Externalizing Behavior and the Higher Order Factors of the Big Five

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Externalizing Behavior and the Higher Order Factors of the Big Five

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The comorbidity of various externalizing behaviors stems from a broad predisposition that is strongly genetically determined (R. F. Krueger, B. M. Hicks, C. J. Patrick, S. R. Carlson, W. G. Iacono, & M. McGue, 2002). This finding raises the question of how externalizing behavior is related to broad personality traits that have been identified in normal populations and that also have a genetic component. Using structural equation modeling, the authors applied a hierarchical personality model based on the Big Five and their two higher order factors, Stability (Neuroticism reversed, Agreeableness, and Conscientiousness) and Plasticity (Extraversion and Openness). Cognitive ability was included to separate variance in Openness associated with Extraversion (hypothesized to be positively related to externalizing behavior) from variance in Openness associated with cognitive ability (negatively related to externalizing behavior). This model was used to predict a latent externalizing behavior variable in an adolescent male sample ($N = 140$) assessed through self- and teacher reports. As hypothesized, externalizing behavior was characterized by low Stability, high Plasticity, and low cognitive ability.

Keywords: externalizing behavior, higher order factors, Stability, Plasticity, cognitive ability

Externalizing behavior is a broad category encompassing aggression, impulsivity, antisocial behavior, hyperactivity, and drug abuse (Achenbach & Edelbrock, 1984; Krueger, Markon, Patrick, Benning, & Kramer, 2007; Krueger et al., 2002; Nagin & Tremblay, 1999). Behavior genetic research indicates that various types of externalizing behavior share a single underlying factor that is strongly genetically influenced and may account for comorbidity among certain disorders (Krueger et al., 2002). Risk for externalizing problems is a continuous trait, normally distributed in the population (Markon & Krueger, 2006). Understanding how the trait of externalizing behavior relates to broad models of person-

ality like the Big Five may help to reveal common processes underlying normal and pathological traits.

Considerable evidence suggests that various specific externalizing behaviors are associated with low Agreeableness, low Conscientiousness, and, to a lesser extent, high Neuroticism (John, Caspi, Robins, Moffitt, & Stouthamer-Loeber, 1994; Miller & Lynam, 2001; Miller, Lynam, & Leukefeld, 2003; Trull & Sher, 1994). However, the Big Five may not be the highest level of generality at which the association between personality and externalizing behavior can fruitfully be examined. In the present study, we examined the predictors of externalizing behavior using a hierarchical model incorporating the higher order factors of the Big Five.

Although the Big Five were originally conceived as orthogonal factors and the most general level of personality description, factor analysis has demonstrated that two higher order factors, or *metatraits*, exist above the Big Five (DeYoung, 2006; DeYoung, Peterson, & Higgins, 2002; Digman, 1997). These metatraits, which we have labeled *Stability* (also known as Alpha) and *Plasticity* (also known as Beta), appear to have a genetic basis (Jang et al., 2006). Stability (the shared variance of Neuroticism reversed, Conscientiousness, and Agreeableness) appears to reflect stable functioning in emotional, motivational, and social domains, whereas Plasticity (the shared variance of Extraversion and Openness/Intellect) appears to reflect the tendency to explore both behaviorally and cognitively.

The relations between externalizing behavior and personality might well be conceived in terms of the metatraits for several reasons. First, the fact that Agreeableness, Conscientiousness, and Neuroticism have all been associated with externalizing behavior

implicates the metatrait Stability. The hypothesis that the general factor underlying externalizing behavior is related to Stability does not negate the possibility that certain specific types of externalizing behavior might be more specifically related to individual Big Five traits. For example, aggression is probably most strongly related to low Agreeableness and impulsivity to low Conscientiousness. However, the existence of the metatraits implies that Agreeableness, Conscientiousness, and Neuroticism covary much like comorbid disorders, and it may be their shared variance that predicts the shared variance of various externalizing behaviors, perhaps reflecting the underlying biological factors that cause these covariations (Jang et al., 2006; Krueger et al., 2002).

The existence of these biological factors provides another reason to think the metatraits may be related to externalizing behavior. Shared biological influences, perhaps involving serotonin and dopamine, might cause them to covary. Increased serotonergic function appears to be associated with reduced externalizing behavior (Chambers, Taylor, & Potenza, 2003; Lee & Coccaro, 2001; Zuckerman, 2005) and with increased Agreeableness and Conscientiousness and reduced Neuroticism (for reviews, see DeYoung et al., 2002; DeYoung & Gray, in press), which might help to account for the established associations of the latter three traits with externalizing behavior. Dopamine, in contrast, is associated with approach and exploratory behavior (Depue & Collins, 1999), and dopaminergic function appears to be associated with increased externalizing behavior (Chambers et al., 2003; Zuckerman, 2005) and with increased Extraversion (Depue & Collins, 1999) and Openness (for reviews, see DeYoung & Gray, in press; DeYoung, Peterson, & Higgins, 2005). We therefore hypothesized that whereas Stability should be negatively associated with externalizing behavior, Plasticity should be positively associated with it.

The hypothesis that Plasticity should be associated positively with externalizing behavior raises the question of why Extraversion and Openness have not often been found to be associated with externalizing behavior (e.g., meta-analysis by Miller & Lynam, 2001). A possible answer is that these associations might tend to be statistically suppressed in zero-order correlations. One likely cause of suppression, specific to Openness, is the fact that Openness is the only Big Five trait positively associated with cognitive ability (a fact reflected in the commonly used compound label *Openness/Intellect*; e.g., DeYoung et al., 2005). Cognitive ability is typically negatively associated with externalizing behavior (e.g., Koenen, Caspi, Moffitt, Rijsdijk, & Taylor, 2006; Séguin, Boulerice, Harden, Tremblay, & Pihl, 1999; Séguin, Pihl, Harden, Tremblay, & Boulerice, 1995), and the negative correlation between cognitive ability and externalizing behavior may tend to suppress positive correlations between Openness and externalizing behavior.

Controlling for cognitive ability may therefore help to reveal an association of Openness with externalizing behavior. This association seems likely because substance use disorders have been associated with higher levels of Openness (Trull & Sher, 1994) and because the tendency to be unconventional and interested in novelty (which is characteristic of Openness; McCrae & Costa, 1997) could incline individuals to engage in behaviors that are not typically socially acceptable, including externalizing behaviors.

Just as the exploratory component of Openness seems likely to be associated with externalizing behavior, so too does the exploratory, approach-oriented component of Extraversion that is associated with assertiveness and dominance (Depue & Collins, 1999).

At least one study has found a significant zero-order association of Extraversion with externalizing problems (John et al., 1994). Another study found Extraversion to be positively associated with externalizing behavior, but only when controlling for other Big Five traits (Nigg et al., 2002), which suggests suppression as a likely reason why Extraversion is not typically correlated with externalizing behavior at the zero order.

Associations of externalizing behavior with both Extraversion and Openness may be suppressed by the halo effect, the tendency for people to rate themselves or others globally positively or globally negatively (Thorndike, 1920). All Big Five traits (and externalizing behavior) have one pole that is socially desirable, and people tend to be biased to maintain the evaluative consistency of their ratings across traits (Saucier, 2002). Thus, correlations between traits that are consistent in desirability tend to be inflated, whereas correlations between traits that are inconsistent in desirability tend to be suppressed.

In latent models of the metatraits, the halo effect is evident as a moderate to strong correlation between the metatraits (DeYoung, 2006; DeYoung et al., 2002). That this correlation is due primarily to bias becomes apparent when the Big Five are modeled as latent variables representing agreement across multiple informants (thereby removing the effects of individual raters' biases); in those models, the metatraits are uncorrelated (DeYoung, 2006). When only single-informant ratings of personality are available, one may circumvent the halo effect by controlling for other traits while examining the independent association of each trait with the variable of interest. Using Stability and Plasticity as simultaneous predictors of externalizing behavior will control for their artifactual positive correlation, removing the halo effect. This approach may reveal a positive association between Plasticity and externalizing behavior, despite the fact that they are opposite in desirability.

In the present study, we tested this hypothesis in a sample of male adolescents. (An all-male sample is appropriate because externalizing problems are less prevalent among females; Hicks et al., 2007.) General cognitive ability (g) was included in the model to test the additional hypothesis that variance in Openness due to g rather than to Plasticity should be negatively associated with externalizing behavior.

Various externalizing behaviors were assessed, using reports from participants and teachers. Teacher reports provide a valuable complement to self-reports, but they describe behavior only in a school setting. Self-reports were used to assess behaviors that take place away from adult supervision. The self- and teacher reports thus assessed not only different behaviors but also behaviors in different contexts. The shared variance of the self- and teacher reports should therefore represent a broad predisposition toward externalizing behavior across contexts.

Method

Participants

Participants were 140 members of a longitudinal study of 1,037 French-speaking Caucasian boys from the 53 lowest socioeconomic-status schools of the Catholic School Commission of Montréal, Quebec, Canada. At age 13 years, 203 boys were selected from the longitudinal cohort on the basis of teacher ratings of physical aggression at ages 6, 10, 11, and 12 years to participate

in several years of laboratory studies, although not all 203 completed assessments in subsequent years (for details, see Séguin et al., 1995, 1999). This subsample intentionally oversampled boys who consistently scored high in aggression. Boys were selected from this sample for the present study if they had completed all assessments used in the analysis. Most excluded boys had not completed the personality test and did not differ significantly in IQ or externalizing behaviors from those who were included, all $ts <$ 1.10, $ps > .27$.

Measures

Personality questionnaires. In the laboratory, at age 16 years, participants completed a French-language version of the NEO Personality Inventory—Revised (NEO-PI–R; Costa & McCrae, 1992). Cronbach's alphas for the Big Five were .82 (Neuroticism), .80 (Extraversion), .72 (Openness), .75 (Agreeableness), and .87 (Conscientiousness). These coefficients are somewhat lower than typical (Costa & McCrae, 1992), possibly due to the fact that the NEO-PI–R is not usually used for participants below 17 years of age.

Externalizing behavior. Teachers rated the boys on physical aggression, opposition, and hyperactivity scales at age 6 years and every year from ages 10–15 years (Nagin & Tremblay, 1999). Mean Cronbach's alphas for these three scales across all years were .84 (three items), .83 (five items), and .86 (two items), respectively. Scores for the present analyses were created by averaging across standardized scores for the four assessment points from ages 12–15 years. This ensured that each boy had at least one assessment of externalizing behavior while avoiding assessment points most temporally distant from the personality assessment, because personality tends to change from childhood to adolescence (Roberts, Wood, & Smith, 2005). The physical aggression score was logarithmically transformed to reduce positive skewness.

Every year from ages 12–15 years, the boys reported on their frequency of engaging in externalizing behaviors in three catego-

ries: physical aggression (seven items), vandalism (six items), and drug use (three items). These reports were made confidentially, using 4-point scales. Mean Cronbach's alphas across years for aggression, vandalism, and drug use were .68, .77, and .72, respectively. All three scores were logarithmically transformed to reduce positive skewness.

General cognitive ability. Three indices of g were used: the Block Design and Vocabulary subtests of the Wechsler Intelligence Scales for Children (WISC–R; Wechsler, 1974) and a working memory (or executive function) score derived from factor analysis of a battery of neuropsychological tasks assessing cognitive abilities associated with prefrontal cortex (for details, see Séguin et al., 1995). Working memory is strongly related to g (Kane, Hambrick, & Conway, 2005).

The two WISC–R subtests (Wechsler, 1974) were administered in the laboratory to subsets of the longitudinal sample every year from ages 9–12 years and again at 15 years (Séguin et al., 1995, 1999). Each participant had at least one IQ assessment ($M = 2.63$, $SD = 1.61$); when more than one was available, scaled subtest scores were averaged. Across all 5 years, Cronbach's alphas for the Block Design and Vocabulary subtests were .93 and .91, respectively. The four working memory tasks were administered as part of a larger battery of cognitive tests administered in the laboratory to the boys at ages 13 and 14 years (Séguin et al., 1995, 1999). Cronbach's alpha for the working memory tasks was .61.

Analysis

A structural equation model (Figure 1) was used to test predictions about the relations of Stability and Plasticity to externalizing behavior while controlling for g. The model was analyzed using Amos 7.0 (Arbuckle, 2006) with maximum likelihood estimation of the full covariance matrix. Self- and teacher reports were used to form two latent externalizing behavior variables, representing externalizing behavior in different contexts. The shared variance of these two variables was modeled as a latent variable representing
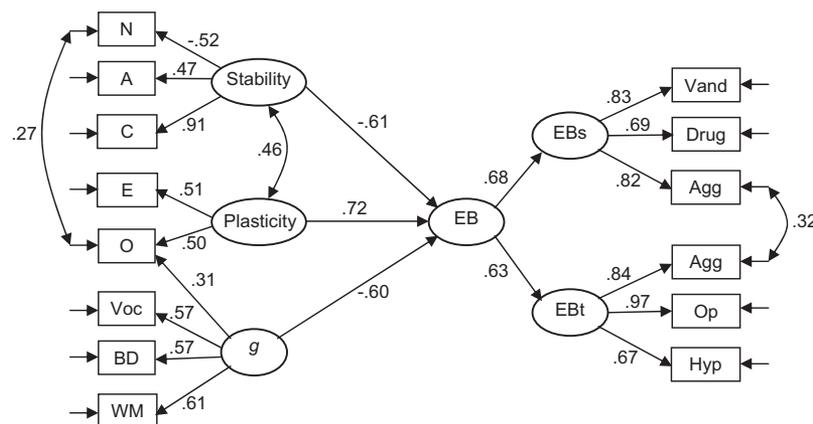
Figure 1. Stability, Plasticity, and g predict externalizing behavior. $N = 140$. See Table 2 for indices of fit. All paths shown are significant at $p < .05$. One significant correlation (between uniquenesses for self-reported aggression and Agreeableness, $r = -.27$) is not shown. N = Neuroticism; A = Agreeableness; C = Conscientiousness; E = Extraversion; O = Openness; Voc = vocabulary; BD = block design; WM = working memory; EB = externalizing behavior; EBs = self-reported; EBt = teacher reported; Vand = vandalism; Drug = drug use; Agg = aggression; Op = opposition; Hyp = hyperactivity.

the general externalizing behavior factor that is the primary focus of the model. Because two indicators do not provide enough information to determine a unique solution for their loading weights on a latent variable (Kline, 2005), the unstandardized paths from the general externalizing factor to self- and teacher-reported externalizing behavior were constrained to be equal, as were those from Plasticity to Extraversion and Openness. Openness was allowed to load on g in addition to Plasticity because we have previously demonstrated that the variance shared between Openness and Extraversion (i.e., variance stemming from Plasticity) is independent of the variance in Openness associated with cognitive ability (DeYoung et al., 2005).

Three pairs of uniquenesses (variance not accounted for by latent variables) were allowed to correlate a priori in the model. Uniquenesses for teacher-reported aggression and self-reported aggression were allowed to correlate because the similarity of these behaviors might render their correlation stronger than what could be accounted for by a general externalizing behavior factor. Uniquenesses for Agreeableness and self-reported aggression were allowed to correlate because similarities in content and method for these two scales might otherwise artificially inflate the association of personality with externalizing behavior. Uniquenesses for Openness and Neuroticism were allowed to correlate because previous studies have shown that this correlation typically exists in single-informant models but, like the correlation between the metatraits, appears to be artifactual (DeYoung, 2006; DeYoung et al., 2002).

Results

Correlations among the measured variables appear in Table 1. As is typical for zero-order correlations, Agreeableness and Conscientiousness were significantly associated with several specific externalizing behaviors. Additionally, Neuroticism was associated with vandalism and Extraversion with hyperactivity.

Structural hypotheses were tested by the model in Figure 1. As predicted, Stability and Plasticity were significant and strong predictors of externalizing behavior. Table 2 provides the chi-square

Table 2

Fit of the Models in Figures 1 and 2 of Traits Predicting Externalizing Behavior

Model	χ^2	df	p	CFI	TLI	RMSEA	$p_{\text{(close)}}$
Figure 1	109.896	67	.001	.93	.91	.068	.102
Figure 2	80.096	65	.098	.98	.97	.041	.679

Note. $N = 140$. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root-mean-square error of approximation.

test for significant discrepancies between the predicted and observed covariance matrices, as well as the comparative fit index, the Tucker–Lewis index, and the root-mean-square error of approximation (RMSEA). A significant chi-square does not necessarily indicate poor fit because chi-square is sensitive to sample size and will often be significant at $p < .05$, even for good models (Kline, 2005). Comparative fit index and Tucker–Lewis index values over .90 indicate adequate fit and values of .95 or higher indicate close fit (Kline, 2005). RMSEA values less than .08 indicate acceptable fit, whereas values of .05 or less indicate close fit (Kline, 2005). The p_{close} statistic indicates whether the RMSEA value is significantly greater than .05.

The fit indices reported in Table 2 suggested that the fit of the model in Figure 1 was adequate but might not be close. Modification indices suggested that the model could be improved by freeing paths from g to teacher-reported externalizing behavior and to self-reported aggression. The model was therefore revised (see Figure 2). Note that this revision does not alter the test of the primary hypothesis that Stability and Plasticity are associated with the general externalizing factor. In fact, it provides a test of whether any lack of close fit in the original model can be explained without altering that hypothesis. The revised model fit the data very well, with the predicted covariance matrix not differing significantly from the observed matrix. The revised model fit significantly better than the original, $\chi^2_{\text{difference}}(2, N = 140) = 29.80$, $p < .001$. The two new paths were significant, whereas the

Table 1

Correlations, Means, and Standard Deviations of Observed Variables in Adolescent Boys

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Neuroticism	—													
2. Agreeableness	−.15	—												
3. Conscientiousness	−.48	.41	—											
4. Extraversion	−.36	.07	.25	—										
5. Openness	.03	.01	.15	.23	—									
6. Vocabulary	−.14	−.01	.03	.05	.23	—								
7. Block Design	−.01	.05	−.07	.06	.20	.31	—							
8. Working Memory	.01	−.06	−.02	−.02	.22	.37	.34	—						
9. Vandalism (self)	.21	−.30	−.29	−.04	.09	−.05	−.04	.03	—					
10. Drug use (self)	.08	−.18	−.25	.02	.12	.05	−.06	.13	.59	—				
11. Aggression (self)	.02	−.31	−.09	.06	.04	−.09	−.18	−.12	.67	.53	—			
12. Aggression (teacher)	.02	−.18	.00	.00	.06	−.26	−.25	−.31	.23	.26	.50	—		
13. Opposition (teacher)	.00	−.14	−.02	.09	.04	−.25	−.29	−.37	.24	.28	.46	.84	—	
14. Hyperactivity (teacher)	.03	−.13	−.08	.17	.08	−.13	−.18	−.23	.22	.19	.31	.56	.66	—
M	82.67	111.54	116.97	120.92	107.76	8.04	10.65	−0.01	0.70	0.69	0.69	0.70	0.02	0.02
SD	15.01	13.34	16.54	14.16	13.16	2.21	2.59	1.01	0.05	0.06	0.06	0.06	0.81	0.73

Note. $N = 140$. Correlations greater than .16 in absolute value are significant at $p < .05$ (uncorrected).

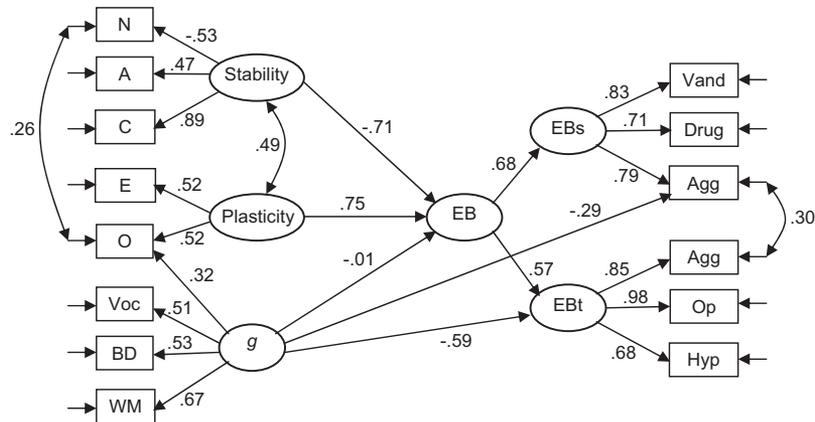*Figure 2.* Modification indices indicated that the model could be improved by freeing paths from *g* to EBt and self-rated aggression. *N* = 140. See Table 2 for indices of fit. All paths shown are significant at *p* < .05, except the path from *g* to EB. One significant correlation (between uniquenesses for self-reported aggression and Agreeableness, *r* = −.28) is not shown. N = Neuroticism; A = Agreeableness; C = Conscientiousness; E = Extraversion; O = Openness; Voc = vocabulary; BD = block design; WM = working memory; EB = externalizing behavior; EBs = self-reported; EBt = teacher reported; Vand = vandalism; Drug = drug use; Agg = aggression; Op = opposition; Hyp = hyperactivity.

path from *g* to the general externalizing behavior factor was no longer significant. This result suggests that the association of *g* with externalizing behavior may be more specific than the association of the metatraits; *g* does not appear to be associated with self-reported vandalism and drug use. However, because this finding resulted from a post hoc modification of the model, it should not be emphasized until replicated.

If *g* and its three specific markers were deleted from either the initial or the revised model, the path from Plasticity to the general externalizing factor fell below significance (*p* = .07). This supports the hypothesis that separating the variance Openness shares with *g* from the variance it shares with Extraversion may be important in demonstrating the association of Plasticity with externalizing behavior. As hypothesized, the variance Openness shares with Extraversion (i.e., Plasticity) was positively associated with externalizing behavior, whereas the variance it shares with cognitive ability was negatively associated with externalizing behavior.

Correlations between the metatraits and *g* were included in the models but were not significant and are not shown in either figure, all *r*s < .16, *p*s > .15. The significant correlation between Stability and Plasticity is typical for latent variables based on single-informant data and probably represents the halo effect.

Discussion

As hypothesized, Stability was negatively associated and Plasticity was positively associated with a general externalizing behavior factor representing the shared variance of self- and teacher-reported externalizing behavior. Cognitive ability also predicted externalizing behavior but more narrowly, as it was not associated with self-reported vandalism or drug use in the best-fitting model. This model fit the data very well, indicating that the metatraits adequately capture the associations between externalizing behavior and personality as assessed by the Big Five.

With regard to Stability, this result is relatively unsurprising because past research has indicated the association of various externalizing behaviors with Agreeableness, Conscientiousness, and Neuroticism. However, Extraversion and Openness have not consistently been associated with externalizing behavior in previous research examining zero-order correlations. Similarly, they were not associated with externalizing behavior in our zero-order correlations. That they showed a significant association in our structural model is an important finding that indicates statistical suppression of zero-order correlations.[1] This suppression is likely to be due both to the halo effect (artifactual consistency in ratings according to traits' social desirability) and to the association of Openness with cognitive ability, which is negatively associated with externalizing behavior. The present model controlled for these sources of suppression by examining independent contributions of Stability and Plasticity to the prediction of externalizing behavior and by modeling variance in Openness shared with Extraversion separately from variance in Openness due to cognitive ability. As predicted, variance in Openness due to Plasticity was positively associated with externalizing behavior, whereas variance due to cognitive ability was negatively associated.

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[1] These suppression effects can be demonstrated with standard regression, although the effect sizes are considerably reduced compared with the structural equation model because both predictor and criterion variables include unique variance and error, whereas latent variables include only shared variance. We used regression to predict a composite externalizing variable, the average of the six observed markers of externalizing behavior (standardized). In the first block, we entered Neuroticism, Agreeableness, and Conscientiousness, R^2 = .08, *p* < .01. Adding the three cognitive ability markers in the second block significantly improved the fit of the model, ΔR^2 = .08, *p* < .01. Crucially, when entered in the third block, Openness and Extraversion also significantly improved the fit of the model, ΔR^2 = .05, *p* < .05.

In common sense terms, our findings indicate that if one examines two individuals or groups who are equal in Stability and cognitive ability, the one higher in Plasticity is likely to show higher levels of externalizing behavior. This pattern is in keeping with descriptions of externalizing behavior, which typically emphasize not only instability and lack of restraint but also exploratory, approach-oriented behavior. Individuals high in both Extraversion and Openness appear to be strongly motivated to explore and approach (Depue & Collins, 1999; McCrae & Costa, 1997).

One potential benefit of mapping externalizing behavior onto the metatraits is that it suggests the possibility of unifying biological models of the two phenomena. Potential biological connections with serotonin (related to restraint) and dopamine (related to approach) provide a promising direction for future research on the shared substrates of personality and externalizing behavior.

Although our sample had the advantage of thorough assessments of externalizing behavior and cognitive ability, the present study had several limitations. First, the sample was not large by the standards of structural equation modeling, and the NEO-PI–R showed lower than normal internal consistency. Replication would therefore provide greater confidence in the results. Additionally, the sample was all male and was selected to overrepresent consistently aggressive boys. Future work should determine whether these findings generalize to female populations and to more representative male samples. Nonetheless, understanding externalizing behavior is particularly important in at-risk populations, such as the one studied here. We are hopeful that our results will lead to a new and more thorough understanding of the personality processes associated with externalizing behavior.

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