had been assigned as primary caretaker for the participant during the time in the institution. We used the ‘Griffith Empathy Measure’ (GEM; Dadds et al., 2008) to assess cognitive and affective empathy. The ‘Reactive-Proactive Aggression Questionnaire’ (RPQ; Raine et al., 2006) was applied to assess reactive and proactive aggression. To measure emotional and behavioral problems and prosocial behavior, caseworkers completed the ‘Strengths and Difficulties Questionnaire’ (SDQ; Goodman, 1997).

### **3.2.3 Statistical Analysis**

To address the main study aim we calculated bivariate and partial correlation coefficients. Further, we performed linear regression analysis to determine whether behavioral outcome measures could be predicted from empathy facets. We used the IBM-SPSS software package, Version 19 (IBM SPSS Inc., Chicago, USA) for the statistical analysis.

## **3.3 Article 3: Variants of Girls and Boys with Conduct Disorder: Anxiety Symptoms and Callous-Unemotional Traits**

### **3.3.1 Participants**

The study sample was taken from the ‘Swiss Model Project for Clarification and Goal-attainment in Child Welfare and Juvenile-Justice Institutions’ (MAZ; Schmid, Kölch, Fegert, Schmeck, & MAZ.-Team, 2013). A total of 158 adolescents (48 girls; 109 boys) diagnosed with CD according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000) were selected from the total MAZ sample. Adolescents were between the ages of 12 and 18. Exclusion criteria were low intelligence ( $IQ < 70$ ) and psychotic disorders.

### **3.3.2 Procedure and Measures**

Participants and qualified caseworkers underwent the Kiddie Schedule for Affective Disorders and Schizophrenia Present and Lifetime Version (Delmo, Weiffenbach, Gabriel, Stadler, & Poustka, 2005) with trained professionals visiting the institution. Diagnostic information was integrated across informants after completion of the structured clinical interviews. Subsequently, computer-administered questionnaires were completed. The ‘callous, unemotional’ (CU) dimension of the Youth Psychopathic Traits Inventory (YPI; Andershed, Kerr, Stattin, & Levander, 2002) was used to assess CU traits. We applied the ‘Massachusetts Youth Screening Instrument Second Version’ (MAYSI-2; Grisso & Barnum,

2006) to screen for anxiety symptoms, anger, traumatic experiences, and substance abuse. The ‘aggressive behavior’ (AB), the ‘delinquent behavior’ (DB), and the ‘attention problems’ (AP) syndrome scales of the CBCL (Achenbach, 1991) were used to indicate externalizing behavior. The ‘Junior Temperament and Character Inventory-Revised’ (JTCI 12–18 R; Goth & Schmeck, 2008) was completed to assess personality development. IQ was assessed with the ‘Culture Fair Intelligence Test’ (Weiss, 2006) or the ‘Raven Progressive Matrices’ (Raven, Raven, & Court, 2003).

### **3.3.3 Statistical Analysis**

We performed the TwoStep cluster analysis (CA) procedure using the IBM-SPSS software package, Version 19 (IBM SPSS Inc., Chicago, USA). This procedure is a scalable CA algorithm developed to automatically find the optimal number of clusters in large datasets. We used the YPI CU dimension and the MAYSI-2 AD scale as clustering variables. Univariate analysis of variance (ANOVAs) was applied to compare resulting clusters on clustering variables and on theoretical, empirical, and clinically relevant dimensions. For post-hoc multiple comparisons between clusters we applied the Tukey HSD test. For the gender specific analysis, we used independent samples t-tests to compare CD girls and boys on clustering and external validation measures, irrespective of cluster affiliation.

## 4 Summary of the Results

Overall, the research presented in this thesis aimed to better understand behavioral consequences of dysfunctional emotional processing in aggressive adolescents. We therefore investigated how dysfunctions in neurocognitive processes contribute to different forms of aggressive and antisocial behavior. Further, we assessed whether variants of aggressive and antisocial adolescents can be distinguished based on characteristics related to dysfunctional emotional processing.

In Article 1 (Euler, Sterzer, & Stadler, 2014b) we investigated the consequences of distressing emotional stimulation processing on cognitive control. Results confirmed our hypothesis and indicated that cognitive control, assessed with a computerized Stroop test, was more susceptible to the deleterious effects of distressing emotional stimulation in CD patients than in healthy controls. Our data suggest that over-reactivity to distressing emotional stimulation in reactive aggressive CD patients interferes with cognitive control of behavior.

The objective of Article 2 (Euler, Steinlin, & Stadler, 2015) was to assess associations between empathy, aggression, and prosocial behavior. In a high-risk sample of adolescents that differed on a number of characteristics, we tested if cognitive and affective facets of empathy are related to subtypes of aggressive behavior with distinct motivational underpinnings. In line with our hypothesis, results indicated that lower cognitive empathy is associated with higher proactive aggression. However, contrary to our expectations, we did not find an association between affective empathy and proactive aggression. Results concerning the relationship between reactive aggression and empathy facets were in line with our assumptions. Data indicated that cognitive and affective facets of empathy were not associated with reactive forms of aggressive behavior. Finally, results confirmed our assumptions regarding the associations between both facets of empathy and prosocial behavior. Cognitive and affective empathy were both positively related to prosocial behavior.

In Article 3 (Euler et al., 2014a), we assessed if variants of CD patients can be disaggregated based on characteristics, namely anxiety symptoms and CU traits, that predispose individuals for the neurocognitive dysfunctions identified in the first two studies. In line with our expectations, we identified three CD variants with altering levels of anxiety symptoms and CU traits and distinct patterns of psychopathology and personality development. According to their psychometric profiles, the first variant designated a CD-only variant with anxiety symptoms and CU traits in the normal range. The second variant designated a CD variant with moderate CU traits and elevated anxiety symptoms. The third

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variant designated a CD variant with severe CU traits. Notably, the two CD variants with CU traits showed psychopathologies similar to the primary and secondary variants of psychopathy described by Karpman (1941). The CD variant with moderate CU traits and elevated anxiety symptoms had the most severe pattern of comorbid psychopathology. Our results further indicated specific profiles of personality development for the three variants. The proportion of girls and boys in the identified variants differed significantly and confirmed our assumptions regarding a gender-specific cluster affiliation. Girls were overrepresented in the CD variant with moderate CU traits and elevated anxiety symptoms. Overall, CD girls had more severe behavioral problems and comorbid psychopathologies than CD boys.

## 5 Discussion

### 5.1 General Discussion

With the three studies included in this thesis we aimed to investigate behavioral consequences of dysfunctional emotional processing in subgroups of aggressive children and adolescents. Taken together, the results of the research presented in this dissertation help to better understand the heterogeneity of symptoms elicited by different variants of aggressive and antisocial children and adolescents. Furthermore, the findings add to the current knowledge about the involvement of dysfunctional neurocognitive components in reactive and proactive forms of aggressive behavior.

In Article 1 (Euler et al., 2014b), we report results from an experimental paradigm that was developed to assess if cognitive control is more susceptible to the deleterious effects of distressing emotional stimulation in CD patients than in healthy controls. When interpreting the findings of this study, it is important to keep the characteristics of the study group in mind. Notably, participating CD patients elicited primarily reactive aggressive behavior, and were characterized by elevated anxiety symptoms and CU traits in the normal range. Hence, we report a specific impairment related to dysfunctional emotional processing in a subgroup of aggressive adolescents with a distinct psychometric profile. Based on our data, we conclude that a higher susceptibility to distressing emotional stimulation impairs cognitive control of behavior in reactive aggressive CD patients. Results indicate that dysfunctional emotional processing in aggressive children and adolescents leads to insufficient control of maladaptive behavioral impulses. Our findings confirm previous studies reporting hyper-responsiveness to distressing and neutral environmental cues in CD children and primarily reactive aggressive adults (Chan, Raine, & Lee, 2010; Herpertz et al., 2008; Passamonti et al., 2010). The present data further support the results of an earlier fMRI study that indicated a suppression of neuronal activation associated with dysfunctional behavioral control in CD patients while passively viewing distressing emotional stimuli (Sterzer et al., 2005). Moreover, our results are in line with research indicating that reactive aggressive children are characterized by a hostile attribution bias and are more likely to act aggressively towards peers in situations of ambiguous provocation (Crick & Dodge, 1996). It is noteworthy that contrary to these findings in emotionally over-reactive aggressive children and adolescents, a number of empirical studies show that aggressive children and adolescents elicit reduced behavioral, physiological, and neuronal responsiveness to emotional stimulation (De Wied et al., 2009;



Fairchild et al., 2010; Fairchild, Van Goozen, Stollery, & Goodyer, 2008). Further, blunted responsiveness to distressing emotional stimulation has been identified as a key characteristic of aggressive and antisocial children and adolescents with elevated CU traits (Jones et al., 2010; Marsh et al., 2013; Munoz, 2009). The heterogeneity of the literature on emotional processing deviations in aggressive children and adolescents stresses the importance of characterizing specific subgroups. In this regard, our findings further emphasize that it is crucial to indicate whether children and adolescents show aggressive behavior that is primarily defensive, as an immediate reaction to a threat or provocation, or offensive, as a planned and callous act. This is particularly important if the behavioral consequences of dysfunctional emotional processing are investigated.

The main objective of Article 2 (Euler et al., 2015) was a relatively straightforward and clinically relevant question: are cognitive and affective facets of empathy associated with reactive and proactive forms of aggression? At present, empirical data do not indisputably support a direct relationship between aggressive behavior and empathy (for a review see Vachon et al., 2014). This appears particularly surprising because fostering empathy is a fundamental component of many treatment programs developed for aggression related psychiatric disorders in children and adolescents (Dadds, Cauchi, Wimalaweera, Hawes, & Brennan, 2012; Dadds et al., 2006). Therefore, we investigated the interrelations between cognitive (i.e., understanding of others emotions) and affective (i.e., shared emotional states) facets of empathy and distinct forms of aggression. In line with our assumptions, the present findings show that cognitive empathy predicted lower levels of proactive aggression. Surprisingly, we did not find associations between affective empathy and proactive aggression. Hence, our data indicate that the understanding of others' emotions inhibits proactive aggression, while the mere sharing of emotional states does not. It has been argued that cognitive understanding of others' emotions is dependent upon affective sharing and that the appearance of both is important for the inhibition of maladaptive behavior (Smith, 2009). Current neurodevelopmental frameworks of empathy further support this assumption and indicate that both facets are interrelated, and the development of each component strongly depends on the other (Decety & Sveltova, 2011). Affective empathy following distress elicited by another child is expected to foster cognitive empathy. Similarly, the ability to understand others' emotions is likely to promote shared affective experience (Frick et al., 2014). In our study both empathy facets were unrelated to reactive aggression. Our data support the assumption that in reactive aggressive individuals, frustration, anxiety and anger are likely to disturb aggression-inhibition mechanisms usually triggered by empathy (Lovett

& Sheffield, 2007). Finally, we show that cognitive and affective components of empathy are positively associated with prosocial behavior. Included within this expectation is the assumption that feeling and understanding the emotions elicited by others directly guides behavior in a prosocial direction. Both empathy facets uniquely predicted prosocial behavior and explained one third of the variance. According to the results, a direct link between cognitive and affective empathy and prosocial behavior is supported. In conclusion, our data possibly account for some of the conflicting findings on the association between empathy and aggression found in previous research. We revealed that empathy is involved in the inhibition of aggressive behavior with proactive motivational underpinnings, but not with reactive aggression. Given the robust findings for a positive association between cognitive and affective empathy and prosocial behavior, it can be assumed that empathy is involved in the motivation of positive social interactions.

The objective of Article 3 (Euler et al., 2014a) was the investigation of characteristics that define subgroups of aggressive children and adolescents. Variants of CD patients were disaggregated based on the presence of CU traits and anxiety symptoms. We chose these characteristics for three main reasons: (1) recent investigations with aggressive and antisocial children and adolescents emphasized the importance of CU traits and anxiety symptoms as characteristics of distinct variants (Kahn et al., 2013; Kimonis et al., 2012a), (2) both characteristics have been associated with a more severe pattern of aggressive behavior (Angold et al., 1999; Frick & Nigg, 2012) and (3) both characteristics are related to dysfunctional emotional processes that were the focus of the first two studies (De Wied et al., 2010). CU traits are negatively associated with anxiety and neuroticism (for a review see Frick & White, 2008), and children and adolescents with CU traits are characterized by a fearless temperament (Barker, Oliver, Viding, Salekin, & Maughan, 2011). Based on these results, children and adolescents with CU traits are generally expected to score low on measures of anxiety. However, our data show that the presence of CU traits does not necessarily indicate the absence of anxiety symptoms in aggressive and antisocial adolescents. It is a critical observation that the combination of CU traits and anxiety in our study was associated with a more severe pattern of psychopathology. This finding is in line with the results of a recent study by Humayun, Kahn, Frick, and Viding (2014). In a community sample of 7-year-olds Humayun et al. (2014) also found more severe behavior problems in children with CU traits and anxiety symptoms. Nonetheless, it is somewhat surprising because higher levels of CU traits often indicate a more severe antisocial behavior profile and more long-term problems (Viding et al., 2012). While it is highly inappropriate to classify children

and adolescents as psychopaths, it is tempting to speculate that the two identified CD variants with psychometric profiles similar to the primary and secondary variants of psychopathy described by Karpman (1941) are at heightened risk for developing primary or secondary psychopathy in adulthood. Previous research has already demonstrated the possibility of this developmental pathway (Lynam, Caspi, Moffitt, Loeber, & Stouthamer-Loeber, 2007). Further longitudinal investigations are needed to confirm this assumption. Empirical research suggests that deviant personality development enhances the likelihood for aggressive and antisocial behavior in children and adolescents (Schmeck & Poustka, 2001). We therefore also addressed the question if identified CD variants are characterized by a specific pattern of personality development. Based on our findings, assumptions about the developmental pathways of the behavioral dysfunctions and CU traits in identified CD variants may be formulated. Our data suggest that the temperament dimension of novelty seeking is more pronounced in both CD variants with CU traits. Higher novelty seeking is associated with higher rates of risk-taking behavior and children with such a temperament are likely to be involved in dangerous activities (Cloninger et al., 1993). In line with this, our findings showed a higher frequency and pervasiveness of alcohol and drug use in both CD variants with CU traits. The outcome of the risk-taking behavior may influence the development of future psychopathology: if the consequences of such activities are negative, they may cause higher rates of stressful life events and lead to traumatizing life events (Kimonis et al., 2013; Kimonis et al., 2012b). Interestingly, this was actually indicated by the comorbid psychopathology of the CD variant with moderate CU traits and anxiety symptoms in our study. If on the other hand, the outcome of the risk taking behavior is positive (e.g., enhanced peer status, monetary gain) such behaviors may reinforce the development and manifestation of CU traits (Howard, Kimonis, Munoz, & Frick, 2012). Although the developmental pathway of CU traits are still under debate, based on our data it may be speculated that temperament dimensions, such as novelty seeking and the associated behavioral patterns, lead to different outcomes depending on the environmental context and determine the manifestation of future psychopathology accordingly. We also found differences between CD variants on the character dimension of cooperativeness. Lower scores in this dimension signal a dysfunctional and self-centered personality style causing problematic social interactions and more severe antisocial behavior in the future (Svrakic et al., 2002). A further aim of Article 3 was to address gender-specific questions. Previous research showed that conduct problems are more common in boys than girls, but if girls elicit conduct problems they show more severe psychopathology overall (Waschbusch, 2002). The present findings support the assumptions

of the CD gender paradox (Keenan et al., 2010; Wasserman, McReynolds, Ko, Katz, & Carpenter, 2005): girls are less likely to show aggressive and antisocial behavior, but if they do, the severity of the behavioral problems and rates of comorbid psychopathologies are higher and the developmental prognosis is worse.

## **5.2 Strengths and Limitations**

One significant contribution of this thesis to the current literature is the investigation of distinct neurocognitive components associated with specific phenotypes of aggressive behavior. In Article 1 (Euler et al., 2014b), we showed that in reactive aggressive CD patients with elevated anxiety symptoms and normal levels of CU traits the confrontation with distressing emotional stimulation leads to cognitive control failure. The specific characterization of the CD patients included in this experimental study was of significant value. The inclusion of a more heterogeneous CD patient group would have made results difficult to interpret. Hence, with the specification of the aggression subtype, the assessment of anxiety symptoms and CU traits, our study presents an advance in gaining a better understanding of dysfunctional emotional processing in a distinct subgroup of aggressive children and adolescents. One limitation of this investigation is that we did not include other CD patient groups with different psychometric profiles (e.g., normal levels of anxiety symptoms, elevated CU traits). Nonetheless, the investigation of a CD subgroup characterized by over-reactive emotionality without elevated CU traits represents an important contribution to the current literature, especially because epidemiological studies show that this subgroup represents a large proportion of CD patients (Kahn, Frick, Youngstrom, Findling, & Youngstrom, 2012). This was further supported by the numeric distribution of CD variants identified in Article 3 (Euler et al., 2014a). An additional strength of Article 1 is the innovative experimental design that combined the presentation of distressing emotional stimulation with one of the most studied and validated tests for cognitive control (MacLeod, 1991). The design was developed based on the findings in a previous fMRI investigation conducted by Sterzer et al. (2005). By investigating the interactions between affect, arousal, and cognition, such approaches allow the identification of characteristics that determine the preparedness of individuals to show aggressive behavior in a specific situational context.

The specificity of the conceptualization of the constructs under investigation in Article 2 represents a further strength of this dissertation. We show that the interrelation between empathy and aggressive behavior depends on the conceptualization of the constructs. Based on the results presented here, it may be concluded that enhancement of cognitive empathy

reduces proactive but not reactive aggression. Improvement of clinical interventions that aim to reduce aggressive and antisocial behavior by fostering empathy is dependent upon research that clearly distinguishes between subcomponents of empathy and aggression. Nonetheless, conclusions about the sequential dependence of different empathy components upon each other and the influence of their interaction on aggression cannot be drawn based on our investigation. In this regard the data assessed in Article 2 are limited.

Article 3 identified subgroups of CD patients based on characteristics that are related to the dysfunctional components identified in Article 1 and 2 and therefore has important clinical implications. The different psychometric profiles associated with the CD variants that were characterized based on the presence of anxiety symptoms and CU traits may help clinicians to decide what type of treatment may be most effective for a certain adolescent. Further, the identification of CD subgroups based on the presence of anxiety symptoms and CU traits offers the possibility to advance the understanding of etiological pathways that cause aggressive and antisocial behavior. One important limitation of Article 3 is that no measure of reactive and proactive aggression was applied. However, empirical research indicates that adolescents with CU traits may display both forms of aggression or solely proactive aggression (Fanti, Frick, & Georgiou, 2009). Reactive aggression has uniquely been associated with negative emotionality (Fite, Raine, Stouthamer-Loeber, Loeber, & Pardini, 2010). Only the CD variant with elevated anxiety symptoms and CU traits in our study was characterized by negative emotionality (e.g., elevated anger and anxiety symptoms). Therefore, based on the psychometric profile of the identified variants and previous research results, it is tempting to speculate that the CD variant with anxiety symptoms and CU traits was characterized by both reactive and proactive forms of aggression, while the CD variant with severe CU traits was characterized primarily by proactive aggression. The investigation of gender specific questions is another important contribution to the literature. Our results confirm previous differences between CD girls and CD boys and emphasize the relevance of these differences for appropriate treatment.

Overall, the strength of this dissertation is the investigation of specific deficits in neurocognitive components and their impact on different phenotypes of aggression. We focused on the distinction between reactive and proactive phenotypes of aggression within the broad category of aggression. It is important to acknowledge that there are other categories of aggression such as physical, verbal, sexual, and relational aggression (Buss & Shackelford, 1997). Another limitation refers to the general construct of reactive and proactive aggression. Although reactive and proactive aggression have distinct theoretical underpinnings, and are

associated with a number of specific behavioral outcomes (Polman, Orobio de Castro, Koops, van Boxtel, & Merk, 2007), both aggression subtypes often co-occur and are statistically related. Consequently, the value of the differentiation has been questioned (Bushman & Anderson, 2001). Further, it should be acknowledged that the time of onset of the maladaptive aggressive and antisocial behavior displayed by participants was not evaluated. Moffitt (1993) introduced the influential developmental taxonomic theory of antisocial behavior that distinguishes between life-course-persistent and adolescence-limited patterns of antisocial behavior. The differentiation of childhood-onset and adolescence-onset CD is one of many important implications of this theory. Nonetheless, recent empirical evidence indicates that the differences between the developmental pathways are more dependent on type, severity, and quantity of the aggressive and antisocial behavior displayed (for a review see Fairchild, van Goozen, Calder, & Goodyer, 2013). Fite et al. (2010), for example, showed that proactive aggression progresses to a more persistent pattern of antisocial behavior. The authors argue that the occurrence of proactive aggression during adolescence predicts life-course-persistent antisocial behavior and more negative long-term consequences.

### **5.3 Implications**

Overall, the present dissertation advances knowledge about dysfunctional emotional processing in aggressive children and adolescents. We show that in situations of emotional distress, reactive aggressive adolescents have insufficient cognitive control to inhibit undesired behavioral impulses. Further, we report that proactive aggressive adolescents have lower levels of cognitive empathy. Finally, we show that the presence of anxiety symptoms and CU traits are important attributes for subgroup characterization, and give an example of how distinct subgroups of aggressive children and adolescents may be characterized. The research presented in this dissertation supports a better understanding of factors involved in specific phenotypes of aggressive behavior and has several important implications for clinical practice and future research.

#### **5.3.1 Clinical Practice**

Our results indicate that children and adolescents who have problems to manage distressing emotional situations are likely to show maladaptive reactive aggressive behavior. Consequently, they are prone to develop internalizing problems (Connor, Ford, Albert, & Doerfler, 2007; Stadler et al., 2010). In contrast, children with lower cognitive empathy and difficulties to understand others' emotions show higher levels of proactive aggression. Improved understanding of pathological aggression in children and adolescents allows the

development of specific treatment forms tailored to distinct subgroups with unique characteristics. For example, social rejection is one of the consequences that have been reported following maladaptive reactive aggression (Dodge & Coie, 1987). Social rejection, in turn, has been discussed as the central mechanism causing elevated levels of sadness and unhappiness in reactive aggressive children (Fite et al., 2010). Hence, especially when social rejection appears within the peer group, internalizing problems and emotional distress are likely to occur (Polier, Vloet, Herpertz-Dahlmann, Laurens, & Hodgins, 2012). Therefore, internalizing problems such as symptoms of anxiety and depression need to be treated in children and adolescents that are primarily characterized by reactive aggression. To prevent future peer rejection, adaptive strategies fostering positive interactions should be practiced during group therapy. Further, based on the results of the present work, interventions for reactive aggressive children and adolescents should teach emotion regulation strategies and coping skills in situations with high negative emotional arousal (Grasman & Stadler, 2011). In contrast, our data suggest that primarily proactive aggressive children may profit more from interventions that foster empathic understanding (Dadds et al., 2006; Newman, Curtin, Bertsch, & Baskin-Sommers, 2010). Given the nature of proactive aggression, problem-solving skills that encourage the evaluation of positive and negative consequences of behavior might also be beneficial (Leiberg, Klimecki, & Singer, 2011). Enhancing moral reasoning is another approach that seems promising to reduce proactive aggression (Glick, Gibbs, & Goldstein, 2011). Because of the frequent co-occurrence of both aggression subtypes focusing on just one of the aggression subtypes seems inadequate. Nonetheless, attention towards the prominent subtype of aggression elicited by an adolescent would probably increase effectiveness of the treatment.

### **5.3.2 Future Research**

An important implication for future research is the development of experimental paradigms that assess behavioral, physiological, and neuronal data with high ecological validity. According to Decety (2010), the experience of empathy comprises affective arousal, emotion understanding, and emotion regulation. A complex network of bottom-up and top-down mechanisms enables flexible and adequate behavioral responses. These further depend on motivational aspects in a given situation and are moderated by appraisal, attitude, and mood. Given this complexity, the development and application of appropriate experimental paradigms appears necessary to draw conclusions about the interaction of different components of emotional processing and empathy that are involved in the inhibition of different forms of aggressive behavior. Furthermore, future research should implement

longitudinal studies. Additional time points of measurement will allow conclusions about the developmental course of the mechanisms under investigation. Finally, the vast majority of empirical research on aggression in children and adolescents has been conducted with boys (Berkout, Young, & Gross, 2011). However, empirical research indicates significant gender differences regarding aggression symptoms and their etiology (for a review see Stadler, Euler, & Schwenck, 2013). Therefore, investigating girls with aggressive and antisocial behavior represents a critical aim for future research in the field.



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## **Appendix A: Article 1**

Euler, F., Sterzer, P., & Stadler, C. (2014b). Cognitive Control under Distressing Emotional Stimulation in Adolescents with Conduct Disorder. *Aggressive Behavior*, *40*(2), 109-119.

# Cognitive Control Under Distressing Emotional Stimulation in Adolescents with Conduct Disorder

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Aggressive behavior has been linked to deficient processing of emotional stimulation and recent studies indicate that in aggressive juveniles executive functions are impaired when distressing emotional stimulation is being processed. This study examines the interrelation of distressing emotional stimulation and cognitive control in aggressive adolescents and healthy controls. We combined a color-word Stroop test with pictures from the International Affective Picture System with either neutral or distressing emotional content to assess Stroop interference under neutral and distressing emotional stimulation in 20 male reactive aggressive patients with conduct disorder (CD) and 20 age-matched male control participants. We found impaired Stroop performance under distressing emotional stimulation in patients compared to healthy controls. No difference was present under neutral emotional stimulation. Our results indicate that cognitive control under distressing emotional stimulation was affected in adolescents with CD but not in healthy controls. We conclude that executive functions in reactive aggressive CD patients are more susceptible to the deleterious effects of distressing emotional stimulation. The results provide a possible explanation for pathologic impulsive-aggressive behavior under emotional distress in CD patients. *Aggr. Behav.* 40:109–119, 2014.  
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**Keywords:** emotional stimulation; executive functions; self-control; Stroop test; reactive aggression; antisocial behavior

## INTRODUCTION

Conduct disorder (CD) is a disruptive behavior disorder characterized by a repetitive and persistent pattern of serious oppositional-aggressive and antisocial behavior (American Psychiatric Association, 1994). CD comprises a wide range of abnormal behavioral patterns, reaching from impulsive hot-tempered aggressive reactions to instrumentally planned and goal-oriented acts. Various mechanisms underlying pathological juvenile aggression and antisocial behavior have been discussed (Hodgins, de Brito, Simonoff, Vloet, & Viding, 2009; Stadler, Poustka, & Sterzer, 2010; Vloet & Herpertz-Dahlmann, 2011). One line of evidence indicates an inverse relationship between executive functions and aggressive behavior in children and adolescents (Ellis, Weiss, & Lochman, 2009; Hobson, Scott, & Rubia, 2011). Executive functions refer to a family of top-down mental processes and are important for cognitive controlled behavior and effective problem solving (Morgan & Lilienfeld, 2000). There is a common understanding that there are three core executive functions: inhibitory control, working memory, and cognitive flexibility (Miyake et al., 2000). Because inhibitory control involves being able to control behavior,

attention, thought, and emotions, it has been of particular interest for research on juvenile aggression and studies show that it is impaired in aggressive children and adolescents (Feilhauer, Cima, Korebrits, & Kunert, 2012; Morgan & Lilienfeld, 2000; Raaijmakers et al., 2008). Self-control represents the aspect of inhibitory control that involves control over one's behavior and defines a class of regulatory processes that enable the inhibition of undesired behavioral tendencies (Diamond, 2013; Hofmann, Friese, & Strack, 2009; Hofmann, Schmeichel, & Baddeley, 2012). Recent experimental studies show that self-control efficacy is related to aggressive behavior (Denson, DeWall, & Finkel, 2012 for a review) and self-control efficacy can be reduced or enhanced depending on the situational context. Research demonstrates that

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Received 21 December 2012; Accepted 14 August 2013

DOI: 10.1002/ab.21508

Published online 20 September 2013 in Wiley Online Library (wileyonlinelibrary.com).

reduced self-control leads to impaired suppression of aggressive urges while increased self-control enhances the suppression of aggressive urges (Baumeister, Vohs, & Tice, 2007; Denson, Capper, Oaten, Friese, & Schofield, 2011). Processing potent emotional cues has been shown to cause self-control failure, indicating that strong bottom-up impulses can overwhelm top-down prefrontal control (Heatherton & Wagner, 2011). Thus, efficient and adequate processing of emotional stimulation seems to represent an important mechanism in successful self-control. Moreover, dysfunctional emotional stimulation processing might cause impaired self-control associated with pathological aggression. This assumption is indirectly supported by studies demonstrating deficient processing of emotional stimulation in aggressive adolescents (Davidson, Putnam, & Larson, 2000; Sharp, van Goozen, & Goodyer, 2006; Sterzer & Stadler, 2009). Although deviant processing of emotional stimulation has often been discussed as a mechanism underlying juvenile aggression, research has provided conflicting and heterogeneous results. While some aggressive and violent children exhibit blunted emotional responses to emotional stimulation, others are characterized by an elevated emotional and physiological arousal. There is much evidence that aggressive children with high levels of callous-unemotional traits (CU traits), characterized by a shallow emotional life and a lack of empathy, guilt, and remorse, show impaired recognition of distress-related emotions in others (Anastassiou-Hadjicharalambous & Warden, 2008; Dadds et al., 2006; Frick & White, 2008; Frick et al., 2003; Kimonis, Frick, Fazekas, & Loney, 2006; Loney, Frick, Clements, Ellis, & Kerlin, 2003; Marsh, Beauchaine, & Williams, 2008; Marsh et al., 2011; Munoz, 2009) and reduced electrodermal activity to distressing stimuli (Blair, 1999; Fung et al., 2005). Contrary, aggressive children, and adolescents with non-elevated CU traits show a hyperresponsiveness to distressing and negative emotional stimulation (Herpertz et al., 2008; Kimonis et al., 2006; Loney et al., 2003; Pardini, Lochman, & Frick, 2003). A hyperresponsiveness towards emotional stimulation might consequently represent a neurocognitive bias allocating more cognitive resources to the processing of distressing emotional stimulation in reactive aggressive individuals (Blair, 2012; Chan, Raine, & Lee, 2010; Curtis & Cicchetti, 2011), causing temporal impairments of control mechanisms, required for emotionally neutral cognitive tasks. MacDonald (2008) distinguishes different types of self-control: cognitive control and control of socio-affective processing. Cognitive control includes processes involved in the control of predominantly cognitive responses and is primarily related to volitional self-control under affectively neutral conditions that can be measured with Stroop-like tasks.

Control of socio-affective processes includes mechanisms involved in the control of automatic affectively charged responses triggered by affective input. Concordantly, executive functions have been distinguished as (1) cool executive functions, primarily needed for decontextualized problems and (2) hot executive functions, primarily needed for the regulation of affect and motivation (Zelazo & Müller, 2002). Cool aspects of executive functions are associated with ventral and medial regions of the prefrontal cortex and hot aspects of executive functions with regions of the dorsolateral prefrontal cortex (Hongwanishkul, Happaney, Lee, & Zelazo, 2005). Different forms of self-control interact and a load on either one inhibits functionality of the other (MacDonald, 2008; Schmeichel, 2007). Performance on the Stroop task can be impaired when subjects attempt to control socio-affective responses (Unsworth, Heitz, & Engle, 2005) and poorer executive functions have been associated with impaired facial-affect recognition in violent offenders (Hoaken, Allaby, & Earle, 2007). Thus, pathological interrelations of these different types of self-control may contribute to aggressive behavior. Neuroimaging work supports the notion that a problematic interrelation of emotional stimulation processing and impaired executive functions may underlie pathological aggression in adolescents: In previous functional magnetic resonance imaging (fMRI) experiments, we found reduced activity in the dorsal anterior cingulate cortex (dACC) in CD patients during the presentation of distressing emotional stimuli and the abnormal activation pattern was related to poorer executive functions (Stadler et al., 2007; Sterzer, Stadler, Krebs, Kleinschmidt, & Poustka, 2005). However, only few studies have investigated the direct impact of temporally extended emotional stimulation on cognitive controlled behavior. Two recent studies with healthy adults showed that processing of emotional stimulation affected cognitive control only under low cognitive demand. When cognitive demand increased, the adverse effect of emotional stimulation on cognitive functions was counteracted (Hart, Green, Casp, & Belger, 2010; Hu, Bauer, Padmala, & Pessoa, 2012). To our knowledge, no previous study has investigated the direct impact of temporally extended emotional stimulation on cognitive control in aggressive adolescents. In the present study, we aimed to fill this gap by testing the direct influence of distressing emotional stimulation on cognitive control in aggressive CD patients and healthy controls. To assess cognitive control we used a computerized color word Stroop test (Stroop, 1935), where appropriate responding requires the inhibition of a habitual, largely automatic response in favor of a less automatic response. Inhibiting a habitual response entails the mobilization of cognitive control. To trigger socio-affective processing during the

Stroop test, we combined the Stroop test with emotional stimulation using neutral and distressing pictures from the International Affective Picture system (IAPS; Lang, Bradley, & Cuthbert, 2005). The objective of the study was to investigate the impact of socio-affective processing on cognitive control in aggressive CD adolescents. In addition, this study enables us to probe the significance of our previous fMRI findings, indicating deficient functionality in neural areas responsible for cognitive control during the presentation of distressing emotional stimulation, on the behavioral level (Stadler et al., 2007; Sterzer et al., 2005). We expected a larger impairment in Stroop performance in CD patients in the distressing emotional stimulation condition compared to the neutral emotional stimulation condition.

## METHODS

### Participants

Twenty-two adolescents with CD who had been admitted to the department of Child and Adolescent Psychiatry because of abnormal aggressive behavior and 22 age matched control participants from secondary schools were recruited for the experiment. All patients underwent a structured clinical interview (Diagnostic System for Psychiatric Disorders in Childhood and Adolescence; Dopfner & Lehmkuhl, 2000). The diagnosis of CD and its severity was established in accordance with the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 1994). Five patients also met the DSM-IV-TR criteria for attention-deficit/hyperactivity disorder (ADHD). Both groups were screened for emotional and behavioral problems using the Child Behavior Checklist/4-18 (CBCL; Achenbach, 1991). Parents of control participants were asked whether their child had ever been diagnosed with a psychiatric disorder and none of the parents reported any history of psychiatric disorder for their child. All participants were male, between 11 and 17 years old and had normal color vision. Exclusion criteria were low intelligence ( $IQ < 80$ ), learning disabilities, and psychotic disorders. Participants were free of any psychoactive medication at the time of testing. Parents or caregivers gave written informed consent prior to the experiment. The local ethics committee approved the experimental protocol.

### Psychometric Assessment

For both study groups, parents or primary caregivers completed the CBCL (Achenbach, 1991). The CBCL can be scored on eight syndrome scales. We used the aggressive behavior, the attention problems, the delinquent behavior, and the anxiety/depression scales to compare groups on characteristics of interest. All

participants completed the Inventory of Callous Unemotional Traits (ICU; Essau, Sasagawa, & Frick, 2006). The ICU is a 24-item self-report questionnaire that captures callousness, uncaring, and unemotional behaviors measured on a four-point Likert scale (0—not at all true, 1—somewhat true, 2—very true, 3—definitely true) with acceptable internal consistency and good construct validity (Essau et al., 2006; Kimonis, Frick, Munoz, & Aucoin, 2008). We applied the 23-item Reactive-Proactive Aggression Questionnaire (RPQ, Raine et al., 2006) to measure the extent of reactive and proactive aggression in our study sample. The RPQ uses a three-point Likert scale (0—never, 1—sometimes, 2—often) and factor analyses confirm the two-factor conceptualization of the items. The RPQ has been shown to assesses both types of aggression in adolescents reliably and validly (Baker, Raine, Liu, & Jacobson, 2008; Raine et al., 2006). For the patient group, clinical data were included to estimate general cognitive functions. In the control group, we assessed IQ with the Culture Fair Intelligence Test (CFT 20-R; Weiss, 2006). For patients, IQ was assessed during diagnostic routine either with the Culture Fair Intelligence Test (CFT 20-R; Weiss, 2006) or the German version of the Wechsler Intelligence Scale for Children (WISC-IV; Petermann & Petermann, 2007). Characteristics of the patient group and the control group are listed in Table I. Compared to the control group CD patients had significantly higher *T*-scores on the aggressive behavior, the delinquent behavior, the attention problems, and the anxiety/depression CBCL scales. Both

**TABLE I. Demographic and Behavioral Characteristics of CD Patients and Controls**

	Patients ( <i>N</i> = 20)		Controls ( <i>N</i> = 20)		<i>P</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
CBCL					
Aggressive behavior	69.40 <sup>a</sup>	11.34	53.70	4.45	<.001
Delinquent behavior	67.15 <sup>a</sup>	7.94	52.85	4.66	<.001
Attention problems	67.05 <sup>a</sup>	7.00	52.80	3.33	<.001
Anxiety/depression	65.25	5.15	52.50	4.12	<.001
ICU					
Callousness	8.85	5.10	6.20	2.40	n.s.
Uncaring	9.85	4.13	8.90	4.18	n.s.
Unemotional	6.50	2.69	7.10	1.77	n.s.
ICU total score	25.20	9.07	22.20	5.71	n.s.
RPQ					
Reactive aggression	11.25 <sup>b</sup>	3.93	7.80	2.48	.002
Proactive aggression	5.80	4.94	2.05	2.04	.003
Age	14.25	1.52	14.15	0.875	n.s.
IQ	95.50	11.38	110.45	10.95	<.001

CBCL, Child Behavior Checklist/4-18; ICU, Inventory of Callous Unemotional Traits; RPQ, Reactive-Proactive Aggression Questionnaire.

<sup>a</sup>CBCL scales above borderline clinical relevance ( $T \geq 67$ ).

<sup>b</sup>1 *SD* above group mean reported in Fite et al. (2010).

groups reported CU traits in the normal range (Essau et al., 2006) and neither the total ICU score nor any of the ICU subscales revealed significant group differences. The patient group showed significantly higher scores on the reactive- and the proactive-aggression scales of the RPQ. The mean score on the RPQ reactive aggression scale was more than 1 *SD* higher than the mean score reported in a large sample of adolescents (Fite, Raine, Stouthamer-Loeber, Loeber, & Pardini, 2010). The mean score on the RPQ proactive aggression scale was in the normal range. While groups did not differ in age a significant group difference for IQ was present.

### Experimental Design

To assess cognitive control, a color word Stroop test (Stroop, 1935) was used. Stroop-stimuli comprised German language color words for red, green, and yellow, presented centrally on a 14-inch computer monitor in capital letters against a black background. We asked participants to indicate the color of a presented word with a button press, using their right-hand index, middle and ring finger to press the V, B, or N keys of the computer keyboard. In the congruent condition, color words were presented in their respective color and in the incongruent condition in colors incompatible with the meaning of the color word. The number of congruent and incongruent stimuli was equal and trial order was pseudo-randomized to avoid sequential repetition of identical Stroop trials. Stroop trials began with the presentation of a white fixation cross in the center of the computer monitor for 1,000 msec. We asked the participants to fixate their gaze on the fixation cross when it was presented. A Stroop stimulus replaced the fixation cross and remained on the monitor until one of the response buttons was pressed. The following Stroop trial was started, if no response occurred after 4,000 msec. The experiment was programmed and run with Presentation Software (Version 12.2, Neurobehavioral Systems, Inc., Albany, CA). To compare Stroop performance in CD adolescents and healthy controls under emotional stimulation, we combined the task with standardized affective pictures from the IAPS (Lang et al., 2005) in a 2 (study group)  $\times$  2 (emotional stimulation) factorial study design. The within-subject factor emotional stimulation was realized through presentation of neutral and distressing visual stimuli from the IAPS. The IAPS is a widely used stimulus set and presents one of the most reliable and valid systems for experimental investigation of emotional processing. Here, we used 48 distressing and 48 neutral images out of the IAPS. Distressing images included a balanced number of images of people, animals, scenes, and objects. Neutral images were matched and depicted comparable situations. Pictures were selected according to normative ratings in the dimensions of valence and

arousal reported in the IAPS manual (Lang et al., 2005; for a full list of IAPS pictures see Supplementary Material 1 available online). According to the manual average normative rating scores for selected distressing pictures were 2.67 (*SD* = 0.81) for valence and 5.91 (*SD* = 0.73) for arousal. For neutral pictures, average scores were 5.79 (*SD* = 0.88) for valence and 3.65 (*SD* = 0.82) for arousal. Normative ratings of distressing and neutral stimuli differed significantly (valence: [ $F(1,94) = 234.41, P < .0001$ ]; arousal: [ $F(1,94) = 121.93, P < .0001$ ]). To explore whether a variation in emotional exposition time would yield different results we varied picture presentation time. IAPS pictures were presented for either 300 or 4,000 msec blockwise. Since this experimental manipulation was of methodological interest only, the results are solely reported in the Supplementary Material (see Supplementary Material 2 available online).

### Procedure

Experimental sessions started with standardized verbally provided general instructions. Participants were familiarized with the Stroop test in a practice block (20 Stroop trials). No emotional stimulation was presented during practice. The experimenter controlled accuracy of practice trials. Any mistakes during practice were discussed with the participant, to check if the task was understood correctly. Participants were informed that during the following experiment pictures with neutral and distressing emotional content would be presented. The experiment consisted of eight blocks, each comprising 36 Stroop trials and 12 pictures. Participants performed a total of 288 Stroop trials. During the experiment a picture stimulus was presented after presentation of three Stroop trials. We varied emotional stimulation and exposition time across blocks. Block order was pseudo-randomized and counterbalanced across participants. Examples of experimental conditions and temporal structure are depicted in Figure 1. Finally, participants answered questionnaires and were debriefed. For the control subjects assessment of general cognitive abilities followed the experiment. Experimental sessions lasted 90 min. Participants received 15 Euro financial reward for participation. We asked parents or caregivers to answer the CBCL while their child participated in the experiment.

### Statistical Analyses

We used a two factor repeated measure analyses of covariance (ANCOVA) to analyze performance on the Stroop test with study group as between-subjects factor and emotional stimulation as within-subjects factor. The dependent variable Stroop interference was calculated by

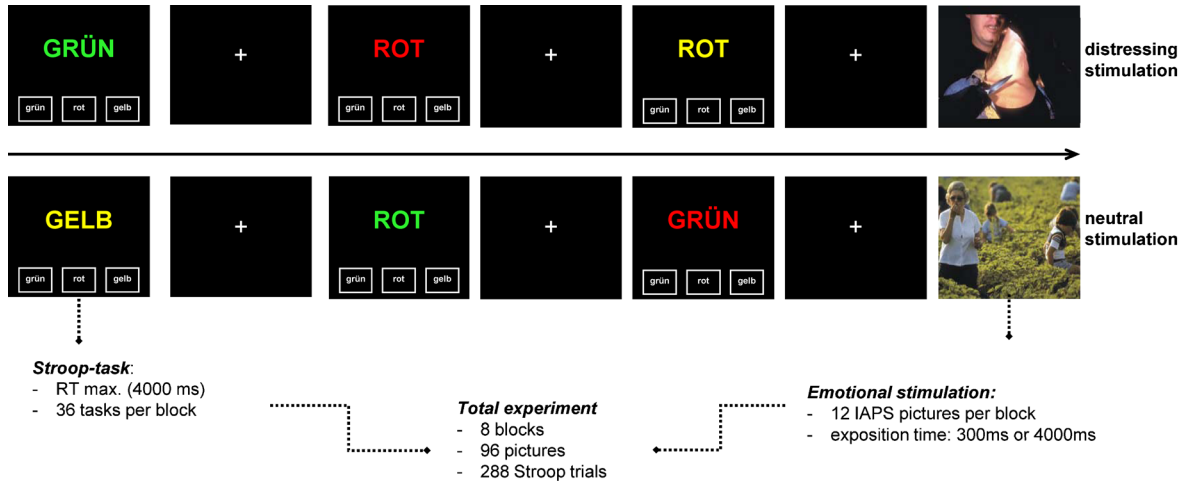


Fig. 1. Experimental structure of manual trial-by-trial Stroop test. Examples of emotional stimulation and Stroop trials. Valence of emotional stimulation and emotional exposition time varied blockwise.

subtracting mean reaction times (RTs) for congruent from mean RTs for incongruent Stroop trials. Post hoc we conducted univariate ANCOVAs to test for group differences on Stroop interference. According to MacLeod (1991) the evaluation of RTs is more adequate for evaluating Stroop interference than error analysis. We therefore used Stroop interference based on RTs for the analysis of our study question. We included the CBCL scale attention problems and IQ as covariates, because groups differed significantly on these measures and both variables have been shown to influence Stroop performance (Friedman et al., 2006; Gray, Chabris, & Braver, 2003; King, Colla, Brass, Heuser, & von Cramon, 2007; Lansbergen, Kenemans, & van Engeland, 2007). Post hoc we also performed correlation analysis of the dependent variables and the covariates to assess the relationship of these variables (see Supplementary Material 3 available online).

## RESULTS

### Preliminary Analyses

Prior to the main analyses we screened Stroop interference data for outliers, response failures, and incorrect responses. According to the criteria defined by Tabachnick and Fidell (2007), one patient and two controls were discarded from further analyses because their Stroop interference values deviated more than  $\pm 2$  standard deviations from the group mean. One patient had to be excluded because data revealed that task instructions had not been followed correctly. We excluded incorrect Stroop trials and response failures a priori from RT data analyses. The final dataset included data of 20 participants in each study group. Stroop interference values met criteria of normal distribution.

We evaluated the validity of the computerized Stroop test and compared mean RTs for Stroop conditions (Fig. 2). Concordant with classical Stroop paradigms, RTs were significantly longer for incongruent than for congruent trials in both groups (patients: [ $T = 12.96$ ,  $P < .0001$ ]; controls: [ $T = 12.18$ ,  $P < .0001$ ]). Stroop accuracy analysis reconfirmed the validity of the Stroop test. Both groups committed significant more errors on incongruent than on congruent trials (patients:

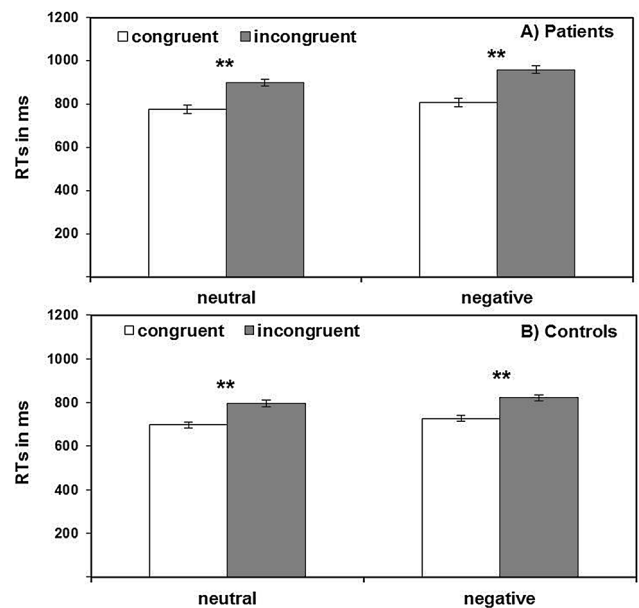


Fig. 2. Mean reaction times (RTs;  $\pm 1$  SE) for congruent and incongruent Stroop trials, neutral and distressing emotional stimulation. Upper figure (A) depicts RTs for patients, lower figure (B) for controls. (\*\* indicates significant differences between congruent and incongruent Stroop trials,  $P < .0001$ )

[ $T=2.89$ ,  $P<.01$ ]; controls: [ $T=3.91$ ,  $P<.01$ ]. Groups did not differ significantly on errors in incongruent ( $T=1.18$ ) or congruent trials ( $T=.12$ ). Mean error rates for both groups are presented in the Supplementary Material (see Supplementary Material 4 available online). Hence, successful implementation of the experimental Stroop test was confirmed for both study groups.

### Stroop Interference Under Distressing Emotional Stimulation

To analyze whether distressing emotional stimulation influenced Stroop interference, we conducted a two factor repeated measures ANCOVA with IQ and attention problems as covariates. In line with our predictions, we found a significant group-by-emotional stimulation interaction ( $F(1;36)=4.57$ ,  $P=.039$ ;  $\eta^2=.11$ ), illustrated by Figure 3. The main effect of emotional stimulation was not significant ( $F(1;36)=0.59$ ) and none of the covariates had a significant effect (IQ:  $F(1;36)=0.46$ ; attention problems:  $F(1;36)=0.20$ ). Post hoc univariate ANCOVAs indicated a significant difference in Stroop interference between groups for distressing emotional stimulation ( $F(1;36)=19.19$ ,  $P<.001$ ;  $\eta^2=.35$ ), indicating larger Stroop interference under distressing emotional stimulation in patients. For neutral emotional stimulation no significant group difference was present ( $F(1;36)=0.24$ ). To probe the influence of emotional stimulation on general RTs, we compared RTs under neutral and distressing emotional stimulation independently of stimulus congruency, in a two-factor repeated measures ANCOVA, with study group as the between-subjects factor and emotional stimulation as the within-subjects factor, and IQ and attention problems as covariates. No significant main effect or any significant

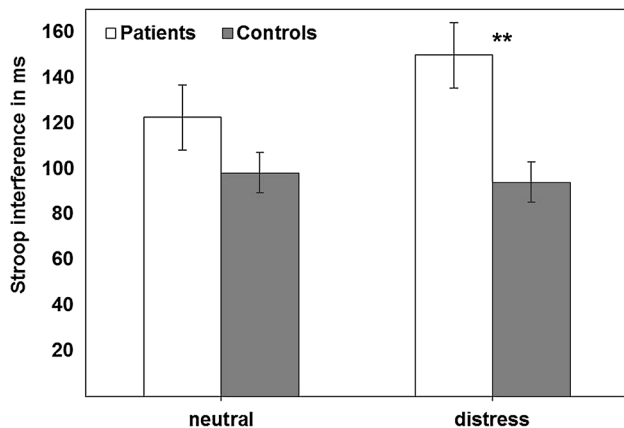


Fig. 3. Stroop interference ( $\pm 1$  SE) for neutral and distressing emotional stimulation separately for study groups. Cognitive control was impaired under distressing emotional stimulation in patients compared to controls. (\*\* indicates significant differences between patients and controls,  $P<.001$ )

interaction was present. General RTs were not influenced by the distressing emotional stimulation in the patient or the control group.

## DISCUSSION

The current study investigated the interrelation of cognitive control and emotional stimulation processing. We measured Stroop interference under distressing and neutral emotional stimulation and found impaired cognitive control in aggressive CD patients compared to healthy controls when distressing stimuli were presented. Stroop interference measures the capacity to inhibit a habitual largely automatic response. Our results show that cognitive control was impaired in CD patients when exposed to distressing emotional stimulation and indicate a problematic interrelation of socio-affective processing and cognitive control in aggressive adolescents. Notably, when we combined RTs for congruent and incongruent trials, we did not find general RT differences under negative and neutral emotional stimulation independent of stimulus congruency either in the patient or in the control group. Hence, the effect of distressing emotional stimulation in CD patients occurred only when cognitive resources for the interference task were required. Thus, a higher susceptibility to distressing emotional stimulation seems to impair cognitive control in CD patients only when cognitive demand is high. Studies investigating the interrelation of executive functioning and emotional stimulation processing using Stroop paradigms with healthy adult subjects reported that performance impairment, provoked by emotional stimulation under low cognitive demand, was counteracted when cognitive demand increased (Hart et al., 2010; Hu et al., 2012). Our results indicate that under confrontation with distressing emotional stimulation, counteracting mechanisms normally enabling individuals to focus on task relevant dimensions when cognitive demand increases, may be insufficient in CD patients. Our findings are in line with previous studies indicating deficient performance in cognitive tasks as a result of hypervigilance to negative affective stimuli in reactive aggressive male adults (Chan et al., 2010). Although Stroop interference under neutral emotional stimulation was higher in CD patients compared to controls, the difference was non-significant. This is somewhat contrary to previous studies reporting general deficits in executive functions in CD patients (Ellis et al., 2009; Raaijmakers et al., 2008). Nevertheless, in line with our hypotheses, the current study provides evidence for a specific impairment of cognitive control under distressing emotional stimulation in CD patients. In our previous fMRI studies, we found abnormal deactivation in the dACC in CD patients



when exposed to comparable distressing IAPS pictures (Stadler et al., 2007; Sterzer et al., 2005). Since the dACC plays an important role in the regulation of behavior (Bush, Luu, & Posner, 2000; Dolcos & McCarthy, 2006; Drevets & Raichle, 1998), our previous findings indicated a suppression of neuronal activation associated with dysfunctional behavioral control. While our previous fMRI findings were only an indirect indication, the present results support our assumption of deficient interrelations of cognitive and socio-affective control directly on the behavioral level. The study provides a possible explanation why cognitive control in aggressive youth is impaired when they are confronted with emotionally distressing situations.

The present clinical sample was characterized by CU traits in the normal range, elevated anxiety, and high scores on reactive aggression. These features characterize a specific subtype of aggressive behavior which needs to be differentiated from the proactive aggression subtype (Hodgins et al., 2009). Both differ not only in regard to their phenotype but also in regard to their biological basis (Kempes, Matthys, de Vries, & van Engeland, 2005; Stadler et al., 2010). Although there is evidence that responsiveness to distressing cues in this specific patient group is elevated (Herpertz et al., 2008; Sterzer et al., 2005), the interrelation between deficient processing of emotional stimulation and cognitive control has scarcely been investigated until now. Although research indisputably shows a more pervasive and severe pattern of antisocial behavior in CD patients with high CU traits and indicates the importance of CU traits for developmental trajectories of behavioral problems in children and adolescents (Herpers, Rommelse, Bons, Buitelaar, & Scheepers, 2012), further research including CD patients without elevated CU traits is of comparable importance because epidemiologic studies indicate that this subgroup represents an even larger proportion of CD patients (Kahn, Frick, Youngstrom, Findling, & Youngstrom, 2012; Rowe et al., 2010). Our results are not only of significance for a better understanding of mechanisms underlying subtypes of aggressive behavior but also for further refinement of specific treatment options. Our study indicates that cognitive control is impaired under emotionally distressing conditions and therefore, treatment of reactive-aggression should focus on enhancing cognitive control strategies in such distressing conditions. In this regard, multi-systemic (Henggeler, Schoenwald, Borduin, Rowland, & Cunningham, 2009) or intensive multimodal behavioral therapies (Grasmann & Stadler, 2008) working with CD patients in daily-life situations represent promising approaches. Interestingly, especially CD patients characterized by elevated physiological activity and CU traits in the normal range seem to profit from such interventional

approaches (Stadler, 2012), whereas for CD patients with low physiological arousability and high CU traits existing therapeutic interventions seem to be less effective (Frick & Dickens, 2006 for a review).

Some limitations of our study should be taken into account. First, we characterized the participants in this study using a self-report instrument to assess CU traits, reactive and proactive aggression and a parent-report instrument to assess general behavioral and emotional problems. This method should be regarded as a first tentative approach towards differentiating the heterogeneous group of CD patients for scientific purposes. Because of the recurrent co-occurrence of reactive and proactive aggression the utility of subgrouping CD patients based on the type of aggressive behavior has been questioned (Bushman & Anderson, 2001). Originally, the existence of two distinct subgroups with primarily reactive or proactive aggression had been hypothesized (Dodge, 1991). Yet, empirical data show that aggressive children often display both subtypes of aggression (Kempes et al., 2005) and proactive aggression is rarely present alone (Crapanzano, Frick, & Terranova, 2010; Stickle, Marini, & Thomas, 2012). Instead of exclusive categories, subtypes seem to be better conceptualized as continuous dimensions in each child (Hubbard, McAuliffe, Morrow, & Romano, 2010). Nonetheless, reactive and proactive aggressive behaviors lead to different behavioral outcomes, are driven by different social and emotional processes, and show age-related trajectories (Cima, Raine, Meesters, & Popma, 2013; Hubbard et al., 2010). To further investigate and explain distinct deficits in CD patient subgroups, well-defined characteristics on the basis of personality traits and clinically relevant cut offs need to be developed. Especially in future investigations of deviant neural processes involved in juvenile aggression, such criteria seem to be inevitable.

Second, despite our efforts to compare two groups that differed only in variables of interest, mean IQ was significantly higher and attention problems were significantly lower in control participants compared to CD patients. We included both variables as covariates in our analysis and performed correlation analyses between the dependent variables and the covariates. No significant effects of the covariates and no significant correlations were present. Nevertheless, statistical control is not a perfect replacement for experimental control and we therefore cannot completely rule out that group differences were, to some extent, due to differences in IQ and attention problems. However, if differences in IQ and attention problems, rather than the experimental manipulation of distressing and neutral emotional stimulation were to explain differences in Stroop interference, differences should be present under distressing and

neutral emotional stimulation. We found significant differences in Stroop interference only under distressing emotional stimulation. It has been argued that the comorbid existence of CD and ADHD symptoms represent a unitary distinct disorder rather than a parallel presence of two separate disorders (Vloet et al., 2011) and lower IQ has been identified as a risk factor for CD (Burke, Loeber, & Birmaher, 2002). Thus, both factors may contribute to altered executive functions under distressing emotional stimulation processing in CD patients. In addition, it should be mentioned that the reported mean IQ for the control group might be overestimated since we assessed IQ for controls in group sessions using the CFT 20-R (Weiss, 2006) and controls appeared highly motivated to perform well on the test due to group assessment. Patients performed the WISC-IV (Petermann et al., 2007) or the CFT 20-R as part of the clinical assessment in personal sessions.

Third, some methodological deficiencies in the design of the Stroop paradigm should be outlined. We used a set of IAPS pictures displaying a variety of scenes to elicit distress in the observer. Pictures were selected according to normative ratings in the dimensions of valence and arousal reported in the IAPS manual (Lang et al., 2005). Aggressive CD adolescents show distinct deficits in recognizing emotional expressions depending on their psychometric profile (Blair & Coles, 2000; Dadds et al., 2006; Herpertz et al., 2005; Munoz, 2009). To examine whether the effects reported here are generic, or whether specific categories of distressing stimuli interfere more than others with cognitive control in subgroups of CD patients, clearly defined picture categories should be used in future investigations. Moreover, the inclusion of positive emotional stimulation would be of interest.

Fourth, we investigated a group of CD adolescents with CU traits in the normal range. Research indicates that adolescents with elevated CU traits show a hypovigilance for emotional stimulation (Blair, Colledge, Murray, & Mitchell, 2001; Fung et al., 2005; Kimonis et al., 2006; Marsh et al., 2008) and it is still unclear how executive functioning deficits are related to elevated CU traits in adolescents (Feilhauer et al., 2012). Therefore, we cannot generalize our results to the entire heterogeneous group of CD patients.

We conclude that confrontation with distressing emotional stimulation interferes more strongly with cognitive control in CD patients of the reactive aggressive subtype than in healthy control adolescents. The results are important because this is the first study to assess the direct impact of distressing emotional stimulation on cognitive control in aggressive adolescents. To further strengthen the notion that reduced cognitive control under temporally extended distressing emotional stimulation reflects a dysfunctional interrela-

tion of emotion stimulation processing and executive functioning, future investigations should target underlying neural mechanisms. This line of research will help to further elucidate the etiological underpinnings of different subtypes of aggressive behavior and form the basis for the development of specific and adequate therapeutic approaches.

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### **SUPPORTING INFORMATION**

Additional supporting information may be found in the online version of this article at the publisher's web-site.

## **Appendix B: Article 2**

Euler, F., Steinlin, C., Stadler, C. (2015) Cognitive and Affective Empathy: Associations with Aggressive and Prosocial Behavior in Adolescents. Manuscript submitted to *Child Psychiatry and Human Development*. Draft of February 25<sup>th</sup>, 2015

# **Cognitive and Affective Empathy: Associations with Aggressive and Prosocial Behavior in Adolescents**

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Running head: Empathy and Aggression in Adolescents

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## **Abstract**

Research results on the relationship between empathy and aggression are heterogeneous. This heterogeneity might be partly explained by the type of empathy and the type of aggression under study. The purpose of the present study was to investigate associations of cognitive and affective empathy with reactive and proactive forms of aggression and prosocial behavior. Participating adolescents lived in socio-educational and juvenile justice institutions (N=164; mean age = 16.91 years; 38% girls). We applied the Griffith Empathy Measure, the Reactive-Proactive Aggression Questionnaire, and the Strengths and Difficulties Questionnaire. Results indicated that cognitive but not affective empathy was negatively associated with proactive aggression. Cognitive and affective empathy were unrelated to reactive aggression. Prosocial behavior was positively associated with cognitive and affective empathy. The present study extends previously published findings on the association of empathy with aggression, and may explain conflicting results in previous research. We conclude that empathy is involved in the inhibition of proactive but not reactive aggression. Our study emphasizes that the association between empathy, aggression, and prosocial behavior depends on the conceptualization of the constructs under study. Implications for clinical praxis are discussed.

*Keywords:* cognitive empathy; affective empathy; reactive aggression; proactive aggression; children



## **Introduction**

Empathy is a complex interpersonal phenomenon in which observation, memory, knowledge, and reasoning are combined to give insights into the thoughts and feelings of others [1]. It describes an affective response that involves the perception and the understanding of the emotional state of someone else [2; 3]. Empathic individuals are thought to utilize information about emotional states in others to constrain potentially harmful behaviors [4]. Empathy is associated with helping and comforting another individual [5], and is assumed to inhibit antisocial and aggressive behavior [6; 7]. Empathy is an important aspect of reciprocal human relationships and represents an essential component of adequate moral and social development during adolescence [8]. Empathy usually develops when children are between two and three years old and start to have a greater awareness of the experience of others [9]. From a theoretic developmental perspective, distress elicited by an individual following an aggressive act becomes an aversive stimulus and consequently inhibits future aggressive behavior through reinforcement learning [10; 11]. Hence, empathic individuals experience the consequences of their aggressive behavior as aversive and choose alternative behaviors. Empathy dysfunction has been described as a precursor to disruptive behavior disorders [12]. Clinicians working with antisocial and aggressive individuals often notice significant empathy impairments in their patients. Nonetheless, empirical research over the past years has not definitely supported the assumption of a direct relationship between empathy and aggression [13]. Because successful social interactions during adolescence have a large impact on socio-emotional functioning, the interrelation of empathy and behavior during that age period is an important subject of investigation. The present study aimed to examine the association between distinct subcomponents of empathy and specific forms of aggressive behavior, as well as prosocial behavior in a sample of adolescent girls and boys.

Despite the numerous definitions of empathy, research nowadays generally acknowledges that empathy involves both affective and cognitive components. According to Jolliffe and Farrington [14], affective empathy is ‘affect congruence’ and cognitive empathy ‘the understanding of others emotions’. Dadds et al. [15; 16] define affective empathy as ‘feeling the emotions of others’ and cognitive empathy as ‘knowing the how, and the why of other peoples emotions’. Several meta-analyses have summarized empirical research on the association between empathy, aggression, and prosocial behavior. These include samples of young children, adolescents, adults, offenders, and psychiatric patient groups. In their influential review, Miller and Eisenberg [17] summarized that empathy was negatively related to aggression, although the strength of the association varied from low to moderate depending on the study. Jolliffe and Farrington [6] investigated the association between empathy and offending. They analyzed 35 studies of which most investigated samples of adult offenders and controls. The authors concluded that offending was moderately and negatively related to empathy. Their findings suggested that the association was stronger for cognitive than for affective empathy, weaker for adults than adolescents, and moderated by intelligence and socioeconomic status (SES). Lovett and Sheffield [18] analyzed 17 studies on the association between affective empathy and aggression in children and adolescents. Overall, the authors summarized that findings on the association were inconsistent, but outlined that studies using adolescent self-report found more homogenous results and indicated a negative relationship between affective empathy and aggression. In their recent review, Eisenberg et al. [8] concluded that lower levels of empathy were moderately associated with higher levels of aggressive behavior and that the association was stronger in adolescents than in younger children. Interestingly, in their most recent meta-analyses, Vachon et al. [13] concluded that empathy and aggression share only a small amount of variance, and that a differentiation of cognitive and affective empathy does not influence the association between empathy and aggression.

Nonetheless, their meta-analysis showed that the relationship is stronger when aggression is assessed directly and not only compared between groups meeting certain characteristics (e.g. psychiatric patients, offenders). This conclusion is somewhat surprising because a number of experimental studies did find reduced empathy-related responses in patients with disruptive behavior disorders (DBD) compared to healthy controls. These investigations used different experimental stimulations such as story vignettes [19; 20], static and dynamic emotional expressions [21; 22], and emotion-eliciting film-clips [23-25]. In summary, although research has made considerable effort, a definite conclusion on the interrelation between specific empathy components and aggression remains difficult and several unresolved issues remain. Another important component of social interactions related to empathy is prosocial behavior. It is defined as voluntary behavior intended to benefit another and includes various forms of behavior such as helping, sharing, and comforting [5]. Previous reviews concluded that empathy and sympathetic concern enhance altruism and consequently lead to prosocial behavior [26]. Empathy, along with other mechanisms, therefore seems to determine the degree to which individuals engage in prosocial behavior. Interestingly, empirical studies show a stronger and more consistent relationship between empathy and prosocial behavior than between empathy and aggression [27; 28].

### **Limitations of previous research**

Previous findings are accompanied by a number of limitations. Over the past years, empirical studies have conceptualized and assessed empathy and aggression in a number of ways. In some studies, the concept of empathy has been defined more broadly than in others, and consequently has been equated with related, but distinct concepts, such as sympathy or compassion [14]. Current empathy research emphasizes the importance of the differentiation between affective and cognitive empathy components. Specific behavioral correlates have been reported for cognitive

and affective empathy facets [4]. Despite these specific behavioral associations for cognitive and affective empathy components, previous studies investigating the interrelation between empathy and aggression have often neglected the differentiation between cognitive and affective empathy. Furthermore, empirical studies showed that both empathy subcomponents are differently associated with subtypes of disruptive behavior in children and adolescents [20; 29; 30]. Hence, the inhibitory effect of empathy on aggression may only apply to specific forms of aggressive behavior. Aggression is usually defined as behavior deliberately aimed to harm individuals and/or objects [31]. Dodge and Coie [32] introduced the distinction between reactive and proactive aggression in children. Reactive aggression is described as an impulsive response to a perceived threat or provocation, often associated with high emotional arousal, anxiety, and anger. Proactive aggression is described as instrumental, organized, cold-blooded, and motivated by the anticipation of reward [32-34]. The differentiation has been useful to understand the underlying motivational mechanisms and etiological pathways of juvenile aggressive behavior [32; 33]. Previous empirical research indicated that empathy primarily inhibits proactive aggression [35; 36]. Theoretic assumptions also imply that affective empathy is more likely to hinder proactive aggression than reactive aggression [18]. Moreover, proactive aggression in the form of bullying, defined as repetitive action aiming to harm or cause distress in an individual, has been associated with lower levels of affective empathy [37]. Nonetheless, Feshbach and Feshbach [38] argued that empathy hinders both types of aggression. In a study with children with Autism Spectrum Disorders (ASD) and healthy controls, empathy was associated with reactive but not with proactive aggression [39]. Hence, it remains unclear how cognitive and affective empathy are associated with reactive and proactive forms of aggression. The interrelation of empathy facets and prosocial behavior seems to be more robust and clear. Although, to date, the question if cognitive and affective facets of empathy contribute equally to the occurrence of prosocial

behavior in adolescents has scarcely been investigated. Especially for the development of clinical interventions that aim to foster prosocial behavior it seems important to understand which facets of empathy should be the main focus of intervention programs.

### **Aim of the present study**

Given the limitations of previous investigations, the present study aimed to answer the following research questions: (a) Are cognitive and affective facets of empathy related to reactive and proactive forms of aggression? (b) Are cognitive and affective facets of empathy both associated with prosocial behavior? Based on previous empirical findings and theoretical assumptions regarding the motivational underpinnings of reactive and proactive aggression, we hypothesized that cognitive and affective facets of empathy are negatively related to proactive aggression, but not to reactive aggression. We predicted empathy to contribute to the inhibition of proactive aggression. Furthermore, we expected to replicate previously reported positive associations between empathy and prosocial behavior. We hypothesized that cognitive and affective aspects of empathy contribute to the occurrence of prosocial behavior.

## **Methods**

### **Participants**

A total of 184 adolescents between the age of 12 and 22 years participated in the survey. Participants were recruited in socio-educational institutions in the German-speaking part of Switzerland. All participating institutions were accredited by the Swiss Ministry of Justice. We choose these institutions because we expected to recruit a sample of adolescents with elevated aggressive behavior there. Adolescents were admitted to these institutions by way of either

criminal (54.0%) or civil (46.0%) law. Hospitalization by civil law occurred if adolescents were no longer able to live in their family or environment of origin due to severe psychological or behavioral problems or precarious life conditions. In case of a hospitalization by civil law, the adolescents' return to their family or environment of origin was arranged if circumstances were evaluated as safe and acceptable. In case of hospitalization by penal law, adolescents were to be released upon completion of their sentence. Adolescents with insufficient German language skills were excluded a priori from the study. If sufficiency of the language skills was questionable according to the judgment of the primary case worker, participants had to answer and explain several test items of comparable difficulty. At the time of testing, most of the participants were attending regular middle-school or high-school (77.6%) or vocational training (10.6%). Some of the participants (11.8%) were not involved in any gainful activity at the time of testing. A total of 15 subjects had to be excluded from the analysis because of a large number of missing items on the self-report questionnaires or because other-report data was missing. Two subjects were excluded after having reported that they had marked items randomly without understanding them. Therefore, a total of 167 data sets were used in the statistical analysis.

## **Procedure**

In a first step, we contacted child welfare and juvenile justice institutions in the German speaking parts of Switzerland. If an institution agreed to participate, adolescents and social workers were informed about the project. If written informed consent for the survey was given by the adolescents and the person entitled to their custody, the research team visited the institution and participants filled in questionnaires during group sessions. Other-report assessment was conducted by the caseworker that had been assigned as primary caretaker for the participant during the time in the institution. The selected caseworkers had to know the adolescent for at least one month prior to the begin of the study, and additionally had to confirm that they knew

the adolescent well enough and were confident to validly answer the survey questions. Information disclosed by the youths and the caseworkers remained confidential and feedback was given only if the adolescent consented. Subjects received a movie theater gift voucher for participation in the study. Ethical approval for the study was obtained by the Institutional Review Board of the University of Basel, Switzerland.

## **Instruments**

*Empathy:* To assess empathy we used the Griffith Empathy Measure [GEM; 15]. The GEM comprises the subscales ‘cognitive empathy’ and ‘affective empathy’, and a ‘total empathy’ scale. The instrument is adapted from the Bryant’s Index of Empathy for Children and Adolescents. Previous investigations supported convergent, discriminant, and predictive validity of the GEM scales across age and gender [15]. We administered a German version of the GEM that had originally been translated and validated by Greimel et al. [40]. We adapted the wording of some of the items to suit the application to socio-educational institutions. In the present study, caretakers rated how much each item applied to a child in their custody on a 9-point Likert scale (-4 = ‘strongly disagree’, +4 = ‘strongly agree’). For the current sample, the GEM affective empathy scale ( $\alpha = .80$ ) and total empathy scale ( $\alpha = .85$ ) demonstrated good, the cognitive empathy scale ( $\alpha = .62$ ) sufficient internal consistencies.

*Aggressive behavior:* We applied the Reactive-Proactive Aggression Questionnaire [RPQ; 33] to assess aggression subtypes. The RPQ uses a three-point Likert scale (0=never, 1=sometimes, 2=often) and comprises the subscales ‘reactive aggression’, ‘proactive aggression’ and a ‘total aggression’ scale. The RPQ assesses both types of aggression in adolescents reliably and validly, and factor analyses have confirmed the two-factor conceptualization of the items[41]. In the present study, we administered a German version of the RPQ. The original instrument was translated and back-translated by native English and German speakers. Internal consistencies for

the reactive aggression ( $\alpha = .86$ ), the proactive aggression ( $\alpha = .88$ ), and the total RPQ scale ( $\alpha = .92$ ) of the German RPQ version in the present study were excellent.

*Behavioral strengths and difficulties:* We used the teacher version of the Strengths and Difficulties Questionnaire [SDQ; 42] to assess emotional and behavioral problems during the past 6 months. The SDQ contains 25 items. A ‘total difficulties’ score and the subscales ‘emotional symptoms’, ‘conduct problems’, ‘hyperactivity’, ‘peer problems’, and ‘prosocial behavior’ can be computed. The questionnaire has been tested extensively in numerous countries. The items are formulated as statements about the child, and teachers or caregivers are asked to indicate their responses on a three-point rating scale (‘Not true’, ‘Somewhat true’ and ‘Certainly true’). Clinical cut-off scores are available from a large German adolescent norm population [43]. The subscales ‘emotional symptoms’ ( $\alpha = .83$ ), ‘conduct problems’ ( $\alpha = .85$ ), ‘hyperactivity’ ( $\alpha = .82$ ), ‘peer problems’ ( $\alpha = .93$ ), ‘prosocial behavior’ ( $\alpha = .90$ ), and the total difficulties score ( $\alpha = .95$ ), showed good to excellent internal consistency in the present study.

*Time and quality of participant–caseworker relationship:* Caseworkers reported how long they had known the participant and were asked to rate how well they believed to know the participant on a five point Liker-scale (1= ‘very little’; 2=‘a little’; 3= ‘fairly well’ 4=‘well’; 5=‘very well’).

## **Statistical Analyses**

As a first step, we assessed differences of demographic variables between boys and girls with independent samples t-tests. Using univariate analyses of variance (ANOVA), we subsequently tested whether boys and girls differed in the main study variables cognitive, affective and total empathy, reactive and proactive aggression and prosocial behavior across age. We used the median split to divide the study sample into two age groups for this analysis. To address the primary study aim to investigate the association between empathy facets, reactive and proactive aggression as well as prosocial behavior, we first calculated bivariate correlations for gender and



age with these variables. If bivariate analysis indicated significant correlations between any of the main study variables and gender or age we performed partial correlation analysis including gender and age as control variables. Finally, we performed linear regression analyses to determine whether behavioral outcome measures could be predicted from empathy facets. We used the IBM-SPSS software package, Version 19 (IBM SPSS Inc., Chicago, USA) for the statistical analysis. The critical value of significance was set to  $p < .01$ . Prior to our analysis, we screened data for violation of assumptions. Explorative analysis suggested that normality was a reasonable assumption for the main study variables. Normality was tested via the Shapiro-Wilk test. According to the criteria defined by Tabachnick and Fidel [44], three subjects were discarded from further analyses because they had scores deviating more than  $\pm 2$  SD from the group mean. For each regression model we tested independence of errors using the Durbin-Watson statistics. Homogeneity of variance was evaluated using the Variance Inflation Factor (VIF). The VIF measures the impact of collinearity among the variables in a regression model. With the use of a  $p < .001$  criterion for Mahalanobis distance, outliers were identified and removed from the regression analyses.

## **Results**

### **Descriptive statistics**

Demographic and behavioral characteristics are reported in Table 1. Behavioral characteristics were measured using the SDQ. Scores indicated that, compared to the norm sample, [43] girls and boys in the present study had a mean score in the borderline clinical range on the SDQ total difficulties scale. Boys scored in the borderline clinical range on the SDQ conduct problems, the peer problems, and the prosocial behavior subscales. Compared to the norm sample, girls had

scores in the borderline clinical range on the emotional problems subscale. Independent samples t-test revealed that girls were significantly younger than boys ( $t_{(162)} = 4.40, p < .001$ ). Further, girls had higher scores on measures of prosocial behavior ( $t_{(162)} = -3.56, p < .001$ ) and total empathy ( $t_{(162)} = -4.06, p < .001$ ). Boys scored higher on scales for proactive ( $t_{(162)} = 4.43, p < .001$ ) and total aggression ( $t_{(162)} = 3.29, p < .001$ ). To control whether gender differences were present across age groups, we used a 2 (gender) by 2 (age group) factorial design. Factorial ANOVAs revealed a significant main effect of gender on total empathy ( $F_{(1,160)} = 12.86, p < .001; \eta^2 = .08$ ), proactive aggression ( $F_{(1,160)} = 19.27, p < .001; \eta^2 = .11$ ), and prosocial behavior ( $F_{(1,160)} = 15.07, p < .001; \eta^2 = .09$ ). Results indicated that there was no main effect of age on any of the variables and no significant gender by age interaction.

### **Bivariate analysis**

Results of the bivariate analysis for the main study variables are depicted in Table 2. The zero-order Pearson  $r$  indicated that proactive and total aggression scores correlated negatively and significantly with cognitive empathy. Associations between affective empathy scores and proactive, reactive, or total aggression were not significant. Total empathy scores were negatively and significantly correlated with proactive and total aggression scores. Prosocial behavior was significantly and positively correlated with cognitive, affective, and total empathy scores. Prosocial behavior was significantly and negatively associated with proactive and total aggression, but not with reactive aggression. Aggression subtypes correlated significantly with each other while empathy components did not. Bivariate analysis also revealed that age and gender were significantly correlated with some of the main study variables. For these variables, we additionally performed partial correlation analysis controlling for age and gender. For associations of interest, partial correlation analysis revealed significant negative correlations for proactive aggression with cognitive empathy ( $r = -.24, p < .01$ ) and with total empathy ( $r = -.25,$

$p < .001$ ). The positive associations between prosocial behavior and cognitive ( $r = .47, p < .001$ ), affective ( $r = .36, p < .001$ ), and total empathy ( $r = .66, p < .001$ ) also remained significant after controlling for age and gender.

### **Regression analysis**

We performed standard multiple regression analyses to test if empathy facets predicted proactive aggression and prosocial behavior. We only entered variables into the regression models that were significantly associated with the dependent variables in preceding bivariate analysis. In the first set of regression models we entered proactive aggression as the dependent variable. In the second set of regression models we entered prosocial behavior as the dependent variable. Evaluation of the assumptions indicated that linearity, independence of errors, and homoscedasticity of residuals were acceptable for each regression model.

*Proactive aggression:* To predict proactive aggression we included gender, age, and cognitive empathy as independent variables in the first regression model. Gender, age, and total empathy were included as independent variables in the second regression model. Table 3 summarizes the raw and standardized regression coefficients of the predictors, their squared semipartial correlations and their structure coefficients for both regression models with the independent variable proactive aggression. The first model was statistically significant,  $F_{(3,160)} = 10.64, p < .000$ , and accounted for approximately 17% of the variance in proactive aggression ( $R^2 = .17$ , Adjusted  $R^2 = .15$ ). Proactive aggression was significantly predicted by cognitive empathy and by gender. Age did not add significantly to the prediction. The unique variance explained by each of the variables indexed by the squared semipartial correlations was low. The second regression model was also statistically significant,  $F_{(3,159)} = 10.96, p < .001$ , and accounted for approximately 17% of the variance in proactive aggression ( $R^2 = .17$ , Adjusted  $R^2 = .16$ ). Proactive aggression was significantly predicted by total empathy and by gender. Age did not add

significantly to the prediction. Again, the unique variance explained by each of the variables indexed by the squared semipartial correlations was quite low.

*Prosocial behavior:* To predict prosocial behavior we included gender, age, cognitive, and affective empathy as independent variables in the third regression model. In the fourth regression model gender, age, and total empathy were entered as independent variables. Table 4 summarizes the raw and standardized regression coefficients of the predictors, their squared semipartial correlations and their structure coefficients for both regression models with the independent variable prosocial behavior. The third regression model was statistically significant,  $F_{(4,158)} = 20.71, p < .000$ , and accounted for approximately 31% of the variance in prosocial behavior ( $R^2 = .34$ , Adjusted  $R^2 = .33$ ). Prosocial behavior was significantly predicted by cognitive and affective empathy, and by gender. Age did not add significantly to the prediction. The unique variance explained by cognitive empathy was higher than for the other predictors, although affective empathy also uniquely explained variance in prosocial behavior. The fourth regression model was statistically significant,  $F_{(3,159)} = 45.26, p < .000$ , and accounted for approximately 42% of the variance in prosocial behavior ( $R^2 = .46$ , Adjusted  $R^2 = .45$ ). Prosocial behavior was significantly predicted by total empathy. Age did not add significantly to the prediction. The unique variance explained by total empathy was high.

## **Discussion**

The present study aimed to investigate the association between cognitive and affective empathy, and reactive and proactive aggression in a high-risk sample of adolescent girls and boys. Furthermore, we tested the relationship of both empathy components with prosocial behavior. Results indicated that cognitive empathy was negatively associated with proactive aggression, while affective empathy was not. Affective and cognitive empathy were both

unrelated to reactive aggression. Prosocial behavior was related to cognitive and affective empathy facets. Regression analyses indicated a significant predictive value of cognitive empathy and gender for proactive aggression. Both empathy facets significantly predicted levels of prosocial behavior, whereas gender was less predictive for prosocial behavior. Before we proceed with the interpretation of our results, we outline the limitations of the study.

First, we assessed reactive and proactive aggression using a self-report measure. Participants were instructed to rate their level of reactive and proactive aggression during the past six months. Social desirability may present a problem when self-report is used for the assessment of antisocial behavior. Nonetheless, we used the RPQ for two reasons: (1) It has excellent psychometric properties and (2) we expected adolescents to have the best knowledge of their general aggressiveness. Second, internal consistency for the GEM cognitive empathy subscale was only borderline acceptable. This indicates that the scale possibly contains substantial measurement error. Notably, the developers of the questionnaire also reported comparable reliability for the cognitive empathy subscale [15]. The authors recommend the use of the subscale because results of confirmatory factor analysis were excellent, and convergent validity with a number of variables was shown. The GEM was originally developed as a parent-report instrument. In the present study, caseworkers completed the questionnaire, which possibly added to the measurement error. Third, adolescents living in child-welfare and juvenile-justice institutions are characterized by a unique sociodemographic background [45]. A number of relevant risk-factors (e.g. traumatic experiences, anxiety symptoms, negative peer-relationships) that possibly influence the association between empathy and aggression were not controlled. Therefore, the results need to be carefully interpreted and replications of our findings are required before these can be generalized to other populations. It is also important to outline that psychological treatment and educational consulting differed between institutions. Moreover, the

duration of the time spent in institutions at the time of testing varied between participants. We did not test general cognitive abilities of the study sample. In Switzerland, adolescents with low intellectual abilities are generally placed in particular institutional settings that were not included in the recruitment protocol. We therefore assume that most adolescents had average intelligence. Fourth, it is plausible that the age and gender composition of the sample influenced the present findings. Although we used an empathy measure that has been found to show adequate validity across age groups and gender, both variables need to be considered as confounds in empathy research because differences have been reported [14; 46-48]. In line with the suggestion made by Lovett and Sheffield [18] we conducted a two way interaction analysis for age and gender. Results indicated that gender, but not age, influenced scores on cognitive and affective empathy and proactive aggression. We subsequently controlled for gender influences in further analyses. Statistical control is never an optimal replacement for experimental control. Thus, our results need to be confirmed in larger samples that allow gender-specific investigations of the associations. Fifth, the present study is cross-sectional which does not allow conclusions about the causality and the temporal stability of the associations indicated by our data. Bearing these limitations in mind, we interpret our results as follows.

The present findings allow conclusions to be drawn on the interrelations of theoretically distinct aggression subtypes and different empathy facets. The assessment of specific empathy components and aggression subtypes is one of the strengths of the current study. The more specifically these concepts are defined and assessed, the better their relationships can be understood. Results of the study partially confirmed our hypotheses. As expected, we found negative associations between cognitive empathy and proactive aggression. Although correlation coefficients were small, associations remained significant after controlling for gender and age. Our results are in line with recent research indicating that proactive aggression is related to lower

levels of empathy [8; 49] and with studies that show that bullying is associated with lower levels of empathy [50]. Thus, a higher ability to understand the cause and reason of emotions in others seems to reduce the amount of aggression that is instrumental, organized, and motivated by the anticipation of reward. Contrary to expectations, affective empathy was unrelated to proactive aggression. Regression analysis indicated that the cognitive empathy subscale explained just as much variance in proactive aggression as the total empathy scale, including all items from the cognitive and the affective empathy subscale. According to our data, affective empathy facets do not seem to be associated with lower proactive aggression. This finding is contrary to a number of studies that indicated that affective empathy is negatively related to antisocial behavior [18]. Further, callous unemotional traits show strong positive correlations with proactive aggression [51]. The concept of callous unemotional traits comprises, per definition, deficits in affective empathy. Hence, our findings regarding affective empathy are surprising and need to be interpreted carefully. Lovett and Sheffield [18] argue that behavioral or experimental measures of affective empathy indicate stronger relationships with aggression. Thus, it would be interesting to investigate if our results can be replicated with experimental paradigms that differentiate between cognitive and affective empathy. Results confirmed our hypothesis that reactive aggression is unrelated to cognitive and affective components of empathy. We based our assumptions on the specific characteristics of reactive aggression. Reactive aggression is often impulsive and follows a perceived threat or provocation. Reactive-aggressive individuals are characterized by impaired emotion regulation [52] and reduced cognitive control under emotional stimulation [53]. For reactive aggression, emotional arousal, frustration, anxiety, and anger are likely to disturb aggression-inhibition mechanisms usually triggered by empathy. Thus, inconsistent findings on the association of affective empathy and aggression in previous studies are possibly due to

insufficient assessment of aggression subtypes. In this light, the presented results contribute to existing literature.

A further strength of the present study is the investigation of the interrelation of empathy and aggression in a sample of adolescents in juvenile justice institutions. Recent reviews have criticized that studies investigating the association between empathy and aggression did not include populations with elevated levels of aggression [13; 18]. Moreover, it has been argued that research has often applied dichotomous group classification to assess aggressiveness. The present study aimed to fill this gap in the literature. We investigated a study sample that was likely to show elevated levels of aggressiveness. In fact, reactive and proactive aggression scores in the present sample were comparable or even higher than in studies applying the same measure in antisocial juvenile populations [33; 54; 55]. Further, we applied a continuous measure to assess two subtypes of aggressive behavior with different underlying motivational mechanisms and etiological pathways.

Our data indicated that affective and cognitive components of empathy are both positively associated with prosocial behavior. This is in line with recently published research on children [22] and adults [52]. Relationships were moderate and remained significant after controlling for the influence of age and gender. Both empathy facets together explained one third of the variance in prosocial behavior and uniquely predicted prosocial behavior. This indicates that each component is important for the motivation of prosocial behavior. We replicated findings of previous studies on the positive association of empathy and prosocial behavior. Our study contributes to the current literature by explicitly indicating that both cognitive and affective facets of empathy are positively associated with prosocial behavior. It is also important to take note that according to our findings, this association is also present in aggressive adolescents. Using caseworker-report instead of parent-report for the assessment of cognitive and affective empathy



and prosocial behavior also yielded a number of advantages. Socio-educational institutions offer many situations where social interactions can be observed (e.g. group meals, leisure activities, sports). Caseworkers are used to working with adolescents with disruptive behavior and are trained in the evaluation of behaviors relative to a certain age group. Furthermore, it is difficult to collect parent-report from institutionalized adolescents. By choosing case-worker reports a larger sample size could be achieved.

### **Practical implications and future direction**

The findings of our study have important clinical implications. Results indicate different associations between empathy facets and aggression subtypes. This is an important observation because even though empirical evidence is inconsistent, it is often assumed that fostering empathy during clinical interventions will directly reduce future aggressive behavior. According to our data this assumption might be misleading, at least for primarily reactive aggressive individuals. Nonetheless, our data indicate that higher levels of cognitive empathy are associated with lower levels of proactive aggression and support the idea that improving empathy reduces proactive aggressive behavior. The results are in line with other studies emphasizing the importance of specific therapeutic approaches for different variants of aggressive adolescents [56; 57]. Interestingly, the association of empathy with prosocial behavior was more robust. Thus, exercising and encouraging empathic responding during therapeutic interventions possibly fosters positive social interactions more than it inhibits dysfunctional aggressive behavior. However, improved social functioning can be expected from such interventions either way. Two important aspects for future research on the association between empathy and behavior should be considered. Longitudinal studies are necessary to understand the causality and the temporal stability of the relationship indicated by the present results, especially in adolescents at risk for future antisocial behavior. Research also indicates that motivational and appraisal processes

influence the experience of empathy and corresponding neuronal and behavioral correlates [9; 58; 59]. Subsequently, it is important to investigate empathy-induced inhibition or motivation of behavior considering relevant moderator variables such as attitude, mood, and disposition.

### **Summary**

Overall, our findings suggest that cognitive empathy is associated with less proactive aggression. Further, according to the results, cognitive and affective empathy are both associated with higher levels of prosocial behavior. In contrast, the study implicates that affective empathy is unrelated to proactive aggression and both empathy facets are unrelated to reactive aggression. In conclusion, the interrelation between empathy and social behavior depends on the conceptualization of the constructs. This possibly accounts for conflicting findings on the association of empathy and aggression in previous research.

### **Conflict of interest**

The authors declare that they have no conflict of interest.

### **Acknowledgments**

The authors thank the participating institutions for their efforts during data collection.

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**Table 1** Demographic characteristics and descriptive statistics of the study sample

	Girls (N= 63)		Boys (N=101)		Total (N=164)		Range	N
	M	(SD)	M	(SD)	M	(SD)		
<i>Demographic characteristics</i>								
Age	15.95	(1.76)	17.50	(2.42)	16.91	(2.31)	12-22	-
Time in institution (months)	11.53	(8.38)	9.26	(7.72)	10.11	(8.03)	3-24	-
Quality of relationship	3.80	(.78)	3.67	(.64)	3.72	(.70)	1-5 <sup>b</sup>	-
History of immigration (%)	55.6	-	57.1	-	56.1	-	-	-
<i>Behavioral characteristics (SDQ)</i>								
Emotional symptoms	4.43 <sup>a</sup>	(2.07)	3.40	(2.43)	3.79	(2.35)	0-9	5
Conduct problems	2.89	(2.32)	3.53 <sup>a</sup>	(2.28)	3.29	(2.31)	0-10	5
Hyperactivity-inattention	4.22	(2.74)	4.44	(2.51)	4.35	(2.59)	0-10	5
Peer problems	3.10	(2.25)	3.54 <sup>a</sup>	(2.43)	3.37	(2.36)	0-10	5
Prosocial behavior	6.46	(2.00)	5.27 <sup>a</sup>	(2.30)	5.60	(2.29)	0-10	5
Total difficulties	14.63 <sup>a</sup>	(6.30)	14.91 <sup>a</sup>	(2.29)	14.80 <sup>a</sup>	(6.73)	0-39	25
<i>Empathy (GEM)</i>								
Cognitive empathy	6.32	(7.25)	3.85	(6.81)	4.80	(7.07)	-13-23	6
Affective empathy	4.37	(11.32)	1.23	(9.99)	2.43	(10.60)	-28-27	9
Total empathy	19.94	(19.89)	6.97	(19.88)	11.95	(20.81)	-49-64	23
<i>Aggression (RPQ)</i>								
Reactive aggression	11.21	(4.89)	12.61	(5.51)	12.07	(5.31)	0-24	12
Proactive aggression	4.29	(3.81)	7.91	(5.75)	6.52	(5.38)	0-21	11
Total aggression	15.49	(7.82)	20.52	(10.43)	18.59	(9.81)	0-45	23

SDQ = Strengths and Difficulties Questionnaire; GEM = Griffith Empathy Measure; RPQ = Reactive-Proactive Aggression Questionnaire

<sup>a</sup> borderline clinical range

<sup>b</sup> higher scores indicate higher quality of participant caseworker relationship

**Table 2** Bivariate analysis for main study variables

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
1. GEM cognitive empathy	-							
2. GEM affective empathy	.14	-						
3. GEM total empathy	.60**	.78**	-					
4. RPQ reactive aggression	-.18	-.01	-.17	-				
5. RPQ proactive aggression	-.27**	-.12	-.33**	.69**	-			
6. RPQ total aggression	-.24*	-.07	-.27**	.92**	.92**	-		
7. SDQ prosocial behavior	.49**	.38**	.69**	-.21	-.37**	-.32**	-	
8. Gender <sup>a</sup>	.17	.14	.30**	-.13	-.33**	-.25*	.27**	
9. Age	.00	-.17	-.16	.11	.19	-.16	-.12	-.33**

Pearson coefficients (2-tailed) are given.

<sup>a</sup> positive coefficients indicate higher scores for girls.

\*\* $p < .001$ ; \* $p < .01$

**Table 3** Results of standard multiple regression to predict proactive aggression from (A) cognitive empathy, age, and gender, and from (B) total empathy, age, and gender

(A) Variables	<i>B</i>	$\beta$	$sr^2_{unique}$
Cognitive empathy	-.173*	-.23	.05
Gender <sup>a</sup>	-2.80**	-.25	.07
Age	.261	.11	.01
Intercept = 6.80			
			$R^2 = .166$
			$R^2_{adj} = .151$
			$R = .408$
(B) Variables	<i>B</i>	$\beta$	$sr^2_{unique}$
Total empathy	-.06*	-.24	.06
Gender <sup>a</sup>	-2.53*	-.23	.05
Age	.19	.08	.01
Intercept = 7.62			
			$R^2 = .171$
			$R^2_{adj} = .156$
			$R = .414$

<sup>a</sup> positive coefficients indicate higher proactive aggression for girls

$sr^2$  = squared semipartial correlation

\*\* $p < .001$ ; \* $p < .01$

**Table 4** Results of standard multiple regression to predict prosocial behavior from (A) cognitive empathy, affective empathy, age, and gender and from (B) total empathy, age, and gender

(A) Variables	<i>B</i>	$\beta$	$sr^2_{unique}$
Cognitive empathy	.128**	.42	.17
Affective empathy	.059**	.28	.08
Gender <sup>a</sup>	.655	.15	.02
Age	-.017.	-.02	.01
Intercept = 4.36			
			R <sup>2</sup> = .344
			R <sup>2</sup> <sub>adj</sub> = .227
			R = .587
(B) Variables	<i>B</i>	$\beta$	$sr^2_{unique}$
Total empathy	.068**	.65	.37
Gender <sup>a</sup>	.334	.08	.01
Age	.01	.00	.00
Intercept = 4.43			
			R <sup>2</sup> = .461
			R <sup>2</sup> <sub>adj</sub> = .450
			R = .679

<sup>a</sup> positive coefficients indicate higher prosocial behavior for girls

$sr^2$  = squared semipartial correlation

\*\*p < .001; \*p < .01

### **Appendix C: Article 3**

Euler, F., Jenkel, N., Stadler, C., Schmeck, K., Fegert, J. M., Kolch, M., & Schmid, M. (2014a). Variants of Girls and Boys with Conduct Disorder: Anxiety Symptoms and Callous-Unemotional Traits. *Journal of Abnormal Child Psychology*. doi: 10.1007/s10802-014-9946-x

# Variants of Girls and Boys with Conduct Disorder: Anxiety Symptoms and Callous-Unemotional Traits

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**Abstract** Recent research suggests that among the group of aggressive and antisocial adolescents, there are distinct variants who exhibit different levels of anxiety symptoms and callous-unemotional traits (CU traits). The purpose of the present study was to examine whether such variants are also present in male and female adolescents diagnosed with conduct disorder (CD). We used model-based cluster analysis to disaggregate data of 158 adolescents with CD (109 boys, 49 girls; mean age =15.61 years) living in child welfare and juvenile justice institutions. Three variants were identified: (1) CD only, (2) CD with moderate CU traits and anxiety symptoms, and (3) CD with severe CU traits. Variants differed in external validation measures assessing anger and irritability, externalizing behavior, traumatic experiences, and substance use. The CD variant with moderate CU traits and anxiety symptoms had the most severe pattern of psychopathology. Our results also indicated distinct profiles of personality development for all three variants. Gender-specific comparisons revealed differences between girls and boys with CD on clustering and external validation measures and a gender-specific cluster affiliation. The present results extend previously published findings on variants among aggressive and antisocial adolescents to male and female adolescents diagnosed with CD.

**Electronic supplementary material** The online version of this article (doi:10.1007/s10802-014-9946-x) contains supplementary material, which is available to authorized users.

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**Keywords** Limited prosocial emotions · DSM-5 · Aggressive and antisocial behavior · Temperament and character · Personality development · Cluster analysis

Conduct disorder (CD) is characterized by a pattern of violation of the basic rights of others, violation of age-appropriate norms or rules, and aggressive behavior towards peers, parents, teachers, and caregivers (American Psychiatric Association 2013). Children and adolescents with CD are a heterogeneous group characterized by distinct phenotypes, and several subtypes have been specified in previous investigations (Buitelaar et al. 2013; Hodgins et al. 2009; Stadler et al. 2010). One line of evidence has identified the presence of callous-unemotional traits (CU traits) as an important subgroup characteristic. CD patients with CU traits show a particularly severe and stable pattern of aggressive behavior, benefit less from interventions, have distinct neurocognitive profiles, and specific etiological risk factors (Frick and Nigg 2012; Rowe et al. 2010; Moffitt et al. 2008). Because the presence of CU traits has repeatedly been shown to characterize a specific subgroup of children and adolescents with CD, the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association 2013) has added a CU specifier referred to as ‘specifier for limited prosocial emotions’ to the diagnostic criteria of CD. The specifier designates those CD patients who can be described by a significant lack of remorse or guilt, callous lack of empathy, unconcern about their performance, and a shallow or deficient affect. Inclusion of the specifier to the DSM-5 diagnostic classification contributes markedly to differentiating the heterogeneous group of CD patients.

Another line of evidence with respect to subgroup differentiation has focused on the presence of comorbid anxiety symptoms. Hodgins et al. (2009) postulated that the presence of anxiety symptoms represents the main differentiation

criterion within the group of individuals with persistent antisocial behavior. According to a meta-analysis by Angold et al. (1999), the risk for developing an anxiety disorder is three times higher in children with than in children without CD. Moreover, epidemiological studies reported that the proportion of comorbid anxiety disorders in CD children ranges from 22 to 33 % in the general population and from 60 to 75 % in clinic-referred or institutionalized populations (Russo and Beidel 1994). However, it is still unclear if comorbid anxiety symptoms lead to more severe antisocial behavior or function as a protective factor. Earlier studies indicated that anxiety moderates the manifestation and severity of aggressive and antisocial behavior, while more recent studies concluded that the direction of the relationship differs depending on study group characteristics (Polier et al. 2012; Vloet and Herpertz-Dahlmann 2011). It has been proposed that in nonaggressive children, internalizing problems reduce the risk of future aggressive behavior while for aggressive children the risk of future aggressive behavior is increased (Olsson 2009; Sourander et al. 2007). In community and clinic-referred children and adolescents, severe conduct problems seem to be associated with increased internalizing problems, and comorbidity of conduct problems and internalizing problems is more frequent in clinical than in community samples (Polier et al. 2012). Gender-specific differences have also been reported, indicating that in girls with conduct problems the prevalence of comorbid anxiety is higher than in boys and is associated with more severe antisocial behavior (Lehto-Salo et al. 2009). In addition, specific anxiety constructs are related differently to the severity of conduct problems and CU traits (Olsson 2009). Frick and Ellis (1999) emphasized that it is important to differentiate between fear, possibly decreasing disruptive behavior, and anxiety as a negative affect that may be a result of the behavioral problems and subsequent stress. In a study with clinic-referred children, Frick et al. (1999) investigated the relationship of trait anxiety, conduct problems, and CU traits. Trait anxiety was positively correlated with conduct problems, and was uncorrelated or negatively correlated with CU traits. The authors concluded that trait anxiety in antisocial individuals might be a result of a higher rate of stressful life events that occur as a consequence of risk taking behavior. Moreover, the authors stated that the influence of CU traits might help to explain opposing findings regarding the relationship of anxiety symptoms and conduct problems. In summary, research on CD phenotypes indicates that both anxiety symptoms and CU traits are associated with a more severe pattern of conduct problems. In contrast to this, CU traits are negatively correlated with anxiety (Dolan and Rennie 2007; Frick et al. 1999; Pardini et al. 2007). Hence, the interrelation of CU traits, anxiety symptoms, and the severity of behavioral problems in CD patients seems to be complex and remains incompletely understood.

### Variants of Antisocial Youths: Merging CU Traits and Anxiety Symptoms

Karpman (1941, 1948) introduced a distinction of psychopathy variants<sup>1</sup> based on the presence or absence of anxiety, i.e., a primary and a secondary variant. According to this taxonomy, the two variants are phenotypically indistinguishable but differ with respect to the presence of anxiety and the motivational and etiological origins of antisocial and aggressive behavior. Recent studies applying model-based cluster analysis or latent-profile analysis in samples of adolescent offenders (Kimonis et al. 2011, 2012a, 2012b, 2013; Lee et al. 2010), clinic-referred (Kahn et al. 2013), and community samples of adolescents (Fanti et al. 2013), have identified similar variants based on levels of CU traits or psychopathic traits and anxiety symptoms. In a longitudinal study by Kimonis et al. (2011) with male adolescent offenders, subjects with the secondary variant reported more childhood abuse, depression, hostility, reactive aggression, psychosocial distress, and were more immature than subjects with the primary variant. A study investigating emotional processing in male adolescent offenders indicated that subjects with the secondary variant suffered more from distressing emotional stimuli, reported more maltreatment, anger problems and scored higher on negative emotionality compared to subjects with the primary variant and a comparison group (Kimonis et al. 2012a). In a similar investigation, Lee et al. (2010) also found clusters with altering levels of psychopathic traits and anxiety symptoms. Kimonis et al. (2012b) reported that incarcerated adolescents with the secondary variant had a higher frequency of substance abuse and were more likely to meet the diagnostic criteria for an alcohol or substance abuse disorder than those with the primary variant or offenders without psychopathic traits. In clinic-referred male and female adolescents, Kahn et al. (2013) found that individuals with elevated levels of CU traits, anxiety, and past trauma reported more physical and sexual abuse, scored higher on measures of impulsivity, behavioral inhibition, externalizing behavior, and aggression, than individuals with elevated CU traits and low levels of anxiety and trauma. Thus, recent interpretations of Karpman's taxonomy in samples of children and adolescents represent a promising approach to classify variants of antisocial youths based on the presence of CU traits and anxiety symptoms with distinct behavioral and psychosocial characteristics. Nonetheless, there are still several unresolved issues. First, most study populations in research investigating variants of aggressive and antisocial adolescents did not include subjects diagnosed with a psychiatric disorder according to the DSM. Hence, it is difficult to determine if similar variants are present in patients

<sup>1</sup> In line with Kimonis et al. (2011, 2012a) and Kahn et al. (2013), we use the term 'variants' instead of 'subtypes' since our aim was to identify prototypes instead of discrete categories of youths.



diagnosed with CD. Second, studies with aggressive and antisocial youths have focused on behavioral psychopathology associated with distinct variants. Based on earlier research reporting that CD is associated with a deviant pattern of personality development (Schmeck and Poustka 2001), we speculated that CD variants also show distinct profiles in personality dimensions. A widely used approach describing personality development is the psychobiological model by Cloninger et al. (1993). This conceptual model includes four temperament dimensions (i.e., novelty seeking, harm avoidance, reward dependence, and persistence) and three character dimensions (self-directedness, cooperativeness, and self-transcendence). The four temperament dimensions are conceptualized as early-developing biologically rooted behavioral tendencies that are relatively stable over time and situations and reflect the variability of behavioral and emotional responses in social interactions (Cloninger et al. 1991). The character dimensions indicate cognitive-intentional experienced attributes forming self-concepts, and describe differences in goals, values, and attitudes of an individual. Studies in CD patients showed that high novelty seeking and low harm avoidance are significantly correlated with externalizing behavior (Schmeck and Poustka 2001). Rettew et al. (2004) found that reward dependence and cooperativeness are lower in children with disruptive behavior disorders than in healthy controls or children with ADHD. In community children, harm avoidance was associated with internalizing problems, novelty seeking, self-transcendence, and reward dependence with externalizing problems (Copeland et al. 2004). To our knowledge, deviant personality development in different variants of antisocial adolescents has not previously been investigated. Third, the majority of studies that aimed to identify variants of aggressive and antisocial youths were conducted in male offenders. Although CD is more often diagnosed in boys than girls, the prevalence in girls is still between 1 % and 3 %, and psychosocial development seems to be severely impaired. It has been argued that sex differences represent true differences in the sociocultural experiences and biogenetic development for boys and girls. Given that adolescent girls are at higher risk for anxiety and mood disorders, we can expect a higher amount of overlap among such disorders in CD girls. Previous research has confirmed that anxiety and depression symptoms, as well as substance abuse, are more common in CD girls than in CD boys (Keenan et al. 1999); Waschbusch (2002) showed that girls generally are less likely to develop CD, but those who do, are more likely to show comorbid ADHD symptoms, leading to more severe psychopathology overall. Consequently, a gender paradox for adolescents with CD has been discussed (Keenan et al. 2010; Pajer et al. 2008; Stadler et al. 2013). That is, the gender with the lower prevalence for CD appears more at risk to show a comorbid disorder than the gender with the higher prevalence of the disorder. If the gender paradox also applies for CU traits, one

would expect CD girls to generally show lower levels of CU traits, but in presence of CU traits, to elicit a more severe pattern of behavioral problems and comorbid psychopathology. To our knowledge, only three studies have investigated the interrelation of CU traits, the presence of comorbid psychopathology, and the severity of aggressive and antisocial behavior in mixed gender populations (Fanti et al. 2013; Kahn et al. 2013) or in girls only (Pardini et al. 2012). Compared to boys, girls generally score lower on CU traits, show less severe antisocial behavior, are less often diagnosed with CD, and score higher on internalizing problems (Frick and Nigg 2012; Stadler et al. 2013). In a study attempting to distinguish between primary and secondary variants of psychopathy in a community sample of male and female adolescents, Fanti et al. (2013) found that there were more boys than girls in both variants. However, girls and boys exhibited similar phenotypic manifestations within identified variants. Overall, studies investigating gender-specific variants of CD are still scarce, and it remains unclear if a gender-specific affiliation to previously identified variants can be assumed for CD patients.

### Aim of the Present Study

Given the limitations of previous investigations, we aimed to answer the following research questions: (a) Are variants of antisocial youths with different levels of anxiety symptoms and CU traits described in previous investigations with adolescent offenders, clinic-referred, and community samples of youths also present in adolescents diagnosed with CD? (b) Do identified clusters of CD patients differ significantly with respect to behavioral characteristics, measures of psychopathology, and personality development that have previously been associated with aggressive and antisocial behavior in children and adolescents? (c) Do CD girls and boys differ on variables relevant for identification and description of variants, namely CU traits, anxiety symptoms, externalizing behavior, traumatic experiences, substance abuse, and personality development, and is there a gender-specific pattern of cluster affiliation?

To answer our first study question, we applied model-based cluster analysis to disaggregate CD variants, based on anxiety symptoms and CU traits. We expected to find CD variants with and without CU traits and hypothesized that CD patients with CU traits are further distinguishable based on the presence or absence of anxiety symptoms. For the second study question, we compared emerging clusters with respect to levels of anger and irritability, externalizing behavior, traumatic experiences, substance abuse, and personality development. We hypothesized that the combination of CU traits and anxiety symptoms in CD patients would be associated with more severe comorbid psychopathology. Further, we expected that in CD patients with elevated CU traits, personality

development in the temperament dimension ‘novelty seeking’, and the character dimension ‘cooperativeness’ would be deviant. We additionally hypothesized that CD patients with a combination of CU traits and anxiety symptoms would show deviant development in the temperament dimension ‘harm avoidance’ and the character dimension ‘self-directedness’. To answer our third study question we initially compared CD girls and boys, irrespective of cluster affiliation, on clustering and external validation measures and subsequently analyzed gender distribution in emerging clusters. In line with previous investigations, we hypothesized that CD girls would show higher levels of anxiety symptoms and lower levels of CU traits than CD boys. We expected CD girls to be overrepresented in the variant with anxiety symptoms and CU traits, and underrepresented in the variant with severe CU traits.

## Method

### Participants

The study sample was taken from the Swiss Model Project for Clarification and Goal-attainment in Child Welfare and Juvenile-Justice Institutions (MAZ; for details of the study see Schmid et al. 2013). Between 2007 and 2011, 592 adolescents living in 64 different socio-educational institutions in the German-, French-, and Italian-speaking parts of Switzerland participated in the survey. All institutions were accredited by the Swiss Ministry of Justice. Adolescents were admitted either by criminal law, civil law, or by voluntary placement. Voluntary or hospitalisation by civil law occurred if adolescents were no longer able to live in their family or environment of origin due to severe psychological or behavioral problems, or precarious life conditions. Adolescents’ return to their family or environment of origin was arranged if circumstances were evaluated as safe and acceptable. In case of hospitalisation by penal law adolescents were to be released upon completion of their sentence. To participate, adolescents had to have been placed for at least 1 month in the institution, prior to the conduct of the survey. To address the present research questions, we selected participants between the ages of 12 and 18 years that had been diagnosed with CD as the primary axis I diagnosis according to DSM-IV-TR (American Psychiatric Association 2000) and complete datasets on the clustering variables from the total MAZ sample. Exclusion criteria were low intelligence scores ( $IQ < 70$ ), assessed with the Culture Fair Intelligence Test (Weiss 2006) or the Raven Progressive Matrices (Raven et al. 2003), and comorbid psychotic disorders. This yielded a subsample of 158 participants (109 boys, 49 girls) for the present study. The mean age of the final sample was 15.61 ( $SD = 1.49$ ) and the mean IQ was 95.79 ( $SD 13.14$ ). Of the 158 adolescents 39 % ( $N = 62$ ) had CD without comorbid disorders and 61 % ( $N = 96$ ) had one or

more comorbid disorders. The most frequent comorbid disorder was ADHD (35 %,  $N = 56$ ), followed by substance related disorders (23 %,  $N = 36$ ), anxiety disorders (20 %,  $N = 32$ ) and mood disorders (12 %,  $N = 19$ ). Demographic characteristics and psychometric data were obtained from the MAZ data files.

### Procedure

In a first step, child welfare and juvenile-justice institutions in Switzerland were contacted by the MAZ study team. After institutions agreed to participate, social workers were introduced to the survey. During counseling appointments, adolescents and the person entitled to their custody were informed about the project. If written informed consent for the survey was given, participants and qualified caseworkers underwent the Kiddie Schedule for Affective Disorders and Schizophrenia–Present and Lifetime Version (Delmo et al. 2005) with trained professionals visiting the institution. Diagnostic information was integrated across informants after completion of the structured clinical interviews. Subsequently, computer-administered questionnaires were completed. For the other-report assessments, caseworkers that had been assigned as primary caretaker for the participating adolescent during and after the time in the institution were selected. The selected caseworkers had to know the adolescent for at least 1 month and additionally had to confirm that they knew the adolescent well enough and felt comfortable to validly answer the survey questions. Information disclosed by the youths remained confidential and feedback was made available to the caseworker only if the adolescent consented. Ethical approval for the study was obtained by the Institutional Review Board of the University of Basel, Switzerland.

### Measures

**CU Traits** To assess CU traits, we used the ‘callous, unemotional’ (CU) dimension of the Youth Psychopathic Traits Inventory (YPI; Andershed et al. 2002), a self-report measure for adolescents. The YPI CU dimension includes 20 items and comprises the subscales ‘callousness’, ‘unemotionality’, and ‘remorselessness’. Participants rate how much each item applies to them on a 4-point Likert scale (1 = ‘does not apply at all’, 2 = ‘does not apply well’, 3 = ‘applies fairly well’, 4 = ‘applies very well’). We administered a German version of the YPI. The original YPI was translated and back-translated by two bilingual mother-tongue speakers. Discrepancies were discussed and corrected with the original author. The German version of YPI was validated in a large German-speaking school sample ( $N = 840$ ) in Switzerland. Internal consistency and the three-factor structure were confirmed (Stadlin et al., Construct Validity and factor structure of the German Version of the Youth Psychopathic Traits Inventory (YPI) in a representative school sample, submitted). Means, SD, and internal

consistencies for the YPI CU dimension of the Swiss norm population are reported in the supplementary material (S1). For the current sample, the YPI CU dimension demonstrated good internal consistency ( $\alpha=0.80$ ).

*Anxiety Symptoms, Anger, Traumatic Experiences and Substance Abuse* We applied the Massachusetts Youth Screening Instrument Second Version (MAYSI-2; Grisso and Barnum 2006) to screen for anxiety symptoms, anger, traumatic experiences and substance abuse. The MAYSI-2 is a self-report screening tool developed to identify youths with mental health needs in juvenile-justice institutions. A number of investigations indicate adequate psychometric properties and internal consistency for the MAYSI-2 (for a review see Grisso et al. 2012). The questionnaire consists of 52 questions answered with ‘yes’ or ‘no’. The instrument contains seven scales: ‘alcohol/drug use’ (ADU), ‘angry-irritable’ (AI), ‘depressed-anxious’ (DA), ‘somatic complaints’ (SC), ‘suicide ideation’ (SI), ‘thought disturbance’ (TD), and ‘traumatic experiences’ (TE). For all scales except the TE scale, caution and warning cutoff points are available. We used the DA scale to assess symptoms of anxiety. The DA scale contains nine items assessing depressed and/or anxious feelings. The MAYSI-2 AI scale was used to measure feelings of preoccupying anger. The scale captures a general tendency of anger-related irritability, frustration, and stress. To assess traumatic life events we used the MAYSI-2 TE scale. The TE scale measures self-reported experience of potential traumatizing live events. The MAYSI-2 ADU scale was applied to capture frequency and pervasiveness of substance use. The MAYSI-2 DA ( $\alpha=0.75$ ), AI ( $\alpha=0.80$ ) and ADU ( $\alpha=0.88$ ) scales showed good, the TE scale ( $\alpha=0.62$ ) sufficient internal consistencies in the present study.

*Externalizing Behavior* To assess externalizing behavior via other-report, qualified caseworkers completed the Child Behavior Checklist/4–18 (CBCL, Achenbach 1991). We used the ‘aggressive behavior’ (AB), the ‘delinquent behavior’ (DB), and the ‘attention problems’ (AP) syndrome scales of the CBCL. The AB ( $\alpha=0.83$ ), the DA ( $\alpha=0.80$ ), and the AP ( $\alpha=0.70$ ) CBCL scales showed good internal consistencies.

*Temperament and Character* We applied the Junior Temperament and Character Inventory-Revised (JTCI 12–18 R; Goth and Schmeck 2009), a self-report measure to assess personality development. In line with Cloninger’s biopsychosocial model of personality, the JTCI 12–18 R assesses four temperament scales (‘novelty seeking’, ‘harm avoidance’, ‘reward dependence’, ‘persistence’) and three character scales (‘self-directedness’, ‘cooperativeness’, ‘self-transcendence’). The questionnaire contains 103 items. For the German JTCI 12–18, good scale reliabilities (alphas between 0.79 and 0.85) and excellent construct validity have been shown (Schmeck et al. 2001). We used the temperament dimensions ‘novelty seeking’

(NS), and ‘harm avoidance’ (HA) and the character dimension ‘self-directedness’ (SD), and ‘cooperativeness’ (CO). Internal consistencies for the JTCI dimensions NS ( $\alpha=0.79$ ), HA ( $\alpha=0.80$ ), CO ( $\alpha=0.85$ ), and SD ( $\alpha=0.83$ ) in the present study were good. For the interpretation of the JTCI 12–18 R temperament and character dimensions, cutoff scores from a norm population are available (Goth and Schmeck 2009).

#### Statistical Analyses

To address the primary study aim to identify variants of adolescents with CD, we performed the TwoStep cluster analysis (CA) procedure using IBM-SPSS software package, Version 19 (IBM SPSS Inc., Chicago, USA). This procedure is a scalable CA algorithm developed to automatically find the optimal number of clusters in large datasets. In a first step, the procedure calculates the Bayesian information criterion (BIC) for each number of clusters in a given range. In a second step, a model-based hierarchical technique refines the initial number by estimating the ratio of distance between clusters. We used the YPI CU dimension and the MAYSI-2 AD scale as clustering variables. We interpreted means of each cluster on the MAYSI-2 AD scale according to published cutoff points (MAYSI-2; Grisso and Barnum 2006). Because no established cutoff scores are available for the YPI, we compared scores on the YPI CU for each cluster with an age-matched Swiss school sample ( $N=840$ ; 480 boys, 360 girls) using independent samples *t*-test. In line with Cauffman et al. (2009), we additionally interpreted mean scores of identified clusters that were at least one SD above the mean of the YPI norm sample as elevated. Because of the high prevalence of comorbid disorders in the sample, we used chi-square analysis to test if identified clusters differed according to the presence of comorbid disorders. Results are available in the supplementary material (S2). We used univariate analyses of variance (ANOVAs) to compare resulting clusters on clustering measures, and for post-hoc multiple comparisons between clusters we applied the Tukey HSD test. To compare identified clusters on theoretical, empirical, and clinically relevant dimensions we conducted univariate ANOVAs. We used the Tukey HSD test for multiple comparisons between clusters. We additionally performed bivariate analysis for age, gender and attention problems with all clustering and external validation measures. Results are reported in the supplementary material (S3). If bivariate analysis indicated significant correlations of age, gender, or attention problems with a clustering or an external validation measure, these variables were included as covariates in univariate analysis of covariance (ANOCVAs) for cluster comparisons on that measure. Because results of group comparisons remained unchanged after inclusion of the covariates, we only report ANOVA results. For the gender-specific analysis, we used independent samples *t*-tests to compare CD girls and boys on clustering and external

validation measures irrespective of cluster affiliation. Levene's test confirmed homogeneity of variance for all whole-group gender comparisons, with the exception for the MAYIS-2 AI and JTICI 12–18 R CO dimensions. Reported results for these dimensions are adjusted for inequality of variances. We used chi-square analysis to test gender distribution in identified clusters.

## Results

### Cluster Analysis

The two-step cluster procedure indicated a three-cluster solution (Cluster I,  $N=77$ ; Cluster II,  $N=31$ ; Cluster III,  $N=50$ ). The algorithm judged the three-cluster solution to be the best fit for our data, with a BIC change of  $-19.94$  between the two- and three-cluster solutions and a ratio of distance measure of 1.81. The three-cluster solution represented a better fit than the four-cluster solution with a BIC change between the three- and four-cluster solution of  $-1.92$  and a ratio of distance measure of 1.53. The correlation between the MAYSI-2 DA scale and YPI CU dimension was low (CU:  $r=0.14$ ,  $p=0.09$ ). There were no significant differences between clusters on age or IQ. Clusters differed significantly on the MAYSI-2 DA scale ( $F(2,155)=131.98$ ,  $p<0.001$ ;  $\eta^2=0.63$ ) and the YPI CU dimension ( $F(2,155)=99.85$ ,  $p<0.001$ ;  $\eta^2=0.56$ ). Post-hoc comparisons revealed significant differences for all between-cluster comparisons on the MAYSI-2 DA scale and the YPI CU dimension. Table 1 shows the mean scores for clustering and external validation measures for the total study sample and each CD variant, and lists results of post-hoc group comparisons. On the MAYSI-2 DA scale Cluster II had a mean score in the warning range, while Cluster I and III had a mean score in the normal range. For the YPI CU dimension, independent samples t-tests revealed that Cluster II ( $t(869)=2.92$ ,  $p<0.01$ ) and Cluster III ( $t(888)=12.61$ ,  $p<0.001$ ) had significant higher scores than the Swiss High School norm sample. Cluster I did not differ from the Swiss High-School sample. Cluster III had a mean score more than 1 SD above the mean of the High School sample. According to the psychometric profile on the clustering variables, Cluster I designated a 'CD only variant' (CD only), Cluster II a 'CD variant with moderate CU traits and anxiety symptoms' (CD CU<sup>+</sup>ANX<sup>+</sup>), and Cluster III a 'CD variant with severe CU traits' (CD CU<sup>++</sup>). These labels are further used to refer to the respective clusters in this manuscript.

### Validating and Comparing Identified Variants

On the MAYSI-2 AI scale, variants differed significantly ( $F(2,155)=33.68$ ,  $p<0.001$ ;  $\eta^2=0.30$ ) and post-hoc tests

confirmed that all between-variants comparisons were significant. The score of the CD CU<sup>+</sup>ANX<sup>+</sup> variant on this scale was in the warning range, the score of the CD CU<sup>++</sup> variant was in the caution range and the score of the CD only variant was in the normal range. Figure 1 shows the z-scores on clustering and external validation measures for identified variants. To analyze if variants differed on self-reported traumatic experiences, we compared scores on the MAYSI-2 TE scale. ANOVA results indicated significant differences between variants ( $F(2,155)=15.41$ ,  $p<0.001$ ;  $\eta^2=0.17$ ). Post-hoc tests confirmed significant differences between the CD CU<sup>+</sup>ANX<sup>+</sup> variant and the two other variants. The CD CU<sup>+</sup>ANX<sup>+</sup> variant scored in the caution range of the MAYSI-2 TE. The two other clusters had scores in the normal range. We used the MAYSI-2 ADU scale to analyze self-reported past substance use. ANOVA results revealed a significant difference ( $F(2,155)=8.52$ ,  $p<0.001$ ;  $\eta^2=0.10$ ) between variants. Post-hoc comparisons showed significant differences between the CD CU<sup>+</sup>ANX<sup>+</sup>, and the CD only variant. The CD CU<sup>+</sup>ANX<sup>+</sup> and the CD CU<sup>++</sup> variant had a mean score in the caution range, while the mean score for the CD only variant was in the normal range.

On the CBCL AB and the DB syndrome scales, the CD CU<sup>+</sup>ANX<sup>+</sup> variant had a T-score in the clinical range (T-score  $\geq 70$ ), while the CD only and the CD CU<sup>++</sup> variants scored in the borderline clinical range (T-score  $\geq 65$ ). On the CBCL AP syndrome scale the CD CU<sup>+</sup>ANX<sup>+</sup> variant had a T-score in the borderline clinical range (T-score  $\geq 65$ ), the two other variants scored in the normal range. Variants differed significantly on the CBCL AB ( $F(2,151)=3.45$ ,  $p=0.034$ ;  $\eta^2=0.04$ ), DB ( $F(2,151)=7.61$ ,  $p<0.01$ ;  $\eta^2=0.09$ ), and AP ( $F(2,151)=3.31$ ,  $p=0.034$ ;  $\eta^2=0.04$ ) syndrome scales. Post-hoc tests showed that the CD CU<sup>+</sup>ANX<sup>+</sup> variant had significantly higher scores than the CD only variant on the CBCL AB and the DB syndrome scales. Compared to the CD CU<sup>++</sup> variant, the CD CU<sup>+</sup>ANX<sup>+</sup> variant scored significantly higher on the CBCL DB and the AP syndrome scales.

Last, we tested if variants differed on the JTICI temperament scales NS and HA as well as the JTICI character scales SD and CO. In line with our hypothesis, results showed significant differences between variants in both temperament dimensions [NS: ( $F(2,155)=8.60$ ,  $p<0.001$ ;  $\eta^2=0.10$ ); HA: ( $F(2,155)=10.04$ ,  $p<0.001$ ;  $\eta^2=0.23$ )]. The CD CU<sup>+</sup>ANX<sup>+</sup> and the CD CU<sup>++</sup> variants had higher T-scores in the NS dimension than the CD only variant, and post-hoc comparisons confirmed significant differences between the CD only variant and both other variants. In the HA dimension, post-hoc comparisons indicated that the CD CU<sup>+</sup>ANX<sup>+</sup> variant scored significantly higher than the other two variants. CD Variants also differed significantly on both character dimensions [SD: ( $F(2,155)=13.08$ ,  $p<0.001$ ;  $\eta^2=0.14$ ); CO: ( $F(2,155)=19.79$ ,  $p<0.001$ ;  $\eta^2=0.20$ )] and post-hoc comparisons

**Table 1** Mean scores for clustering and external validation measures and results of group comparisons for identified variants

	total sample (n=158)		CD only (n=77)		CD CU <sup>+</sup> ANX <sup>+</sup> (n=31)		CD CU <sup>++</sup> (n=50)		CD only vs. CD CU <sup>+</sup> ANX <sup>+</sup>	CD only vs. CD CU <sup>++</sup>	CD only vs. CD CU <sup>++</sup>
	M	(SD)	M	(SD)	M	(SD)	M	(SD)	p	p	p
<i>YPI</i>											
callous unemotional	11.36	(2.51)	9.75	(1.48)	11.07	(1.74)	14.03	(1.89)	<0.01	<0.001	<0.001
<i>MAYSI-2</i>											
depressed-anxious	2.99	(2.35)	1.62	(1.41)	6.58 <sup>1</sup>	(1.31)	2.86	(1.54)	<0.001	<0.001	<0.001
angry-irritable	5.13	(2.71)	3.79	(2.48)	7.68 <sup>2</sup>	(1.30)	5.60 <sup>2</sup>	(2.41)	<0.001	<0.001	<0.001
Traumatic experiences	2.57	(1.47)	2.16	(1.44)	3.74 <sup>2</sup>	(1.00)	2.48	(1.39)	<0.001	ns	<0.001
alcohol/ drug use	5.13	(2.71)	2.87	(2.70)	5.23 <sup>2</sup>	(2.85)	4.04 <sup>2</sup>	(2.84)	<0.001	ns	ns
<i>CBCL</i>											
aggressive behavior	68.00	(10.75)	66.20 <sup>3</sup>	(10.89)	72.20 <sup>4</sup>	(9.64)	68.16 <sup>3</sup>	(10.67)	=0.026	ns	ns
delinquent behavior	67.71	(8.44)	65.44 <sup>3</sup>	(8.69)	73.00 <sup>4</sup>	(8.01)	67.94 <sup>3</sup>	(6.79)	<0.001	ns	=0.019
attention problems	64.95	(8.00)	64.37	(7.81)	68.23 <sup>3</sup>	(8.36)	63.81	(7.68)	ns	ns	=0.044
<i>JTCI</i>											
novelty seeking	54.56	(9.88)	51.36	(10.34)	57.61	(7.72)	57.58	(8.90)	<0.01	<0.01	ns
harm avoidance	49.27	(9.62)	47.36	(9.24)	55.81	(7.46)	48.16	(9.79)	<0.001	ns	<0.01
self-directedness	47.37	(10.53)	51.26	(10.18)	41.52	(9.61)	45.02	(9.32)	<0.001	<0.01	ns
cooperativeness	46.20	(11.01)	50.23	(9.70)	47.71	(8.10)	39.06 <sup>5</sup>	(10.74)	ns	<0.001	<0.01

p values refer to post hoc comparisons based on Tukey HSD tests for identified variants. *CD only* CD only variant; *CD CU<sup>+</sup>ANX<sup>+</sup>* CD variant with moderate. CU traits and anxiety symptoms; *CD CU<sup>++</sup>* CD variant with severe CU traits, *YPI* Youth Psychopathic Traits Inventory, mean scores, *CBCL* Child Behavior Checklist, T-scores; *MAYSI-2* Massachusetts Youth Screening Instrument-Second Version, raw scores; *JTCI* Junior Temperament and Character Inventory-Revised, T-scores. <sup>1</sup> MAYSI-2 scores in the warning range; <sup>2</sup> MAYSI-2 scores in the caution range; <sup>3</sup> CBCL T-score above cutoff for borderline clinical relevance (T-score ≥65); <sup>4</sup> CBCL T-score above cutoff for clinical relevance (T-score ≥70); <sup>5</sup> JTCI T-score below average of norm population (T-score <40)

indicated that in the SD dimension the CD only variant scored significantly higher than both other variants. In the CO dimension, significant differences between all variants in post-hoc comparisons were present. Compared to the norm population, the CD CU<sup>++</sup> variant obtained a T-score below average (T ≤40) in the CO dimension the. Scores on all the other JTCI dimensions for each of the CD variants were in the normal range.

**Gender-Specific Analysis**

To investigate gender-specific issues, we first compared scores of CD girls and boys on clustering and external validation measures, irrespective of cluster affiliation. Figure 2 indicates mean z-scores on clustering and external validation measures for CD girls and CD boys. Results of the independent samples t-test indicated that CD girls scored significantly higher on the MAYSI-2 DA (t (156)=-4.47, p<0.001), ADU (t (156)=-3.12, p=0.046), AI (t (156)=-3.12, p<0.01) and the CBCL DB (t (152)=5.38, p<0.001), and AP (t (152)=2.40, p=0.018) scales. Girls had also significantly higher scores in the JTCI 12-18 R CO

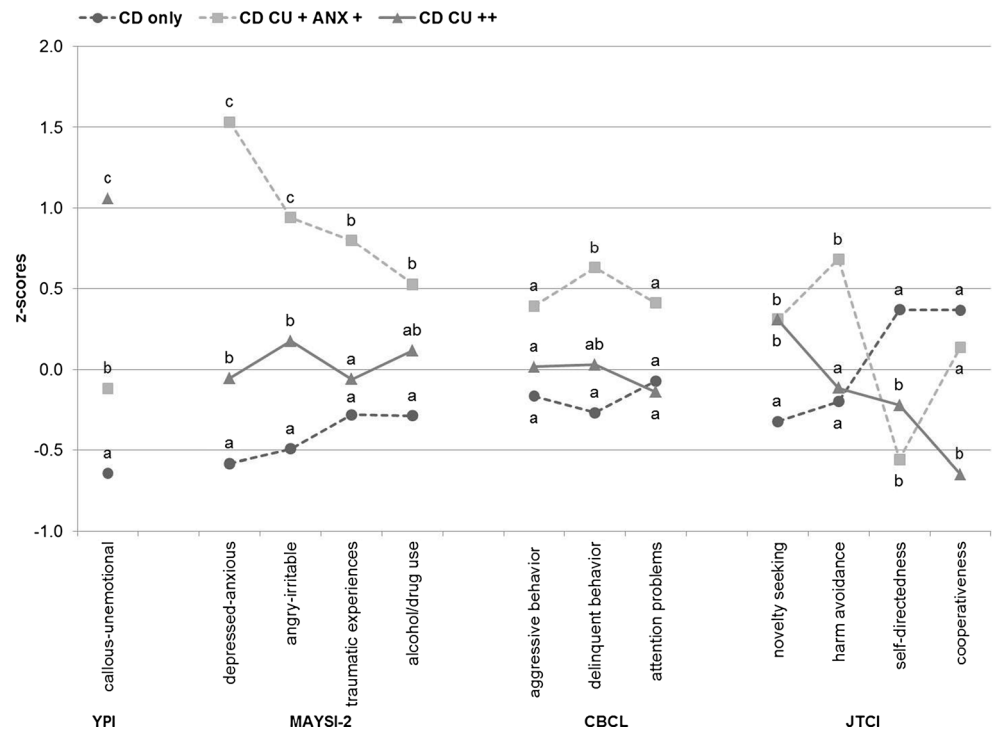
(t (156)=-2.09, p=0.038) and HA (t (156)=-4.40, p<0.001) dimensions. Boys achieved higher values on the YPI CU (t (156)=4.04, p<0.001) and JTCI 12-18 R SD (t (156)=2.13, p=0.034) dimensions. No significant gender differences were present on the MAYSI-2 TE, CBCL AB, and the JTCI 12-18 R NS scales.

Subsequently, we tested if gender distribution differed between variants. Of the 49 CD girls, 51.0 % (N=25) were in the CD only, 36.7 % (N=18) in the CD CU<sup>+</sup>ANX<sup>+</sup>, and 12.2 % (N=6) in the CU<sup>++</sup> variant. Of the 109 CD boys, 47.7 % (N=52) were in the CD only, 11.9 % (N=13) in the CD CU<sup>+</sup>ANX<sup>+</sup>, and 40.4 % (N=44) in the CU<sup>++</sup> variant. Gender distribution between clusters differed significantly (χ<sup>2</sup>=19.13, N=158, p<0.001). As expected, girls were overrepresented in the CD CU<sup>+</sup>ANX<sup>+</sup> variant.

**Discussion**

The current study aimed to distinguish between variants of adolescents with CD based on the presence of CU traits and

**Fig. 1** Mean z-scores on clustering and external validation measures for identified variants. Subscripts (a, b, c) denote significant differences between variants in post-hoc tests ( $p < 0.05$ ). Order of the letters indicates severity of psychopathology. *CD only*= CD only variant; *CD CU<sup>+</sup> ANX<sup>+</sup>*= CD variant with moderate CU traits and anxiety symptoms; *CD CU<sup>++</sup>*=CD variant with severe CU traits; *YPI*=Youth Psychopathic Traits Inventory; *MAYSI-2*=Massachusetts Youth Screening Instrument-Second Version; *CBCL*=Child Behavior Checklist 4/18; *JTCI*=Junior Temperament and Character Inventory-Revised

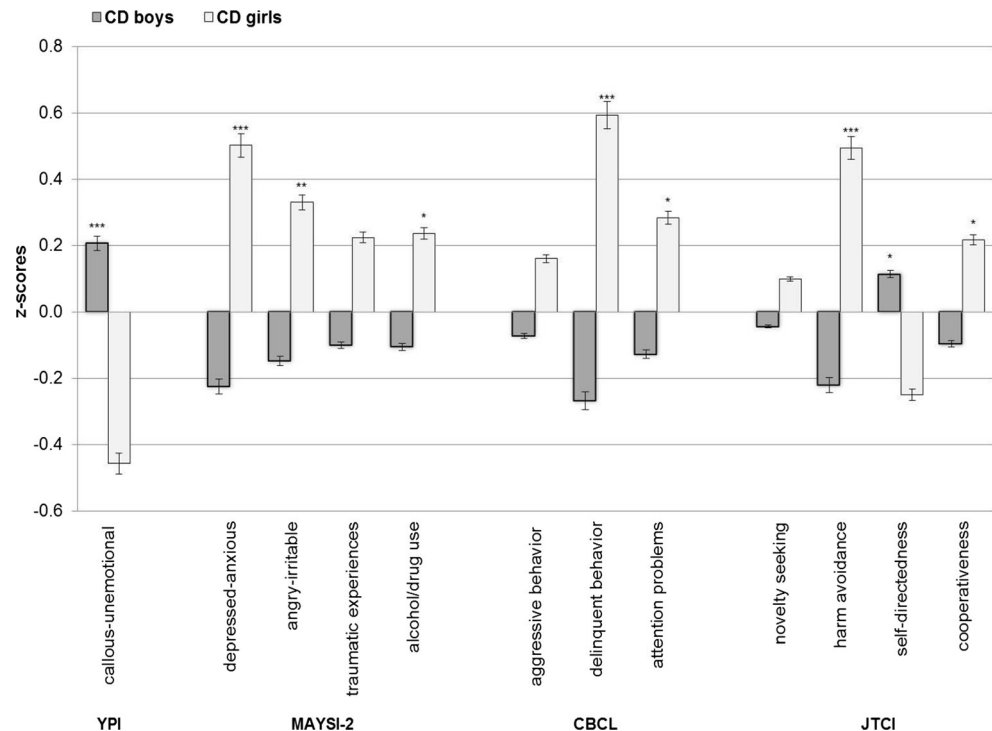


anxiety symptoms in adolescents living in child-welfare and juvenile-justice institutions. We identified three CD variants with distinct patterns of psychopathology and variable deviations of personality development. The CD variant with moderate CU traits and elevated anxiety symptoms showed the most severe psychopathology. Irrespective of cluster

affiliation, gender-specific analysis revealed that CD girls had more severe behavioral problems while CD boys had higher levels of CU traits. Consequently, the proportion of girls and boys in identified variants differed substantially.

Before further interpreting our results, we outline several limitations of the present study. First, we quantified the extent

**Fig. 2** Mean z-scores on clustering and external validation measures for CD girls and CD boys. Asterisks indicate significant differences in independent samples t-tests: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ . *YPI*=Youth Psychopathic Traits Inventory; *MAYSI-2*=Massachusetts Youth Screening Instrument-Second Version; *CBCL*=Child Behavior Checklist 4/18; *JTCI*=Junior Temperament and Character Inventory-Revised



of CU traits using the CU dimension of a self-report questionnaire. It is recommended to use multiple sources of information to assess CU traits. Multi-method assessment is considered important because insufficient agreement between different sources of information has been reported (Fink et al. 2012). Nonetheless, Fink et al. (2012) showed that self-report is more reliable than nonself-report for related constructs. It also needs to be considered that although the CD variant with moderate CU traits and anxiety symptoms scored significantly higher in the YPI CU dimension than the CD only variant and the Swiss norm sample, the mean score was not more than 1 SD above the mean of the norm sample. Second, we used the DA subscale of the MAYSI-2 to assess anxiety symptoms. The MAYSI-2 is a screening instrument developed to identify youths with mental health needs. A high score on the scale does not necessarily indicate that anxiety symptoms can be interpreted as pathological trait anxiety. In our study, a high score on the MAYSI-2 DA scale merely indicated that adolescents exhibited symptoms of anxiety and/or depression at the time of testing. Higher scores might have been caused by long-standing depression or anxiety problems as was assumed in our study, but similar elevations might also be seen as a reaction to an acute life stressor, for example having been arrested or placed in an institution. To confirm and validate the results of the present study, broader and more sophisticated measures of anxiety should be applied. This seems especially relevant since we used the MAYSI-2 DA scale as a clustering variable. Third, several additional aspects concerning the study population should be taken into account. Generalization of the present results to other psychiatric populations is questionable because adolescents living in child-welfare and juvenile-justice institutions are characterized by a unique socio-demographic background often with reduced access to, and use of mental health care (for a review see Fazel et al. 2008). Further, a high prevalence of comorbid mental health problems in antisocial adolescents in juvenile detention centers has previously been indicated (Cauffman 2004). It is also important to note that institutions differed in terms of psychological treatment and educational consulting offered. Moreover, adolescents were not always assessed directly after entering the institution. Thus, time points of assessment differed between adolescents. Nonetheless, we believe that the effects of these confounds are only of minor concern for the interpretation of our results, because only adolescents who reached thresholds for a DSM IV CD diagnosis at the time of testing were included in the study. We also did not control for a possible selection bias using clinical diagnosis, but used CBCL profiles to compare non-participating adolescents with those adolescents that were involved in the study. Despite our effort to investigate equally large groups of CD girls and boys, the proportion of girls in the present sample was smaller. Fourth, more than half of the adolescents included in the study had one or more comorbid disorder. Although overall there

were no differences in the presence or the type of the comorbid disorders between identified variants - with the expected exception of anxiety disorders - this should be taken into account when interpreting our findings. Waschbusch (2002) emphasized that the co-occurrence of CD and ADHD symptoms leads to more severe conduct problems than CD or ADHD symptoms alone. We therefore included attention problems as a covariate in comparisons between variants, if attention problems were related to a measure of interest. Results remained unchanged and thus we conclude that in the present study cluster differences were not substantially driven by comorbid attention problems. The developmental context also needs to be considered when interpreting differences between subgroups with disruptive behavior results (Waschbusch 2002; Connor et al. 2007). It is possible that identified variants differed in the age of onset of their conduct problems. Because diagnostic interviews were not conducted with the parents, we were unfortunately not able to distinguish between childhood and adolescent onset of CD. Fifth, the data of the present study are cross-sectional and therefore, we cannot draw any conclusions on the temporal stability of identified variants throughout adolescents. Bearing these limitations in mind, we interpret our results as follows.

In line with our hypothesis, we identified two variants of CD patients with CU traits and altering levels of anxiety symptoms, and a third variant that was characterized by conduct problems only. CU traits refer to a set of characteristics similar to the affective features of adult psychopathy and represent a downward extension of the concept for children and adolescents (Frick and White 2008; Hart and Hare 1996). The two CD variants with CU traits identified in the present study elicit psychopathologies similar to the primary and secondary variants of psychopathy introduced by Karpman (1941; 1948). The CD only variant was numerically the largest cluster with the least severe psychopathologies. It has previously been reported that CU traits are negatively correlated with anxiety and neuroticism (Frick and White 2008). As an important finding, our data show that the presence of CU traits does not necessarily indicate the absence of anxiety symptoms in CD patients and may even suggest that the combination of anxiety and CU traits is associated with the most severe psychopathologies in CD. Interestingly, it has also been reported that the negative correlation of CU traits and anxiety symptoms is found only after controlling for conduct problems (Frick et al. 1999; Lynam et al. 2005). One of the strengths of the present study is that we diagnosed adolescents according to the DSM-IV, rather than using a dimensional approach to assess psychopathology. This method maximizes the relevance of our investigation to clinicians who generally work within a diagnostic framework. Moreover, the specifier for limited prosocial emotions that was included in the DSM-5 diagnostic criteria for CD designates CD patients that are characterized by a significant lack of

remorse or guilt, show a callous lack of empathy, are unconcerned about their performance, and elicit shallow or deficient affect. Of notice, the YPI CU dimension comprises items to assess callousness, unemotionality, and remorselessness and thus captures a large proportion of the indicators of the DSM-5 specifier for limited prosocial emotions in CD patients. Although no items to assess unconcern about performance in school or at work are included, the two variants with CU traits may represent groups of CD patients that would qualify for the specifier, with differences in the severity of the specifier, and differences in the presence of comorbid anxiety symptoms. Clearly, the validity of the YPI CU dimension to assess the characteristics of the CD specifier for limited prosocial emotions needs further evaluation and should be regarded as a first tentative approach towards an assessment of the specifier for scientific purposes.

Our second aim was to validate identified variants with respect to behavioral characteristics, psychopathology, and measures of personality development. The CD variant with moderate CU traits and prominent anxiety symptoms exhibited the most severe externalizing behavior and anger symptomatology in our study. This finding is somewhat contradictory to a number of studies indicating that particularly the group of adolescents with the most marked CU traits shows the most severe and stable pattern of aggressive behavior (Frick and Nigg 2012; Moffitt et al. 2008; Rowe et al. 2010; Viding et al. 2012). Nonetheless, the present findings are in line with the results of a study by Humayun et al. (2014), and provide further evidence for the assumption that it is the combination of CU traits and anxiety that is associated with the most severe aggressive and antisocial behavior, rather than CU traits alone. In addition, our results showed that the temperament dimension novelty seeking was more pronounced in both variants with CU traits than in the CD only variant. Further, a higher frequency and pervasiveness of alcohol and drug use was present in both CD variants with elevated CU traits, but not in the CD only variant. Frick et al. (1999) proposed that anxiety in antisocial individuals might result from higher rates of stressful life events following a tendency for risk taking behavior. In line with others (Poythress et al. 2010), the CD variant with moderate CU traits and anxiety symptoms in the present study did report traumatizing life events in the caution range. Hence, for the CD variant with CU traits and anxiety symptoms, the presence of anxiety symptoms might represent a consequence of the risk taking behavior. One could speculate that for the CD variant with severe CU traits without symptoms of anxiety, risk taking and antisocial behavior have led to positive outcomes (e.g. enhanced peer status, monetary gain) and consequently have reinforced the development and manifestation of CU traits. Elsewhere it has been discussed that CU traits emerge during childhood in

reaction to a disadvantageous social environment (Kimonis et al. 2013). Thus, for the CD variant with CU traits and anxiety symptoms, the development of CU traits can also be interpreted as an adaptive mechanism to protect the individual from possible emotional or physical harm. However, developmental pathways of CU traits are still under debate. Other studies have emphasized heritability and the interaction of reinforcement learning with genetic factors during socialization (for a review see Frick et al. 2014). Future longitudinal studies are requested to better understand the developmental interrelation of conduct problems, anxiety, temperament, and CU traits. We also found other differences in personality development between CD variants. The CD variant with moderate CU traits and anxiety symptoms scored higher in the harm avoidance dimension. This is in line with a study reporting higher harm avoidance in subjects with disruptive behavior disorders and comorbid internalizing problems (Rettew et al. 2004). Thus, CD patients with moderate CU traits and marked anxiety symptoms were characterized by a specific combination of behavioral activation and inhibition that has been associated with higher levels of neuroticism (Goth and Schmeck 2009). The character dimension cooperativeness represents the concept of how well an individual gets along with the needs and qualities of others, and self-directedness describes how well a person gets along with his or her own needs and qualities. CD patients with severe CU traits exhibited the lowest scores on the character dimension cooperativeness and lower scores on the self-directedness dimension than the CD only variant. The clinical significance of this pattern has been described as a dysfunctional, self-centered personality, and lower scores on both these dimensions are interpreted as a sign of immature character development that has been associated with personality disorders in adults (Svrakic et al. 2002). Adding valuable information to symptom-oriented characterization in CD, the diagnostic potential of the assessment of temperament and character according to the personality concept of Cloninger using the JTCI was supported by the present results.

Our third aim was to address gender-specific questions related to the CD variants. With the inclusion of a large proportion of girls with CD, our study makes an important contribution to the existing literature. Because gender-associated differences and gender-specific phenotypes of CD are still under debate, we aimed to compare CD girls and boys in the present sample. Our results indicated that CD girls, irrespective of cluster affiliation, had more severe behavioral problems, higher levels of anxiety, and lower scores of CU traits than CD boys. Girls were over-represented in the CD variant with moderate CU traits and anxiety symptoms, while there were more boys in the CD variant with severe CU traits. This result is in line with epidemiological research indicating



that girls with CU traits do not necessarily show lower levels of anxiety (Essau et al. 2006), and that in girls anxiety symptoms are associated with more severe violent behavior (Wasserman et al. 2005). It has been outlined that CD girls with CU traits show more severe aggressive and antisocial behavior and more comorbid substance abuse compared to CD boys (Disney et al. 1999; Stadler et al. 2013). We also found the most severe disruptive behavior symptoms and highest levels of substance abuse in the CD variant with moderate CU traits and anxiety symptoms in this study. Although only one third of our study population was female, girls made up more than half of the adolescents in this cluster, while in the CD variant with severe CU traits most adolescents were boys. Overall, our results do not point towards the existence of a gender-specific subtype, but support the assumption of a CD gender paradox (Wasserman et al. 2005): Girls are less often affected by CD, but in case of a CD diagnosis, the severity of behavioral problems and rates of comorbid symptoms are higher, and therefore, developmental prognosis is less positive than in CD boys.

#### Practical Implications and Future Directions

Our results support previously formulated implications that specific treatment approaches are needed for CD variants. For CD patients with comorbid anxiety problems, evidence-based cognitive behavioral treatments (Grasman and Stadler 2011; Silverman et al. 2008) may be most effective. Interventions for CD patients with severe CU traits should focus on adequate emotional and empathic responding. It has been reported that instructions to focus on the eye region reduce deficits in the perception of other people's distress in children with CU traits (Dadds et al. 2006). Recent research has also indicated that the processing of distressing emotional stimulation seems to affect cognitive control in variants of CD patients differently (Euler et al. 2014) and should be considered in clinical practice. Despite these important implications, treatment of adolescents with CU traits is often difficult, because motivation and insight for the necessity of treatment are absent. Others have argued that the treatment of comorbid problems in conduct disorder children might solve this issue (Connor et al. 2007). Given the higher rates of comorbid anxiety symptoms, trauma and substance abuse in the CD variant with CU traits and pronounced anxiety symptoms, focusing on these comorbidities might also enhance compliance in this variant, even in the presence of CU traits. We conclude that improved understanding of the CD symptomatology requires consideration of CU traits as well as the presence of anxiety symptoms. Future longitudinal studies need to investigate possible developmental pathways of identified variants and test additional constructs differentiating between CD variants.

**Acknowledgments** The authors thank the MAZ research team and the MAZ evaluation team for the efforts made during data collection.

**Conflict of Interest** The authors declare that they have no conflict of interest.

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