Aggression and rule-breaking: Heritability and stability of antisocial behavior problems in childhood and adolescence ☆

Sharon Niv [a,*], Catherine Tuvblad [a], Adrian Raine [b,c,d], Laura A. Baker [a]

[a] Department of Psychology, University of Southern California, USA
[b] Department of Criminology, University of Pennsylvania, USA
[c] Department of Psychiatry, University of Pennsylvania, USA
[d] Department of Psychology, University of Pennsylvania, USA

ARTICLE INFO

ABSTRACT

Purpose: This twin study examined the structure of genetic and environmental influences on aggression and rule-breaking in order to examine change and stability across the span of childhood to mid-adolescence.
Methods: Behavioral assessments were conducted at two time points: age 9–10 years and 14–15 years. Using behavioral genetics biometric modeling, the longitudinal structure of influences was investigated.
Results: Aggression and rule-breaking were found to be influenced by a latent common factor of antisocial behavior (ASB) within each wave of data collection. The variance in the childhood-age common factor of ASB was influenced by 41% genetics, 40% shared environment and 19% nonshared environment. In adolescence, 41% of variance in the common factor were novel and entirely genetic, while the remainder of variance was stable across time. Additionally, both aggression and rule-breaking within each wave were found to have unique influences not common across subscales or across waves, highlighting specificity of genetic and environmental effects on different problem behaviors at both ages.
Conclusions: This research sheds light on the commonality of influences on different forms of antisocial behavior. Future research into interventions for antisocial behavior problems in youth could focus on adolescence-specific environmental influences.

© 2013 Elsevier Ltd. All rights reserved.

Introduction

Concern about violence and crime within society is pervasive, as these forms of behavioral problems encompass broad antisocial behavior ranging from crime to drug use, homicide to risky sexual behavior. These are broadly referred to as antisocial behavior problems, and are arguably a problem for society on the whole; high rates of crime, drug use, gang warfare, or risky sexual activity pose risks for the safety and well-being for all members of society, not only those who propagate such behavior. Hence, considerable research is aimed

at understanding the etiology of this behavior in order to better prevent and treat it. However, within the broad category of antisocial behavior problems, the question of aggressive behavior versus rule-breaking behavior (rule-breaking) is an important one. Also referred to as overt (aggressive) and covert (nonaggressive, delinquency or rule-breaking) in past work (Loeber & Hay, 1997), these patterns of behavior are correlated and are known to co-occur at rates higher than would be expected by chance (Eley, et al. 1999). However, evidence has also emerged to support that these are distinct forms of behavior that should be considered separately when studying antisocial behavior.

For example, different developmental trajectories have emerged for these sets of behaviors, highlighting their distinctness. Lack of control in children of ages 3–5 years was found to predict aggression but not rule-breaking in adolescence, suggesting that rule-breaking was more influenced by peers and aggression more innate (Caspi et al. 1995). Rule-breaking also tends to emerge later developmentally than aggression, and is considered by some researchers to be less lifetime persistent and more likely to be adolescence-specific, although both sets of behaviors increase during the period of adolescence (Moffitt, 1993).

Over the course of adolescence, antisocial behavior problems may increase in inherent risk. Whereas younger children are unlikely to

engage in significant substance use behavior, to commit serious crimes, or to behave sexually, adolescents prone to antisocial behavior problems may become involved in these forms of activities. Additionally, forms of antisocial behavior in youth are strongly predictive of adult criminality and antisocial behavior (Loeber & Dishion, 1983), and hence it is important to investigate how influences on aggression and rule-breaking change over the course of childhood to adolescence. Additionally important to consider are sex differences - while males have consistently been found to show higher prevalence (and mean levels) of antisocial behavior, disagreements exist in the literature about whether the genetic and environmental influences on antisocial behavior are equal between the sexes: some meta-analyses conclude equal genetic influence between the sexes (Rhee & Waldman, 2002), and some find higher heritability in males (Miles & Carey, 1997). Further clarifying this discrepancy is an aim of this study.

Antisocial behavior has been found to be heritable in past research. As measured by the Child Behavior Checklist (CBCL), the instrument used in this study, heritability estimates on antisocial behavior problems range from 38-56% (Gjone & Stevenson, 1997; Pesenti-Gritti et al., 2005). Specifically, aggression has been estimated to be heritable at a rate of 38-50% and rule-breaking at 24-40% (Rodgers, et al. 2001). Two recent meta-analysis reviews approached the questions of the distinctions and shared etiologies of aggression and rule-breaking. The first of these concluded that aggression showed higher heritability than rule-breaking, at 65% and 48%, respectively (Burt, 2009). Rule-breaking was also found to be influenced by shared environmental factors, at 18%, further highlighting etiological distinctions between the two forms of antisocial behavior. The second meta-analysis examined covariation between aggression and rule-breaking, and found that 38.4% of genetic influences on these forms of antisocial behavior were shared, whereas the rest of the genetic variance was unique to each (Burt, 2012). In addition, only 10.2% of shared environmental influences were common to both forms of behavior.

At least one previous study has attempted to examine the aggression and rule-breaking subscales of the CBCL longitudinally in late childhood and mid-adolescence, similar to the present research. Correlated genetic factors were found among all four subscales (both subscales at both time points), as well as stronger genetic stability to aggression than to rule-breaking (Eley, et al. 2003). However, this study did not investigate different potential structures to explain influences on the data, such as latent pathways using sophisticated structural equation modeling, which is a strength of the present paper. It is important to discern the structure of influences in order to understand their relationships more precisely and guide future research into molecular genetics or environmental conditions relevant to etiology.

In general, there have been more longitudinal examinations of aggression or widely-defined antisocial behavior than of rule-breaking on its own. In young childhood, over the ages of 3–7 years, genetics and shared home environment were found to contribute to stability in overall antisocial behavior (Van der Valk, et al. 2003). Stability in maternal ratings of aggression across the age span of 3–12 years was 65% accounted for by genetic factors and 25% by shared environmental factors. However, sex differences emerged with genetics as more influential on stability in males and shared environment in females (van Beijsterveldt, et al. 2003).

The purpose of this study is threefold: 1. To examine the structure of genetic and environmental influences on rule-breaking and aggression in order to both examine the nature of etiology and the manner in which influences take effect; 2. To investigate the longitudinal stability and change of influences on aggression, rule-breaking and the covariation between them from late childhood to mid-adolescence; 3. To examine sex differences in these relationships in order to determine whether male and female antisocial behavior should be approached differently.

Methods

Participants

This study uses data collected through the University of Southern California (USC) Risk Factors for Antisocial Behavior (RFAB) twin study, a longitudinal study of over 750 participating families from the greater Los Angeles area. Currently, in its fifth wave of data collection, this study has followed the twins from the age of 9–10 years to their present age of 19–20 years, and concentrates on biological and environmental risk factors for antisocial behavior. The sample is both ethnically diverse and representative of the Los Angeles population breakdown (44% Hispanic, 25% Caucasian, 16% African American, 3% Asian, and 12% mixed or other). Attrition analysis conducted with this sample found no demographic predictors of study continuation. To account for non-returning families from Wave 1, new families were recruited in the third wave of data collection. The analyses in this study utilize data collected in the first and third waves of collection, at which times the twins were 9–10 and 14–15 years of age, respectively. This study uses data from 1204 individuals (269 MZ male, 288 MZ female, 170 DZ male, 184 DZ female, 293 DZ opposite sex) in Wave 1 and 1148 individuals in Wave 3 (249 MZ male, 229 MZ female, 175 DZ male, 212 DZ female, 283 ZD opposite sex). In this study, 73% of Wave 1 families had also participated in Wave 3. Regression analysis found that scores on neither scale were predictive of discontinuation. For full description of the project including zygosity determination, see (Baker et al., 2013; Baker, et al. 2006).

Procedure

The testing protocol was 6–8 hours long in Wave 1, and 4–6 hours long in Wave 3. The twins participated in clinical interviewing and neurocognitive testing, and also psychophysiological testing. Their accompanying parent (>90% biological mothers) participated in daylong clinical interviewing and questionnaire answering aimed at assessing home and school environment, behavior, personality, and psychopathology of both twins as well as of the parent. A portion of families in Wave 3 participated via mail (N = 135), phone (N = 15) or internet surveys (N = 63), while the majority participated in laboratory visits. An analysis of variance found no significant differences in CBCL scores for different participation types.

Measures

CBCL

The CBCL is a widely used caregiver-response instrument for research and clinical work. It measures a wide range of behavior problems in children, both internalizing (consisting of scales for depression, anxiety, and social withdrawal) and antisocial (aggression, rule-breaking) behavior problems (Achenbach, 1991a, 1991b). This instrument has 113 items that use a three-point scale (0 for not true, 1 for sometimes true, and 2 for very or often true). Parents are asked to consider their child's behavior over the last six months. The Rule-breaking subscale of the CBCL (20 items) examines such behavior tendencies as lying, stealing, and destroying possessions. Internal consistencies of the rule-breaking scale were 0.88 and 0.89 at Waves 1 and 3, respectively. The Aggression subscale of the CBCL consists of 13 items and includes behaviors such as arguing, fighting with other children, and bullying others. The internal consistencies in Waves 1 and 3 were found to be 0.61 and 0.71, respectively. This study's internal consistencies of the CBCL antisocial total subscale, which combines the 33 items from the Aggression and Rule-breaking subscales, – 0.88 and 0.91 for Waves 1 and 3, respectively – are consistent with estimates from past research (Pesenti-Gritti et al., 2005; Arsenault, et al. 2003).