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Examination of the importance of age of onset, callous-unemotional traits and anger dysregulation in youths with antisocial behaviors

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Abstract

Background: Age of onset, callous-unemotional (CU) traits and anger dysregulation have separately been proposed as relevant factors in explaining the heterogeneity of antisocial behaviour (ASB). Taking a dimensional perspective, this study examined the specific contributions and the mutual influences (i.e., interactions) of these three characteristics on specific dimensions of ASB (i.e., criminal behaviours and externalizing symptoms). **Method:** Assessments were conducted on 536 youths from institutions with the Youth Psychopathic Traits Inventory (CU traits), the Massachusetts Youth Screening Instrument - Second Version (anger dysregulation), the Criminology Questionnaire (criminal behaviours) and the Child Behavior Checklist (externalizing symptoms), rated by both the youths and their carers. **Results:** Using Bayes as estimators, the results revealed that the number and frequency of crimes (and, more specifically, damage to property, property offenses and media crimes) were explained by a specific contribution of each factor (age of onset, CU traits and anger dysregulation). Additionally, the interactions between age of onset and CU traits or anger dysregulation were relevant predictors of some types of crimes (i.e., damage to property, property offences and media crimes). Furthermore, when rated by youths, externalizing symptoms were explained by CU traits and anger dysregulation. However, when rated by the carer, anger dysregulation was more important in explaining externalizing symptoms. **Conclusion:** This study highlights the importance of considering these factors altogether and the value of using a dimensional perspective when examining the structure of ASB in youths. Consequently, future classifications should take into account the mutual account of these characteristics, which were previously studied separately.

Keywords: *antisocial behaviour; youths; age of onset; callous-unemotional traits; anger dysregulation*

Introduction

Antisocial behaviour (ASB) has been extensively studied over the last few decades because of its high societal costs [1-3]. Understanding the structure and characteristics of ASB is important for preventing the development of severe ASB (i.e., criminal behaviours), externalizing symptoms and psychiatric disorders, such as conduct disorders (CD) or oppositional defiant disorder (ODD) [e.g., 4, 5, 6].

However, heterogeneity has been observed in the profile of youths with ASB. Substantial empirical evidence has led researchers to propose three characteristics for understanding these differences among individuals with ASB (especially severity and resistance to treatment) [e.g., 7, 8-11]: (1) the age of ASB onset; (2) the presence of callous-unemotional (CU) traits; and (3) the presence of severe problems in anger regulation. It is noteworthy that the first two factors have been identified as extremely relevant [e.g., 9, 12, 13] and were included in the *Diagnostic and Statistical Manual* [DSM-IV for age of onset and DSM-V for CU traits; 14] as specifiers of conduct disorder (CD).

Age of onset

Age of onset has been used to identify two subtypes of ASB: childhood onset and adolescent onset [e.g., 12, 15]. It is generally acknowledged that youths with childhood-onset ASB present a more severe, aggressive and chronic pattern of behaviour than youths with adolescent-onset ASB [16-18]. Nevertheless, to understand the trajectories and characteristics of youths with ASB, assessing age of onset is not sufficient, as a considerable heterogeneity remains unaccounted for within both subtypes [7, 15].

CU traits

CU traits have been suggested as another main characteristic of ASB [9, 19, 20]. CU traits refer to specific affective (no guilt, flat affect) and interpersonal (lack of empathy, callous use

of others) patterns of behaviour. More particularly, an important factor identified in children with CU traits is the temperamental fear [9], which is consistently linked to the development of severe ASB and violence [e.g., 21].

Anger dysregulation

A third important characteristic proposed in understanding the heterogeneity of ASB is the dysregulation of anger [9]. Previous research has proposed that children with ASB exhibit a high temperamental negative emotionality [22, 23] and that problems in anger regulation are particularly important in the development of ASB [9]. For instance, high temperamental anger in children was found to be related to aggression and conduct problems later in life [24-26]. A recent model suggested a relationship between the DSM “anger/irritability” component in oppositional defiant disorder and the component of anger dysregulation in conduct disorder [e.g., 27], highlighting the importance of this aspect in ASB in general and supporting the idea of considering anger dysregulation also as a specifier for ASB.

Overlap between ASB characteristics

Although recent studies have highlighted early age of onset [e.g., 28], CU traits [e.g., 10], and anger dysregulation [e.g., 9] as being important factors related to more severe forms of ASB, few studies have taken into account all of these factors together (i.e., measured their respective weight), as well as their potential interactions, in explaining the severity of ASB. Indeed, it is possible that one of these factors explains a larger part of serious ASB, when other factors are controlled. Such a finding would help in the design of more specific interventions focused on the most important factor. Furthermore, it is thought that interactions among these three factors may result in a poorer long-term prognosis or an increased risk for persistent ASB trajectories [29], due to the cumulative effects of negative factors. Studies investigating associations between ASB specifiers have shown that, for example, high CU

traits are typically related to early-onset subtypes of ASB [e.g., 30]. A recent 13-year longitudinal study suggested different developmental pathways linking the early onset of ASB to CU, showing the association between internalizing behaviour and exposure to trauma in infancy [31]. Moreover, an overlap between CU traits and anger dysregulation may be observed in serious and persistent ASB, as both of these factors are specifiers for secondary psychopathy, which is related to more delinquent acts and serious crimes than primary psychopathy (only CU traits). These findings support the cumulative hypothesis that it is the sum of anger dysregulation problems, high CU traits and early-onset ASB that leads to higher delinquency.

The current study

In summary, the majority of previous studies (with a notable exception; see 29) have taken into account only one characteristic (either age of onset, CU traits or anger dysregulation) and adopted a categorical approach when aiming to understand the structure and characteristics of ASB. Accordingly, this may have impaired a clear interpretation of previous evidence and led to an over-interpretation of the specificity or importance of the influence of each separate characteristic on ASB. Consequently, taking into account these three characteristics and their interactions might help in the examination of the specific contribution of each factor and the assessment of their complex interplay in the expression of ASB. Therefore, this study examined whether, beyond general factors such as age, gender, intelligence and past trauma [e.g., 32], we could identify the specific and mutual influence of these three main characteristics (age of onset, CU traits and anger dysregulation) on specific dimensions of ASB- i.e., criminal behaviours and externalizing symptoms.

Method

Sample

The present sample was taken from the Swiss Model Project for the Clarification and Goal Attainment in Child Welfare and Juvenile Justice Institution MAZ study [MAZ, see 33]. Between 2007 and 2011, youths from 64 different institutions participated in the study, and 536 youths aged 11 to 19 years (mean age: 15.73, SD= 2.08) were included. All institutions were accredited by the Swiss Ministry of Justice. Youths had been placed in these institutions either on a voluntary, civil law, or criminal law basis as a function of their situation. Placement by civil law or on a voluntary basis occurred when the youths were no longer able to live with their family or with relatives. Youths later returned to their original environment when circumstances were deemed safe and acceptable. In the case of placement by criminal law, the release occurred upon completion of the sentence. To be eligible for participation in the study (inclusion criterion), the youth should have been placed for at least one month in an institution before the assessment. Another inclusion criterion was the ability to complete questionnaires (sufficient French/German language abilities). No other specific exclusion criterion was applied. Table 1 describes the detailed socio-demographic status of the sample. In particular, we observed that two-thirds of the sample were males. The main type of institution was an educative home (either with or without scholarly activity), and youths mostly lived with their parents before admission to the institution. Custody was usually held by the mother (almost half of cases), and the youths were mostly placed based on civil law. According to mothers and fathers' education, the socio-economic status of the sample was middle-low. Almost a half of the youths received care before placement.

Procedure and ethical considerations

After presenting the research focus and guaranteeing the confidentiality of responses, written consent was obtained from each participant and/or from one parent or a legal representative.

After consenting to participate, each participant was asked to complete computerized questionnaires. Information disclosed by the youths remained confidential. The procedure was approved by the Institutional Review Board of the State of Basel.

Measures

Main measures

Criminal behaviours were assessed using the Criminology Questionnaire [34]. By ensuring anonymity, this self-report questionnaire allows the rating of youth criminal behaviours without a social desirability bias. The outputs are the number and frequency of different types of criminal behaviours, i.e., damage to property, property offences, violent crimes, sex crimes and media crimes (watching age inappropriate violent or sexual video). This questionnaire allows the evaluation of the age of the first criminal behaviours, used as the indicator of ASB age of onset in subsequent analyses.

Externalizing symptoms were assessed with the Child Behavior Checklist (or Adult Behavior Checklist), which was rated by both the carer of the youths in the institution [35] and by the youths themselves [36]. This questionnaire lists 120 emotional and behavioural difficulties commonly found in children, adolescents and young adults. Items are scored from 0= “not true” to 2= “often true”, over the past 12 months. Only the externalizing symptoms score (Cronbach’s $\alpha=.89$ for the self-report and .92 for the carer-rated report) was computed. Scores were transformed into T-scores to merge data from the youth and the young adult version, with higher scores indicating more difficulties.

CU traits were assessed using the Youth Psychopathic Traits Inventory [YPI; 37, 38, 39], which is a 50-item self-report questionnaire. In items such as “I can make people believe almost anything” or “I usually feel calm when other people are scared”, participants have to indicate the degree to which each item applies to them, using a 4-point Likert scale ranging from 1= “does not apply at all” to 4= “applies very well”. The Affective scale relates to CU

traits and was therefore used for this study (Cronbach's $\alpha=.79$). A higher score indicates higher CU traits.

Anger dysregulation was assessed with the Massachusetts Youth Screening Instrument - Second Version [MAYSI-2; 40]. The MAYSI-2 is a screening questionnaire with 52 questions. Participants answered "yes" or "no" to whether the items (e.g., "Have you had a lot of trouble falling asleep or staying asleep?" or "Have you felt angry a lot?") had applied to them during the past month. In the present study, the anger-irritability subscale was used (Cronbach's $\alpha=.78$) as an indicator of anger dysregulation, with a higher score indicating more anger dysregulation.

Ancillary measures

The Inventory of Trauma [Essener Trauma Inventar, 41] was used to assess the presence of *past trauma*. This self-report questionnaire assesses exposure to different types of traumas, such as neglect, abuse, detention, natural disaster or war. The scores used in subsequent analyses are either the presence or the absence of trauma. Fifty-five percent of the sample experienced at least one trauma.

Reasoning ability was assessed by the Standard Progressive Matrices of Raven [SPM; 42]. The SPM consists of series of pictures with a missing part. Participants have to select the correct part to complete the pictures from a set of options. It has been shown to provide a valid measure of intelligence independent of language capacities and formal schooling [43]. The mean IQ score for the sample was 96.67 (SD = 13.9).

Data analyses

The skewness and kurtosis of the variables revealed that they suited normal distributions, with the exception of the criminal behaviours frequency score. Thus, we applied a square root transformation procedure. After this transformation, 4 outliers were still identified, and their frequency scores were subsequently removed from the analyses.

We used Bayes as an estimator in all analyses with the software Mplus v7.11 [44]. The default settings of Mplus were used, except that we used 10,000 iterations and used 4 chains to estimate the parameters. Notably, Bayesian statistics require slightly different interpretations of the effects compared to frequentist statistics. Indeed, in Bayesian statistics, credibility intervals (versus confidence intervals in frequentist terms) are used to indicate the 95% probability that the estimates will lie between the lower and upper bounds of the interval. Therefore, when zero is not included within the credibility interval, the null hypothesis is rejected, and the effect is assumed to be present or “significant” [for a deeper discussion of the Bayesian statistics, see 45, 46]. For all analyses, Bayesian posterior parameter distributions and Bayesian posterior parameter trace plots were inspected for each significant effect, revealing that the estimates converged adequately. One of the main advantages of Bayesian statistics is that it does not assume or require a normal distribution. In our case, with moderation analyses, where the moderator terms are always skewed, one of the best ways to analyse such effect is to use Bayesian methods [47, 48]. This reasoning also applied to our outcome variables, which were skewed count data. Another advantage in conducting our analyses using Bayesian statistics was that in a single model, we could take into account all predicting and outcomes variables in the same analysis. Thus, if the link was significant, it indicated that the variables had a specific importance, even if the other explaining variables (as well as outcome variables) were taken into account.

In particular, we computed a model that explained age of onset, CU traits and anger dysregulation by age, IQ, trauma and gender (allowing us to control for the influence of general factors on specific dimensions). Other factors included were age of onset, CU traits, anger dysregulation (specific contribution and interaction), predicted general criminal behaviours, types of criminal behaviours, and externalizing symptoms (in four different models). Thus, each model allowed in a single analysis the consideration of the influence of

general factors (including their interrelationships) as well as the influence of multiple outcomes (which also include their interrelationships). To compute the interaction effect of the factors, we first centred the variables by subtracting the sample's mean from each individual score (on the original dataset). We then multiplied each factor by the other to compute second-order interactions (age of onset x CU traits; age of onset x anger dysregulation; CU traits x anger dysregulation) and multiplied them all together to compute the three-way interaction (age of onset x CU traits x anger dysregulation). Then, these interaction terms were added into the whole model. Figure 1 illustrates the model for the number and the frequency of criminal behaviours. In case there was an interaction effect, we illustrated the results by plotting graphs. To do so, we split the variables of interest (age of onset, CU traits or anger dysregulation) by the median to be able to produce a graphical representation of the results. As we computed three different models, and to avoid a type I error, we set the significance of the *p*-value at .0166 (Bonferroni correction: .05/3) to interpret the model as significant. This analytic plan allowed us to assess each component (i.e., age of onset, CU traits and anger dysregulation), and interactions between these components, in characterizing ASB (i.e., criminal behaviours and externalizing symptoms), even when controlling for more general factors, such as age, gender, intelligence and past trauma.

Results

The correlations are reported in Table 2. Gender was correlated with all predicting and outcome variables, except age of onset and anger dysregulation. Males were older, reported more CU traits, had a higher IQ, and had committed a higher number of crimes, whereas females reported more trauma, and more self- and carer-rated externalizing symptoms. An older age was particularly related to a higher number of crimes committed. Past trauma was particularly related to anger dysregulation and a higher number of crimes. IQ was significantly correlated only to media crimes; the higher the IQ, the higher the number of

media crimes. Age of ASB onset was not correlated with any other variables. While not correlated with other predictors (except for gender and anger dysregulation), CU traits were correlated with all outcome variables. Anger dysregulation was positively correlated with all outcomes except for sex crimes. Of note, the correlation was especially strong with self-rated externalizing behaviours.

Number and frequency of criminal behaviours

Figure 1 presents the model tested with the number and frequency of criminal behaviours as outcomes. The two regression models, including all types of criminal behaviours (in a single analysis), and the other models including externalizing symptoms (rated by the youths or by the carer) were analogous. For all models, the age of onset was significantly explained by age; CU traits, by gender and past trauma; and anger dysregulation, by past trauma.

The model explained 33.0% ($p < .001$; CI (95%): 22.2-43.5) of the variance in the number of criminal behaviours and 27.9% ($p < .001$; CI (95%): 18.5-37.5) of their frequency. Table 3 reports the results.

In particular, the number and frequency of criminal behaviours were explained by the direct effect of each dimension (age of onset, CU traits and anger dysregulation).

Types of criminal behaviours

Next, each type of delinquent behaviour was entered as a dependent variable in the model shown in Figure 1. Table 3 summarizes the results. The model explained a significant part of almost all types of criminal behaviours, except for sexual crime (which displayed a floor effect—too few sexual crimes to detect differences). In particular, the model explained 29.5% ($p < .001$; CI (95%): 19.1-40.8) of the variance in damage to property, 28.3% ($p < .001$; CI (95%): 18.3-38.6) in property offenses, 19.3% ($p < .001$; CI (95%): 11.6-27.9) in violent crimes, and 30.1% ($p < .001$; CI (95%): 19.0-41.7) in media crimes. Damage to property,

property offenses, violent crimes and media crimes were explained by the specific contribution of each factor. Additionally, the interaction between age of onset and anger explained a significant proportion of variance in damage to property, whereas the interaction between age of onset and CU traits explained a significant part of variance in property offenses. Finally, the interaction between age of onset and anger dysregulation, as well as the interaction between age of onset and CU traits, explained a significant proportion of media crimes. The interaction between age of onset and anger dysregulation was a more influencing factor when associated with later onset, whereas CU traits had more influence when associated with early-onset youths.

Externalizing symptoms

The model, applied to externalizing symptoms rated by the youths, explained 37.3% ($p < .001$; CI (95%): 27.7-47.2) of the variance. Table 4 reports the results. More specifically, externalizing symptoms were explained by CU traits and anger dysregulation. Furthermore, the model explained 11.8% ($p < .001$; CCI (95%): 4.7-21.1) of the externalizing symptoms score, as rated by the carer. More specifically, externalizing symptoms were explained by the specific contributions of anger dysregulation.

Discussion

This study was the first to show the relevance of each component (i.e., age of onset, CU traits and anger dysregulation), and interactions between these components, for characterizing ASB (i.e., criminal behaviours and externalizing symptoms), even when controlling for more general factors, such as age, gender, intelligence and past trauma [e.g., 32]. Furthermore, our study highlighted the importance and usefulness of the dimensional approach in helping in the development a deeper comprehension of ASB's structure.

Number and frequency of criminal behaviours

Consistent with previous literature [e.g. 9, 19], the results revealed that the specific contribution of each dimension was important in explaining the number and frequency of many types of criminal behaviours. Even when controlling for general factors, each specific characteristic (age of onset, CU traits and anger dysregulation) was relevant in explaining ASB. Indeed, previous studies have shown that each of these factors individually enhances the risk of developing severe ASB. For instance, youths with elevated CU traits were shown to experience little emotional arousal in response to distress in others or to punishment for misbehaviours [7], making them “immune” to using empathy or experience to regulate their behaviours. Additionally, children with high levels of anger tend to over-interpret ambiguous social cues as threatening [49], leading to reactive forms of aggression in response to minor provocations [50].

Regarding the influence of age of onset in our sample, we noticed that the older the age of onset of ASB in youths was, the more crime they committed, which seems surprising and contradictory previous studies [e.g. 12, 15, 51] comparing childhood-onset to adolescent-onset ASB. In the present data, adolescent-onset youths were represented almost exclusively, suggesting that within this category, youths are heterogeneous. This result pleads for further studies using a dimensional approach rather than a categorical one, which is more sensitive in detecting heterogeneity among individuals with ASB.

Type of criminal behaviours

Furthermore, interaction effects were observed, showing a cumulative effect between early onset and the presence of CU traits in explaining some types of crimes (property offenses and media crimes). These results are consistent with the fact that CU traits were observed more in youths presenting with early-onset ASB [e.g., 30], which leads to severe ASB. In contrast, we observed that anger dysregulation was more important when associated with later-onset ASB in explaining specific types of crimes (damage to property and media crimes). Again,

this effect could be because the adolescent-onset subtype was overrepresented in our sample. Therefore, the finding that anger dysregulation had more influence on specific crime activities when youths presented with ASB should be confirmed in a sample with childhood-onset ASB.

Externalizing symptoms

The results showed, consistently with the literature [e.g., 9, 19], that externalizing symptoms (rated by the youths) were related to the specific contributions of CU traits and anger dysregulation. This characteristic was particularly relevant, as it also explained variances in externalizing symptoms rated by the carer. Furthermore, the results indicated that when cumulating little emotional arousal in response to distress cues (CU traits) and hostile attribution bias (anger dysregulation), more severe forms of externalizing symptoms (i.e., aggression and delinquent behaviours) may occur. To explain these results, it should be noted that youths with CU traits are known to be frequently involved in different types of serious crimes and assaults, using more proactive aggression and showing little regret and compassion for their victims [10]. Additionally, the hostile attribution bias (related to poor anger-regulation ability) may lead to poorer conflict management and more dysfunctional interpersonal relationships [9]. Taken together, the combined effect of these processes might lead to higher externalizing symptoms and thus a more severe form of ASB.

Limitations

Some limitations of the study should be acknowledged. The cross-sectional design impaired a clear interpretation in terms of causal links. Additionally, this design required the use of retrospective data to assess the age of onset (age of the first conduct disorder symptom), which has been used in other studies [e.g., 11] but is less accurate than using a longitudinal design. Therefore, a future longitudinal study exploring all these dimensions together would be of great importance. Some floor effects in the measure of criminal behaviours (i.e., sexual

crimes) might have impaired the ability to observe a clear link. Although our sample was representative (including girls), further studies with samples including more youths presenting with childhood-onset ASB are needed. Furthermore, the present sample was recruited from 64 youth welfare and juvenile justice institutions, allowing a good representativeness of the adolescents placed in Switzerland. However, this sampling method impacted the homogeneity of the sample, and it was not possible to control for institution-related effects due to different *n* coming from the different institutions. Moreover, the type of placement (i.e., civil, criminal or voluntary basis) was not controlled and might have enhanced the heterogeneity of the sample.

Conclusions

To summarize, the current study specified the role of three important dimensions postulated as influencing the trajectories of youth presenting with ASB, thus refining our understanding of ASB. Moreover, the current study suggested that future classifications should not consider only one characteristic at a time but rather should take into account these three characteristics (i.e., age of onset, CU traits and anger dysregulation), as well as their interactions, to develop a finer model reflecting the heterogeneity of youths presenting with ASB. Nevertheless, further studies must be undertaken to understand the usefulness of introducing anger dysregulation as a specifier for CD.

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Table 1. Socio-demographic data

Variables		Percentage
Gender	Male:Female	67:33
Born in Switzerland	Yes	78.0
Type of insitutions	Observational	11.6
	Educative home and scholar activity	23.5
	Educative home without scholar activity	20.1
	Educative home including scholar activity	31.9
	Other	12.8
Last life place before educative home	Parents	58.6
	Relatives	3.4
	Own home	0.6
	Family care	5.2
	Assisted living form	22.0
	Psychiatric service	6.7
	Homeless	0.2
	Other	3.3
Custody	Both parents living together	21.7
	Both parents	8.6
	Father	6.8
	Mother	48.7
	Guardian	14.1
Type of placement	Civil	54.7
	Criminal	25.0
	Voluntary	3.6
	Other	13.1
Father's education	None	5.6
	Basic	16.9
	Professional	62.5
	High degree eduaction	15.1
Mother's education	None	10.9
	Basic	28.9
	Professional	50.3
	High degree eduaction	9.9
Youth's Education (last before educational measure)	Obligatory special school	35.8
	Obligatory regular school	40.6
	Other	23.9
Receiving psychiatric care	Yes	56.2

Table 2. Descriptive and correlations

	Mean	SD	1.	2.	3.	4	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. Gender (male: 1, female: 2)	-	-	-	-.13**	.23**	-.10*	.04	-.33**	.09	-.22**	-	-.23**	-.11*	-.24**	-.16**	-.14**	-.36**	.10*	.13**
2. Age	15.73	2.09	-	-	-.03	.06	.46**	.08	.01	.28**	-	.28**	.21**	.31**	.23**	.07	.24**	-.07	-.05
3. Trauma (0 / 1)	-	-	-	-	-	-.07	-.02	.08	.17**	.14**	-	.13*	.05	.11*	.13*	.01	.01	.25**	.13*
4. IQ	96.67	13.90	-	-	-	-	.07	.03	-.01	.04	-	.07	.05	.04	.02	-.04	.20**	.00	-.05
5. Age of onset	14.24	2.37	-	-	-	-	-	-.03	.01	.04	-	.05	.06	.07	-.01	-.08	.05	.00	-.10
6. CU traits	32.70	7.47	-	-	-	-	-	-	.24**	.41**	-	.42**	.29**	.40**	.33**	.10*	.37**	.35**	.14**
7. Anger dys.	4.57	2.65	-	-	-	-	-	-	-	.38**	-	.29**	.37**	.28**	.35**	.04	.27**	.52**	.27**
8. Number crime	5.14	4.05	-	-	-	-	-	-	-	-	-	.83**	.80**	.94**	.79**	.16**	.66**	.40**	.23**
9. Fequency	98.55	591.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.17**
10. Sqrt freq	5.46	5.31	-	-	-	-	-	-	-	-	-	-	.68**	.80**	.65**	.08	.59**	.36**	.13**
11. Damage to property	1.09	1.12	-	-	-	-	-	-	-	-	-	-	-	.66**	.55**	.01	.54**	.37**	.22**
12. Property offenses	2.65	2.38	-	-	-	-	-	-	-	-	-	-	-	-	.63**	.08	.63**	.33**	.19**
13. Violent crimes	0.98	1.13	-	-	-	-	-	-	-	-	-	-	-	-	-	.05	.52**	.33**	.23**
14. Sex crimes	0.22	0.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.15**	.04	.04
15. Media crimes	3.66	2.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.29**	.06
16. Externalizing symptoms, self-rated	61.33	10.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.39**
17. Externalizing symptoms, carer-rated	63.63	9.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* $p < .05$, ** $p < .01$

Table 3. Main results of regression models on criminal behaviors

Criterion	Predictors	Estimates	SD	95% C.I.		<i>p</i>
				Lower	Upper	
Number	Age of onset	.18	.06	.06	.30	.006
	CU	.25	.07	.12	.38	.000
	Anger dys.	.38	.06	.27	.49	.000
	Age of onset x CU	.16	.09	-.03	.34	.092
	Age of onset x Anger dys.	-.11	.08	-.27	.06	.192
	CU x Anger dys.	.05	.06	-.07	.16	.424
	Age of onset x CU x Anger dys.	-.06	.09	-.23	.10	.470
Frequency	Age of onset	.17	.06	.05	.29	.008
	CU	.33	.07	.20	.45	.000
	Anger dys.	.25	.06	.13	.36	.000
	Age of onset x CU	.13	.09	-.04	.31	.142
	Age of onset x Anger dys.	-.10	.08	-.26	.06	.250
	CU x Anger dys.	.05	.06	-.06	.17	.382
	Age of onset x CU x Anger dys.	-.06	.08	-.21	.11	.490
Damage to property	Age of onset	.19	.06	.08	.31	.002
	CU	.15	.07	.02	.28	.020
	Anger dys.	.40	.05	.30	.51	.000
	Age of onset x CU	.11	.09	-.06	.27	.222
	Age of onset x Anger dys.	-.15	.07	-.29	-.01	.044
	CU x Anger dys.	.04	.06	-.07	.15	.514
	Age of onset x CU x Anger dys.	-.08	.08	-.23	.09	.360
Property offenses	Age of onset	.18	.06	.05	.30	.006
	CU	.25	.07	.12	.39	.000
	Anger dys.	.28	.06	.16	.39	.000
	Age of onset x CU	.19	.09	.02	.37	.038
	Age of onset x Anger dys.	-.14	.08	-.29	.02	.078
	CU x Anger dys.	.05	.06	-.07	.17	.372
	Age of onset x CU x Anger dys.	-.05	.09	-.22	.12	.544
Violent crimes	Age of onset	.13	.07	-.01	.25	.060
	CU	.23	.07	.10	.36	.002
	Anger dys.	.28	.06	.16	.40	.000
	Age of onset x CU	.06	.09	-.12	.24	.508
	Age of onset x Anger dys.	-.01	.08	-.17	.15	.876
	CU x Anger dys.	.03	.06	-.08	.15	.582
	Age of onset x CU x Anger dys.	.01	.09	-.17	.18	.918
Sex crimes	Age of onset	.03	.07	-.10	.15	.690
	CU	.05	.07	-.08	.19	.494
	Anger dys.	-.03	.06	-.15	.10	.674
	Age of onset x CU	.01	.08	-.15	.17	.872
	Age of onset x Anger dys.	.04	.08	-.11	.19	.586
	CU x Anger dys.	.01	.06	-.12	.12	.934
	Age of onset x CU x Anger dys.	.00	.08	-.15	.17	.954
Media crimes	Age of onset	.16	.06	.04	.27	.010
	CU	.15	.07	.02	.28	.024
	Anger dys.	.29	.06	.18	.40	.000
	Age of onset x CU	.23	.08	.06	.39	.010
	Age of onset x Anger dys.	-.26	.07	-.39	-.11	.002
	CU x Anger dys.	.07	.06	-.05	.18	.268
	Age of onset x CU x Anger dys.	-.03	.08	-.19	.14	.760

Table 4. Main results of regression models on externalizing symptoms

Criterion	Predictors	Estimates	SD	95% C.I.		<i>p</i>
				Lower	Upper	
Externalizing symptoms, self-rated	Age of onset	.05	.06	-.07	.16	.428
	CU	.29	.06	.17	.41	.000
	Anger dys.	.47	.05	.37	.57	.000
	Age of onset x CU	-.10	.09	-.26	.07	.248
	Age of onset x Anger dys.	.08	.08	-.07	.23	.304
	CU x Anger dys.	.08	.05	-.03	.18	.144
	Age of onset x CU x Anger dys.	-.13	.08	-.28	.03	.116
Externalizing symptoms, carer-rated	Age of onset	-.06	.07	-.21	.08	.390
	CU	.07	.08	-.09	.22	.406
	Anger dys.	.20	.07	.06	.33	.006
	Age of onset x CU	-.05	.12	-.28	.18	.650
	Age of onset x Anger dys.	.14	1.0	-.05	.34	.152
	CU x Anger dys.	.01	.07	-.13	.14	.972
	Age of onset x CU x Anger dys.	.03	.11	-.18	.24	.746

Figure 1. Illustration of the regression model

