

Childhood Trajectories of Anxiousness and Disruptiveness as Predictors of Suicide Attempts

Jelena Brezo, PhD; Edward D. Barker, PhD; Joel Paris, MD; Martine Hébert, PhD; Frank Vitaro, PhD; Richard E. Tremblay, PhD; Gustavo Turecki, MD, PhD

Objective: To investigate the association of childhood trajectories of anxiousness and disruptiveness with suicide attempts in early adulthood.

Design: Prospective cohort study.

Setting: Public francophone schools in Quebec, Canada, from the 1986 to 1988 school years.

Participants: Of 4488 French Canadian children attending kindergarten, a representative group of 1001 boys and 999 girls was chosen for follow-up. Of these, 1144 individuals participated in the study during early adulthood.

Main Outcome Measures: Suicide attempt histories by early adulthood, adjusted odds ratios (ORs) associated with membership in high- vs low-risk trajectories of anxiousness and disruptiveness, moderation (by sex), and mediation (by adolescent Axis I disorders).

Results: We observed 4 distinct developmental profiles of anxiousness and disruptiveness and a frequent co-

occurrence of similar levels of these traits. In contrast to anxiousness trajectories (OR=1.60; 95% confidence interval, 1.00-2.65), disruptiveness (OR=1.80; 95% confidence interval, 1.03-3.13) and joint (OR=1.88; 95% confidence interval, 1.05-3.37) trajectories made statistically significant contributions to suicide attempts. We found no support for mediation by adolescent anxiety/mood or disruptive disorders. Sex, however, moderated the effect of joint trajectories, increasing the risk of suicide attempts in women (OR=3.60; Wald $\chi^2=10.93$; $P<.001$) but not men (OR=0.80; Wald $\chi^2=0.23$; $P=.64$) displaying both anxious and disruptive traits as children.

Conclusions: Anxious-disruptive girls and disruptive boys appear to be more likely than their peers to attempt suicide by early adulthood. Preventive efforts will require more research into the possible mechanisms behind this early sex difference, ie, gene-environment interplays and nonpsychiatric mediators.

Arch Pediatr Adolesc Med. 2008;162(11):1015-1021

Author Affiliations: McGill Group for Suicide Studies, Douglas Hospital Research Center (Drs Brezo and Turecki), Research Unit on Children's Psychosocial Maladjustment, University of Montreal (Drs Barker, Vitaro, Tremblay, and Turecki), Department of Psychiatry, McGill University (Drs Paris), and Department of Sexology, University of Quebec (Dr Hébert), Montreal, Quebec, Canada; and King's College London, Institute of Psychiatry, MRC Social, Genetic and Developmental Psychiatry Centre, London, England (Dr Barker).

EVIDENCE SUGGESTS THAT PERSONALITY traits and their behavioral, emotional, and cognitive childhood antecedents may be involved in predisposition to psychiatric phenotypes, including suicidality.¹ Understanding their contribution would be valuable in identifying vulnerable subgroups, preventing suicidal behaviors, or customizing therapy and predicting its success in suicidal individuals.^{2,3}

Research into attempted suicide, an important predictor of completed suicide,² has highlighted the importance of emotional dysregulation (eg, traits such as anxiousness⁴ and neuroticism⁵) and behavioral dysregulation (traits such as impulsive aggression).⁶⁻⁹ While useful, this empirical evidence has mostly been derived from cross-sectional observations relying on one-point snapshots rather than developmental trajectories. This has precluded elucidation of temporal relationships, predictive values, and age-dependent interactions of such traits. Although limited, relevant evi-

dence suggests that internalizing and externalizing tendencies do interact.^{10,11} The question of preventive and therapeutic relevance—when might the dysregulation in both of these aspects of personality confer higher risk for suicidality—remains unanswered.

Methodological issues have also made it difficult to examine mediating mechanisms linking personality traits and their behavioral markers with suicidality. It is, for example, unclear whether their effects may be independent of or mediated by psychiatric disorders as has been suggested.^{12,13} Finally, moderating influences are suspected but rarely tested in a systematic manner. This knowledge is essential for identification of groups at particularly high risk and in need of timely intervention.

To our knowledge, our study is the first to address these methodological limitations in the context of suicide attempts. Using a prospective, school-based cohort, we investigated childhood trajectories of anxiousness and disruptiveness as possible risk factors for lifetime suicide at-

tempts. Drawing from previous findings,¹¹ we hypothesized that higher levels of childhood anxiousness, disruptiveness, or both have stronger positive associations with suicide attempts than their lower levels. To prevent confounding, we controlled for factors previously linked to both personality and suicidality: adolescent and adult anxiety and mood disorder diagnoses,^{1,14,15} substance abuse,¹⁶ family history of suicide attempts,⁹ childhood sexual abuse,¹⁷ and disruptive disorders.¹⁸ Because relevant research suggests not only a substantial degree of stability between early and later markers of personality¹⁹ but also some differences,^{20,21} we controlled for adult anxiety and conduct problems, traits closely related to our childhood personality measures.¹

Our final 2 objectives are in line with calls for a more sophisticated approach to the study of psychiatric phenotypes. First, because of its well-documented involvement with anxious and aggressive personality traits²² and suicide attempts,²³ we examined whether sex moderated the strength or direction of the association between suicide attempts and developmental trajectories.²³ Second, we examined psychiatric Axis I disorders in the role of mediators,^{14,24} variables that can elucidate underlying etiological pathways. This hypothesis was based on the evidence suggesting a “personological” component in psychiatric diathesis¹: negative emotionality and inhibited temperament, for example, predict internalizing disorders,^{1,11,15,24} whereas early disruptiveness, undercontrolled temperament, and hyperactivity increase the risk for conduct, antisocial, and substance abuse disorders.¹

METHODS

In the 1986 to 1988 school years, families of 4488 children attending kindergarten in francophone schools in Quebec, Canada, were recruited using a multistage sampling procedure. Of these, a representative, randomly selected group of 1001 boys and 999 girls was followed up to adulthood. To reduce cultural heterogeneity, only children with parents born in Canada and with French as their native language were included. Eighty-nine percent were non-Hispanic white individuals.

The assessment schedule had 3 stages: wave 1 (childhood; yearly assessments at ages 6-12 years; n=2000); wave 2 (mid-adolescence; mean age, 15.7 years; age range, 15-18 years; n=1233); and wave 3 (adulthood; mean age, 21.4 years; age range, 19-24 years; n=1144). Participants who died, refused participation, or could not be contacted accounted for an overall attrition percentage of 43%. We used 2 variables related to attrition as weights in the analyses: early socioeconomic adversity (this is a composite index consisting of parental age at first child's birth, education, economic status, and living arrangements, scored on a continuous scale from 0-1 with higher scores representing higher adversity) and sex. Mean early socioeconomic adversity was higher in nonresponders (0.32) than responders (0.25). Males represented 50% of nonresponders and 35% of responders.

The study was approved by the research ethics boards of the University of Montreal and McGill University, Montreal, Quebec. Written informed consent was obtained from all of the subjects.

MEASURES

Childhood Risk Factors

The Social Behavior Questionnaire²⁵ assesses several childhood traits using teacher reports. Because teacher raters dif-

fered each year, the yearly assessments from ages 6 through 12 years were independent. We selected 2 traits: disruptiveness and anxiousness. Disruptiveness (Cronbach $\alpha = .90$), encompassing hyperactive, aggressive, antisocial, and oppositional traits, was based on 13 items: is agitated, always running and jumping, or restless; destroys one's own things or those of others; fights with other children; is not liked by peers; is irritable; is disobedient; lies; mistreats or intimidates peers; does not share material used for a particular task; blames others; is inconsiderate of others; hits and kicks others; and fidgets, squirms, or cannot keep still. Anxiousness (Cronbach $\alpha = .74$) was assessed with 6 items: is fearful or afraid of things or new situations; is worried or worries about many things; cries easily; has a tendency to work alone; looks sad, unhappy, or tearful; and is easily distracted.

Covariates and Mediators

Adolescent mood, anxiety, and disruptiveness diagnoses were considered as covariates and mediators and were assessed with the Diagnostic Interview Schedule for Children version 2²⁶ using *Diagnostic and Statistical Manual of Mental Disorders* (Third Edition Revised)²⁷ criteria. We tested collective effects of externalizing Axis I disorders (attention-deficit/hyperactivity, oppositional-defiant, and conduct disorders) on the one hand and the internalizing ones on the other (mood disorders: major depression and dysthymia; anxiety disorders: simple and social phobias, separation anxiety, panic, avoidant, overanxious, and generalized anxiety disorder). Interviewers were psychology students who attended training for 1 to 1.5 days and a practice session.

The Diagnostic Assessment of Personality Pathology²⁸ measures 18 narrow personality traits, each assessed with 12 to 16 questions inquiring about personal preferences and behaviors. We selected anxiousness (Cronbach $\alpha = .92$) and conduct problems (Cronbach $\alpha = .94$) as covariates.

The Diagnostic Interview Schedule for Adults using *Diagnostic and Statistical Manual of Mental Disorders* (Third Edition Revised) criteria²⁹ allowed us to adjust our models for collective effects of internalizing Axis I disorders (anxiety disorders: generalized anxiety, panic, and phobias; mood disorders: major depression, dysthymia, and bipolar disorder) and externalizing Axis I disorders (abuse of and/or dependence on drugs, alcohol, and nicotine). Interviewers were psychology students who attended training for 1 to 1.5 days and a practice session.

Outcome

Lifetime suicide attempts were assessed using both adolescent and adult reports. Adolescent suicide attempts were obtained from parental or adolescent responses to a Diagnostic Interview Schedule for Children version 2 question: “Have you already attempted suicide?” Either parental report or self-report was sufficient for a person to be classified as an attempter. Adult suicide attempts were ascertained with 1 question: “Have you already attempted suicide?”

DATA ANALYSIS

Step 1: Identifying Trajectories of Anxiousness and Disruptiveness

We identified the developmental trajectories—“clusters of individuals following similar progressions of some behavior or outcome over age or time”³⁰—with semiparametric group-based modeling, a type of growth-mixture modeling. Semiparametric group-based modeling assumes that the population

is composed of a mixture of groups of youth following distinct developmental trajectories³⁰⁻³² described by both the shape (low, increasing) and estimated proportions of individuals following them. Semiparametric group-based modeling can accommodate different types of data distribution by way of censored normal, Poisson, 0-inflated Poisson, and Bernoulli algorithms. Polynomial functions (ie, intercepts, slopes, and quadratic trends) model the link between age and the outcome. The Bayesian Information Criterion was used to select the most optimal from a series of models involving different numbers of trajectory groups.³¹ The semiparametric group-based modeling approach offers several advantages: unlike correlation-based procedures, it is less sensitive to outlier data (ie, it can accommodate nonnormal distributions); it can handle missing data through maximum likelihood estimation without losing information as would happen with listwise deletion; by allowing model parameters to differ across groups, it allows for population heterogeneity at the level of the individual at a given time and over age; and for each individual, it outputs posterior probabilities (probabilities of following trajectory subgroups) that are used as weights to account for membership uncertainty.

A generalization of semiparametric group-based modeling is the joint trajectory method.³³ This routine links trajectories of 2 related but distinct outcomes into joint trajectories, allowing examination of the coevolution of 2 behaviors. We used the best-fitting trajectory models for anxiousness and disruptiveness as the starting point for the joint models whose key outputs are the conditional and joint probabilities of following given trajectories of anxiousness and disruptiveness (eg, the probability of following high trajectories of both). The analyses were performed using the SAS-TRAJ procedure (SAS Institute Inc, Cary, North Carolina).^{30-32,34}

Step 2: Linking Trajectories to Suicide Attempts

We differentiated between high-risk (moderate or high level) and low-risk (low and very low level) trajectories of anxiousness and disruptiveness (Figure 1 and Figure 2). Their relationship with possible confounders was examined in a series of univariate (χ^2 test) and multivariate (logistic regression) models. We assessed sizes and significance of odds ratios (ORs) associated with anxiousness and disruptiveness considered both independently of each other and then jointly, ie, their joint trajectories. Analyses were weighted by the inverse of each individual's probability of being in the original sample, conditional on the 2 variables related to attrition: sex and early socioeconomic adversity.

Sex was also tested as a moderator of the relationship between trajectories and suicide attempts.³⁵ Briefly, using hierarchical multiple regression, we entered main effects for trajectories, sex, and their interaction. On finding a significant moderating effect, we conducted post hoc tests to quantify regression slopes and examine their statistical significance according to Wald χ^2 test separately in women and men.³⁵

Disruptive and adolescent anxiety/mood disorders were tested as mediators of the effects of anxiousness and disruptiveness trajectories on suicide attempts.²⁴ Mediators are variables that account for a portion or all of the association between a predictor (P) and an outcome (O). Mediation is also operationalized as a mechanism through which P influences O.²⁴ Mediation testing consists of 4 regression steps²⁴ needed to demonstrate associations between the following: (1) P (trajectories) and O (suicide attempts); (2) P and mediators Me1 (ie, adolescent anxiety/mood disorders as mediators of the effect of anxiousness trajectories on suicide attempts) and Me2 (ie, disruptive disorders as mediators of the effect of disruptiveness trajectories

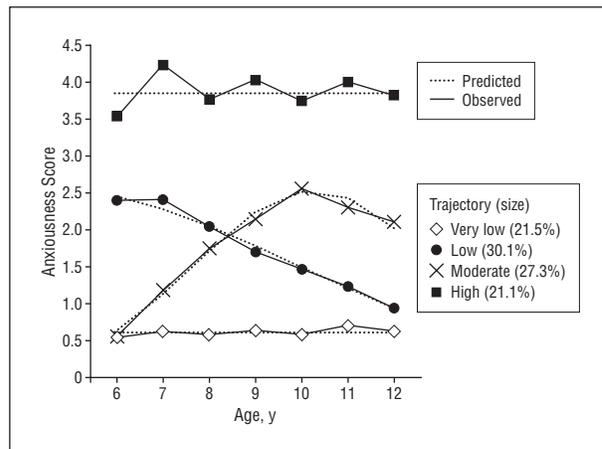


Figure 1. Anxiousness trajectories.

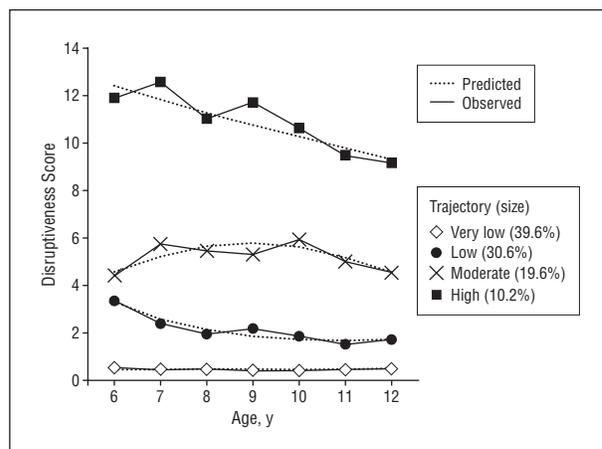


Figure 2. Disruptiveness trajectories.

on suicide attempts); (3) Me and O; and (4) P and O while controlling for Me. Where there is a decrease in the total effect when the mediator is controlled for, suggesting existence of an indirect, mediating effect, Sobel and Goodman tests are used to establish its statistical significance.³⁶ These tests require unstandardized path coefficients and their standard errors.

RESULTS

IDENTIFYING TRAJECTORIES

Trajectories were available for 1869 individuals who had at least 3 childhood data points. The Bayesian Information Criterion suggested the 4-group trajectory solution as the most optimal for both anxiousness and disruptiveness (Figure 1 and Figure 2). Of the 4 trajectories of disruptiveness, the most frequent one was the very low trajectory, representing 40% of the sample, in contrast to the high trajectory followed by only 10% (Figure 2). Moderate (20%) and low (31%) disruptiveness had a more stable character than their anxiousness equivalents, representing 27% and 30% of the sample, respectively (Figure 2). The most commonly followed trajectory of anxiousness was the low trajectory, comprising individuals whose anxiousness declined from moderate to low levels (30%) (Figure 1).

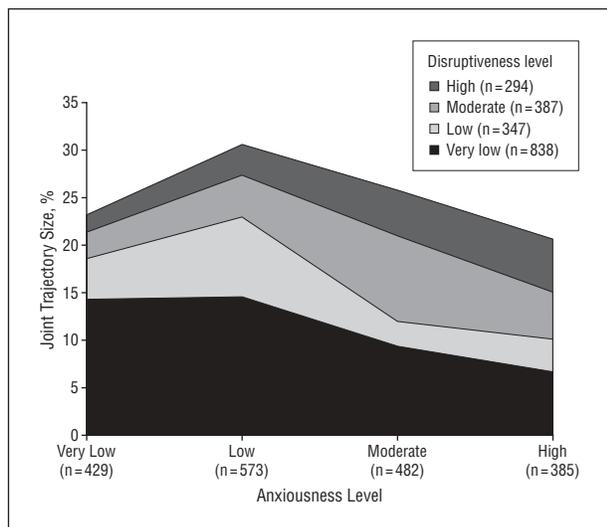


Figure 3. Dual trajectories.

The joint trajectories procedure allowed us to examine the co-occurrence of the 2 traits by estimating proportions of individuals following different combinations of the trajectories of anxiousness and disruptiveness (Figure 3). About one-third of the sample had low or very low levels of both traits, whereas only 5% displayed the highest levels of both. In general, participants were most likely to follow equivalent (prevalence range, 6%-14%) or similar (very low and low or high and moderate; prevalence range, 4%-15%) levels of both traits. Dissimilar anxiousness and disruptiveness levels, eg, very low or low with high or moderate trajectories, were least frequent, occurring in less than 4% of participants.

DESCRIPTIVE STATISTICS

High-risk (moderate- or high-level) trajectories of anxiousness, disruptiveness, or both were associated with higher mean socioeconomic adversity ($P < .001$) in childhood than their low-risk counterparts: 0.30 vs 0.24, 0.32 vs 0.24, and 0.33 vs 0.25, respectively. All of the 3 high-risk groups also had higher prevalence of suicide attempts relative to low-risk groups (Table 1). Furthermore, males, family history of suicide attempts, and substance dependence or abuse disorders were overrepresented in high-risk joint and disruptiveness trajectories (Table 1). Individuals who were highly disruptive as children had a lower prevalence of adolescent mood and anxiety disorders and a higher prevalence of disruptive disorders (Table 1). Childhood sexual abuse was more common in the high-risk joint trajectories than in the low-risk ones (Table 1).

MULTIVARIATE MODELS

Trajectories of Anxiousness

Relative to their low-risk counterparts, high-risk anxiousness trajectories were associated with a 60% increase in the likelihood of attempted suicide, exhibiting a statistically significant trend in the presence of covar-

iates. As for the latter, adolescent anxiety and mood disorder diagnoses (OR=1.41), family history of suicide attempts (OR=2.50), and experiences of childhood sexual abuse (OR=1.37) made statistically significant contributions (Table 2).

Trajectories of Disruptiveness

High-risk disruptiveness was significantly associated with suicide attempts (OR=1.80). In addition to sex (OR=2.28) and substance abuse or dependence (OR=1.50), disruptive disorders were also statistically relevant (OR=2.39). Similarly, familial suicide attempts (OR=2.83) and childhood sexual abuse (OR=1.36) had positive associations with personal history of suicide attempts. In contrast, the personality trait dimension of conduct problems, assessed in adulthood by means of the Diagnostic Assessment of Personality Pathology, was not significant (OR=1.03) (Table 2).

Joint Trajectories

Moderate to high levels of disruptiveness and anxiousness doubled the risk of suicide attempts (OR=1.88). Adolescent internalizing (OR=1.40) and disruptive (OR=2.21) disorders, substance abuse or dependence (OR=1.41), and conduct problems (OR=1.04) were also statistically significant. Family history of suicide attempts tripled the likelihood of personal history of suicide attempts (OR=2.96), whereas childhood sexual abuse had a more modest effect size (OR=1.35) (Table 2).

MEDIATING AND MODERATING EFFECTS

Childhood anxiousness and disruptiveness in this study did not influence the risk for suicide attempts by increasing the likelihood of adolescent anxiety/mood or disruptive disorders, respectively. The 4 criteria required to reject the null hypothesis of no mediation were not met. Only disruptive and disruptive/anxious children had a higher prevalence of disruptive disorders than their low-trajectory counterparts (disruptive children: 10.0% vs 5.0%, respectively; $P < .001$; and disruptive/anxious children, 9% vs 6%, respectively; $P = .11$), but the mediating/indirect effects were not statistically significant.

The relationship between high-risk joint trajectories and suicide attempts was moderated by sex (test of interaction: Wald $\chi^2 = 5.90$; $P = .01$). While the average OR in the sample was 1.88 (Table 2), when stratified by sex, the odds of suicide attempts in children following high-risk joint trajectories were higher among girls (OR=3.60; Wald $\chi^2 = 10.93$; $P < .001$) than among boys (OR=0.80; Wald $\chi^2 = 0.23$; $P = .64$).

COMMENT

Using a developmental, person-centered approach, we examined temporal trends in childhood anxiousness and disruptiveness in relation to lifetime suicide attempts assessed in early adulthood. To our knowledge, this is the first study to examine the codevelopment of anxious-

Table 1. Univariate Differences Between High- and Low-Risk Trajectories^a

Characteristic	Anxiousness Trajectories			Disruptiveness Trajectories			Joint Trajectories		
	Low-Risk		High-Risk	Low-Risk		High-Risk	Low-Risk		High-Risk
	Participants, No. (%)	Participants, No. (%)	OR (95% CI)	Participants, No. (%)	Participants, No. (%)	OR (95% CI)	Participants, No. (%)	Participants, No. (%)	OR (95% CI)
Sex									
Men	465 (49)	443 (49)	1 [Reference]	513 (40)	395 (70)	1 [Reference]	616 (44)	293 (64)	1 [Reference]
Women	499 (51)	461 (51)	1.0 (0.8-1.2)	797 (60)	163 (30)	0.3 (0.2-0.3) ^b	800 (56)	160 (36)	0.5 (0.4-0.6) ^b
Family history of suicide attempts									
Negative	560 (94)	486 (93)	1 [Reference]	774 (95)	272 (9)	1 [Reference]	814 (94)	232 (92)	1 [Reference]
Positive	34 (6)	39 (7)	1.3 (0.8-2.1)	45 (5)	28 (9)	1.7 (1.1-3.0) ^c	51 (6)	22 (8)	1.3 (0.8-2.3)
Personal history of suicide attempts									
Negative	674 (93)	583 (89)	1 [Reference]	923 (93)	334 (88)	1 [Reference]	982 (93)	275 (87)	1 [Reference]
Lifetime	47 (7)	75 (11)	1.8 (1.3-2.7) ^d	73 (7)	49 (12)	1.9 (1.3-2.8) ^d	76 (7)	46 (13)	2.1 (1.4-3.1) ^d
Adolescent mood/anxiety disorder									
Negative	459 (78)	395 (75)	1 [Reference]	609 (75)	244 (82)	1 [Reference]	653 (76)	200 (80)	1 [Reference]
Positive	133 (22)	130 (25)	1.1 (0.9-1.5)	207 (25)	56 (18)	0.7 (0.5-0.9) ^c	210 (24)	53 (20)	0.8 (0.6-1.1)
Disruptive disorder									
Negative	550 (93)	490 (94)	1 [Reference]	772 (95)	268 (90)	1 [Reference]	810 (94)	230 (91)	1 [Reference]
Positive	36 (7)	33 (6)	1.0 (0.6-1.7)	40 (5)	29 (10)	2.0 (1.2-3.3) ^d	47 (6)	23 (9)	1.6 (0.9-2.7)
Adult mood/anxiety disorder									
Negative	440 (78)	376 (74)	1 [Reference]	594 (75)	222 (80)	1 [Reference]	635 (76)	181 (78)	1 [Reference]
Positive	132 (22)	136 (26)	1.2 (0.9-1.6)	206 (25)	62 (20)	0.8 (0.5-1.1)	25 (24)	23 (22)	0.9 (0.6-1.3)
Substance misuse									
Negative	361 (63)	323 (62)	1 [Reference]	536 (66)	148 (52)	1 [Reference]	553 (64)	131 (56)	1 [Reference]
Positive	210 (37)	190 (38)	1.1 (0.8-1.3)	264 (34)	136 (48)	1.8 (1.4-2.4) ^b	295 (36)	105 (44)	1.4 (1.1-1.9) ^c
Childhood sexual abuse									
Negative	474 (84)	406 (80)	1 [Reference]	657 (83)	223 (81)	1 [Reference]	701 (84)	179 (77)	1 [Reference]
Positive	101 (16)	113 (20)	1.3 (1.0-1.8)	149 (17)	65 (19)	1.2 (0.8-1.7)	152 (16)	62 (23)	1.6 (1.1-2.2) ^c

Abbreviations: CI, confidence interval; OR, odds ratio.

^aCounts refer to unweighted counts, and percentages refer to weighted percentages.

^b $P < .001$.

^c $.01 < P < .05$.

^d $.001 \leq P \leq .01$.

ness and disruptiveness and risk for suicide attempts. This is also one of the first efforts to formally evaluate relevant mediating and moderating effects.

We observed 4 distinct developmental profiles of anxiousness and disruptiveness and a frequent co-occurrence of similar levels of the 2 traits. Four trajectories of disruptiveness were also reported in a different French-Canadian cohort focusing on disadvantaged boys and individual components of disruptiveness.³¹ Our data agree with prior studies estimating that highly anxious temperaments occur in 15% to 20% of any population,³⁷ with highly disruptive behaviors being less frequent.³⁸ Intriguingly, we have observed that while high anxiousness can and most often did coexist with very low disruptiveness, the converse was rarely the case. This relational asymmetry requires research into the biological and environmental contributions to each trait as well as epidemiological validation in other samples.

Anxious, disruptive, and, in particular, anxious/disruptive children had a higher prevalence of and higher risk for suicide attempts. The relationship between high-risk joint and high-risk disruptiveness trajectories with suicide attempts persisted in the presence of demographic, psychiatric, experiential, and adult personality covariates. Our conclusions are similar to previous research whose support for anxious traits appears to be less consistent than that for externalizing traits related to disruptiveness.³⁹

As for our covariates, we provide further support for the relevance of Axis I disorders to suicide attempts. This

was evident for externalizing diagnoses in adolescence and adulthood (disruptive and substance abuse disorders) and for internalizing diagnoses in adolescence (mood and anxiety disorders) but not in adulthood. The association of internalizing disorders (mainly major and bipolar depression) and suicidality has been consistently corroborated.⁴⁰ As for externalizing diagnoses, impulse control dysregulation, a feature common to substance abuse and disruptive disorders, may explain their involvement in both suicidal behaviors and psychiatric comorbidity.^{41,42}

Second, of our 2 adult personality constructs, the trait of conduct problems exhibited a stronger relationship with suicide attempts than did adult anxiety. Considered together with the significant involvement of the disruptiveness and joint but not anxiousness trajectories, this suggests that early externalizing behaviors may be more useful markers of the risk for suicidality than both the internalizing ones and those assessed in adulthood.

Third, sex exhibited a main effect in relation to disruptiveness but a moderating one in relation to joint trajectories. (The absence of sex differences in preadolescent anxiousness is not too surprising given that such differences in internalizing behaviors may not appear until adolescence.⁴³) Sex-based differences in joint and disruptiveness trajectories are consistent with the reported sex differences in externalizing behaviors and suicide attempts.^{22,23,43} Together, these findings suggest that sex merits serious consideration in both clinical and research contexts. Clinically, girls at risk for suicide attempts appear

Table 2. Adjusted Models for High-Risk Anxiousness and Disruptiveness as Risk Factors for Lifetime Suicide Attempts

Lifetime Suicide Attempts	OR (95% CI)		
	Anxiousness	Disruptiveness	Joint
High- vs low-risk trajectory membership	1.60 (1.00-2.65) ^a	1.80 (1.03-3.13) ^b	1.88 (1.05-3.37) ^a
Sex	1.94 (0.59-1.81)	2.28 (1.21-4.29) ^b	1.88 (0.96-3.67) ^a
Adult trait of anxiousness	1.01 (0.99-1.03)	NA	0.99 (0.97-1.02)
Adult trait of conduct problems	NA	1.03 (1.00-1.06) ^a	1.04 (1.00-1.08) ^b
Adolescent mood/anxiety disorder	1.41 (1.08-1.85) ^b	NA	1.40 (1.03-1.91) ^b
Disruptive disorder	NA	2.39 (1.23-4.65) ^c	2.21 (1.10-4.44) ^b
Adult mood/anxiety disorder	1.32 (0.76-2.29)	NA	1.09 (0.57-2.08)
Adult substance abuse or dependence	NA	1.50 (1.10-2.04) ^b	1.41 (1.01-1.97) ^b
Family history of suicide attempts	2.50 (1.17-5.34) ^b	2.83 (1.33-6.02) ^c	2.96 (1.34-6.55) ^c
Childhood sexual abuse	1.37 (1.21-1.55) ^d	1.36 (1.19-1.54) ^d	1.35 (1.17-1.55) ^d

Abbreviations: CI, confidence interval; NA, not applicable; OR, odds ratio.

^a.05 ≤ *P* < .10.

^b.01 < *P* < .05.

^c.001 ≤ *P* ≤ .01.

^d*P* < .001.

to display both anxious and disruptive traits and boys appear to display mostly the latter. Before this can be used in tailoring preventive and management programs, mechanisms underlying sex moderation, such as gene-environment interactions, require further research as they may account for sex-specific profiles of personality markers of suicide attempts.

Among candidate endophenotypes that can explain associations between childhood traits and suicidal behaviors, psychopathology is particularly promising because on the one hand it may represent an extreme expression of temperament⁴⁴ and on the other it is strongly associated with suicidality. Nevertheless, our hypotheses predicting that adolescent mood/anxiety and disruptive disorders mediate the effects of childhood anxiousness and disruptiveness, respectively, on suicide attempts were not supported. One explanation may be methodological. Underestimation of the effect of the mediator and overestimation of the effect of the predictor are directly related to the measurement error in the mediator.²⁴ More powerful samples, either larger in size or lower in attrition, will be necessary before we can exclude this possibility.

Alternatively, childhood antecedents may indeed primarily act directly and any mediating effect through adolescent psychopathology may be weak, a situation that is plausible in young suicide attempters identified in the general population. Furthermore, early anxiousness and disruptiveness are undifferentiated, broad, and probably quite heterogeneous,⁴⁵ and their mediators may be further affected by different moderators (eg, turning-point events or sex). Also, given that the effect of temperament on psychopathology may be mediated by both internal and external factors,⁴⁴ multiple mediators—such as nonshared environmental factors and relational variables—acting collectively may also be involved. Because our study population was normative and young, some of these effects may be cumulative, contingent on continued developmental challenges and maturational patterns. In sum, not only can a mediational effect be restricted to specific subgroups but it may also require longer time to manifest. Future studies should therefore inves-

tigate moderated mediation and test multiple mediators simultaneously in suitably sized samples.

Our findings need to be considered in light of several methodological limitations. Given our culturally homogeneous community sample, present conclusions may have limited generalizability to other populations.

Attrition may have affected our internal validity, although we conducted weighted analyses to minimize its effect. Our estimates of ORs are probably larger than their risk ratio counterparts given that they are not equivalent for an outcome whose frequency is more than 10%.

Lastly, mediational tests require temporal ordering of the predictor, mediator, and outcome such that the mediator must follow the predictor and precede the outcome. Because we focused on lifetime suicide attempts and did not have information on their precise time of onset, it is possible that some suicide attempts had occurred before age 16 years, the average age at which our mediators were assessed. However, because less than 1% of suicide attempts occur before age 15 years, we do not believe that this had a major effect on our findings.⁴⁶

Although our trajectories covary with and precede suicide attempts and their association is theoretically plausible and suggested in the literature, our design was not experimental. We may have failed to rule out other variables responsible for their relationship.

These limitations were balanced by a number of methodological strengths. We used a comprehensive, hypothesis-driven approach, relying on multipoint assessments by independent raters and conducting analyses weighted for attrition. Lastly, in establishing the optimal number of trajectories, we used statistical criteria rather than arbitrary cutoffs.

In conclusion, we have demonstrated that the effects of childhood personality markers (primarily externalizing) on suicide attempts are largely independent of related covariates. Moreover, these effects were direct rather than mediated by adolescent psychopathology. Pending further research, preventive programs may benefit from considering sex differences in personality markers as early as childhood.

Accepted for Publication: April 22, 2008.

Correspondence: Gustavo Turecki, MD, PhD, McGill Group for Suicide Studies, 6875 LaSalle Blvd, Montreal, QC H4H 1R3, Canada (gustavo.turecki@mcgill.ca).

Author Contributions: Drs Tremblay and Turecki share senior authorship of this work. Dr Brezo had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Brezo, Paris, Vitaro, and Turecki. *Acquisition of data:* Hébert, Vitaro, Tremblay, and Turecki. *Analysis and interpretation of data:* Brezo, Barker, Paris, Vitaro, and Turecki. *Drafting of the manuscript:* Brezo and Paris. *Critical revision of the manuscript for important intellectual content:* Barker, Paris, Hébert, Vitaro, Tremblay, and Turecki. *Statistical analysis:* Brezo, Barker, and Vitaro. *Obtained funding:* Paris, Hébert, Vitaro, Tremblay, and Turecki. *Administrative, technical, and material support:* Paris. *Study supervision:* Turecki.

Financial Disclosure: None reported.

Funding/Support: This work was supported by grant MOP 151060 from the Canadian Institutes of Health Research and by the National Consortium on Violence Research, Carnegie Mellon University, the Programme National de recherche et de développement en matière de santé, the Conseil Québécois de la recherche sociale, and the Fonds Québécois de la recherche sur la société et la culture.

REFERENCES

1. Krueger RF, Caspi A, Moffitt TE. Epidemiological personology: the unifying role of personality in population-based research on problem behaviors. *J Pers.* 2000; 68(6):967-998.
2. Brezo J, Paris J, Turecki G. Personality traits as correlates of suicidal ideation, suicide attempts, and suicide completions: a systematic review. *Acta Psychiatr Scand.* 2006;113(3):180-206.
3. Coté S, Tremblay RE, Nagin DS, Zoccolillo M, Vitaro F. Childhood behavioral profiles leading to adolescent conduct disorder: risk trajectories for boys and girls. *J Am Acad Child Adolesc Psychiatry.* 2002;41(9):1086-1094.
4. van Heeringen C, Audenaert K, Van Laere K, et al. Prefrontal 5-HT_{2a} receptor binding index, hopelessness and personality characteristics in attempted suicide. *J Affect Disord.* 2003;74(2):149-158.
5. Beautrais AL, Joyce PR, Mulder RT. Personality traits and cognitive styles as risk factors for serious suicide attempts among young people. *Suicide Life Threat Behav.* 1999;29(1):37-47.
6. Koller G, Preuss UW, Bottlender M, Wenzel K, Soyka M. Impulsivity and aggression as predictors of suicide attempts in alcoholics. *Eur Arch Psychiatry Clin Neurosci.* 2002;252(4):155-160.
7. Kausch O. Suicide attempts among veterans seeking treatment for pathological gambling. *J Clin Psychiatry.* 2003;64(9):1031-1038.
8. Turecki G. Dissecting the suicide phenotype: the role of impulsive-aggressive behaviours. *J Psychiatry Neurosci.* 2005;30(6):398-408.
9. Brent DA, Mann JJ. Family genetic studies, suicide, and suicidal behavior. *Am J Med Genet C Semin Med Genet.* 2005;133C(1):13-24.
10. Gil S. The role of personality traits in understanding of suicide attempt behavior among psychiatric patients. *Arch Suicide Res.* 2003;7(2):159-166.
11. Caspi A, Moffitt TE, Newman DL, Silva PA. Behavioral observations at age 3 years predict adult psychiatric disorders: longitudinal evidence from a birth cohort. *Arch Gen Psychiatry.* 1996;53(11):1033-1039.
12. Lonigan CJ, Phillips BM, Hooe ES. Relations of positive and negative affectivity to anxiety and depression in children: evidence from a latent variable longitudinal study. *J Consult Clin Psychol.* 2003;71(3):465-481.
13. Klein MH, Wonderlich S, Shea MT. Models of relationships between personality and depression: toward a framework for theory and research. In: Klein MH, Kupfer DJ, Shea MT, eds. *Personality and Depression: A Current View.* New York, NY: Guilford Press; 1993:1-54.
14. Boden JM, Fergusson DM, Horwood LJ. Anxiety disorders and suicidal behaviours in adolescence and young adulthood: findings from a longitudinal study. *Psychol Med.* 2007;37(3):431-440.
15. Watson D, Clark LA, Harkness AR. Structures of personality and their relevance to psychopathology. *J Abnorm Psychol.* 1994;103(1):18-31.
16. Kelly TM, Cornelius JR, Lynch KG. Psychiatric and substance use disorders as risk factors for attempted suicide among adolescents: a case control study. *Suicide Life Threat Behav.* 2002;32(3):301-312.
17. Santa Mina EE, Gallop RM. Childhood sexual and physical abuse and adult self-harm and suicidal behaviour: a literature review. *Can J Psychiatry.* 1998;43(8):793-800.
18. Renaud J, Brent DA, Birmaher B, Chiappetta L, Bridge J. Suicide in adolescents with disruptive disorders. *J Am Acad Child Adolesc Psychiatry.* 1999;38(7):846-851.
19. Caspi A, Harrington H, Milne B, Amell JW, Theodore RF, Moffitt TE. Children's behavioral styles at age 3 are linked to their adult personality traits at age 26. *J Pers.* 2003;71(4):495-513.
20. Jones CJ, Meredith W. Patterns of personality change across the life span. *Psychol Aging.* 1996;11(1):57-65.
21. Lewis M. *Altering Fate: Why the Past Does Not Predict the Future.* New York, NY: Guilford Press; 1997.
22. Costa PT Jr, Terracciano A, McCrae RR. Gender differences in personality traits across cultures: robust and surprising findings. *J Pers Soc Psychol.* 2001; 81(2):322-331.
23. Beautrais AL. Gender issues in youth suicidal behaviour. *Emerg Med (Fremantle).* 2002;14(1):35-42.
24. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol.* 1986;51(6):1173-1182.
25. Mäse LC, Tremblay RE. Behavior of boys in kindergarten and the onset of substance use during adolescence. *Arch Gen Psychiatry.* 1997;54(1):62-68.
26. Breton JJ, Bergeron L, Valla JP, Berthiaume C, St-Georges M. Diagnostic Interview Schedule for Children (DISC-2.25) in Quebec: reliability findings in light of the MECA study. *J Am Acad Child Adolesc Psychiatry.* 1998;37(11):1167-1174.
27. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders.* 3rd ed, revised. Washington, DC: American Psychiatric Association; 1987.
28. Livesley WJ, Jang KL, Vernon PA. Phenotypic and genetic structure of traits delineating personality disorder. *Arch Gen Psychiatry.* 1998;55(10):941-948.
29. Robins LN, Cottler L, Bucholtz K, Compton W. *Diagnostic Interview Schedule for DSM-IV.* St Louis, MO: Washington University; 1995.
30. Jones BL, Nagin DS. Advances in group-based trajectory modeling and an SAS procedure for estimating them. *Sociol Methods Res.* 2007;35(4):542-571.
31. Nagin D, Tremblay RE. Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. *Child Dev.* 1999;70(5):1181-1196.
32. Jones BL, Nagin DS, Roeder K. A SAS procedure based on mixture models for estimating developmental trajectories. *Sociol Methods Res.* 2001;29(3):374-393.
33. Nagin DS, Tremblay RE. Analyzing developmental trajectories of distinct but related behaviors: a group-based method. *Psychol Methods.* 2001;6(1):18-34.
34. Jones BL. SAS PROC TRAJ. <http://www.andrew.cmu.edu/user/bjones/index.htm>. Accessed November 15, 2007.
35. Holmbeck GN. Post-hoc probing of significant moderational and mediational effects in studies of pediatric populations. *J Pediatr Psychol.* 2002;27(1):87-96.
36. Kenny DA. Mediation. <http://davidakenny.net/cm/mediate.htm>. Accessed November 15, 2007.
37. Prior M, Smart D, Sanson A, Oberklaid F. Sex differences in psychological adjustment from infancy to 8 years. *J Am Acad Child Adolesc Psychiatry.* 1993; 32(2):291-304.
38. Mun EY, Fitzgerald HE, von Eye A, Putterli LI, Zucker RA. Temperamental characteristics as predictors of externalizing and internalizing child behavior problems in the contexts of high and low parental psychopathology. *Infant Ment Health J.* 2001;22(3):393-415.
39. Brezo J, Paris J, Tremblay R, et al. Personality traits as correlates of suicide attempts and suicidal ideation in young adults. *Psychol Med.* 2006;36(2):191-202.
40. Cavazzoni P, Grof P, Duffy A, et al. Heterogeneity of the risk of suicidal behavior in bipolar-spectrum disorders. *Bipolar Disord.* 2007;9(4):377-385.
41. Turecki G. Suicidal behavior: is there a genetic predisposition? *Bipolar Disord.* 2001;3(6):335-349.
42. Verona E, Sachs-Ericsson N, Joiner TE Jr. Suicide attempts associated with externalizing psychopathology in an epidemiological sample. *Am J Psychiatry.* 2004; 161(3):444-451.
43. Bongers IL, Koot HM, van der Ende J, Verhulst FC. The normative development of child and adolescent problem behavior. *J Abnorm Psychol.* 2003;112(2): 179-192.
44. Rettew DC, McKee L. Temperament and its role in developmental psychopathology. *Harv Rev Psychiatry.* 2005;13(1):14-27.
45. Crijnen AAM, Achenbach TM, Verhulst FC. Problems reported by parents of children in multiple cultures: the Child Behavior Checklist syndrome constructs. *Am J Psychiatry.* 1999;156(4):569-574.
46. Goldman S, Beardslee WR. Suicide in children and adolescents. In: Jacobs DG, ed. *The Harvard Medical School Guide to Suicide Assessment and Intervention.* San Francisco, CA: Jossey-Bass Publishers; 1999.