

Aggressiveness, not impulsiveness or hostility, distinguishes suicide attempters with major depression

JOHN G. KEILP^{1,2*}, MARIANNE GORLYN², MARIA A. OQUENDO^{1,2},
BETH BRODSKY^{1,2}, STEVEN P. ELLIS^{1,2}, BARBARA STANLEY^{1,2}
AND J. JOHN MANN^{1,2}

¹ *Department of Neuroscience, New York State Psychiatric Institute, New York;* ² *Department of Psychiatry, Columbia University College of Physicians and Surgeons, USA*

ABSTRACT

Background. Impulsiveness, hostility and aggressiveness are traits associated with suicidal behavior, but also with borderline personality disorder (BPD). The presence of large numbers of BPD subjects in past attempter samples may distort the relative importance of each of these traits to predicting suicidal behavior, and lead to prospective, biological and genetic models that systematically misclassify certain subpopulations of suicidal individuals.

Method. Two hundred and seventy-five subjects with major depressive disorder (MDD), including 87 with co-morbid BPD (69 past suicide attempters, 18 non-attempters) and 188 without BPD (76 attempters, 112 non-attempters) completed standard impulsiveness, hostility and aggressiveness ratings. Differences between past suicide attempters and non-attempters were examined with the sample stratified by BPD status.

Results. As expected, BPD subjects scored significantly higher than non-BPD subjects on all three trait measures. Stratifying by BPD status, however, eliminated attempter/non-attempter differences in impulsiveness and hostility in both patient subgroups. Past suicide attempters in each of the two subgroups of patients were only distinguished by higher levels of aggressiveness.

Conclusions. Once BPD is accounted for, a history of aggressive behavior appears to be the distinguishing trait characteristic of suicide attempters with major depression, rather than global personality dimensions such as impulsiveness or hostility. Aggressiveness, and not these related traits, may be the ideal target for behavioral, genetic and biological research on suicidal behavior, as well as for the clinical assessment of suicide risk.

INTRODUCTION

Impulsiveness, hostility and aggressiveness are risk factors for suicidal behavior (Fawcett *et al.* 1997; Plutchik & van Praag, 1997; Conner *et al.* 2001). Past suicide attempter samples typically exhibit higher levels of these traits, suggesting that they are related to a common underlying behavioral dimension crucial to suicide risk (Mann *et al.* 1999). A propensity to impulsive aggression, a composite of these traits, appears

to be transmitted in families of suicide attempters and to be associated with increased risk (Brent & Mann, 2005). However, these traits are also characteristic of borderline personality disorder (BPD), an Axis II diagnosis that is common in suicide attempter samples (Zisook *et al.* 1994; Soloff *et al.* 2000). To the extent that BPD subjects are heavily represented or over-represented in past attempter samples, the prognostic significance of these traits for all suicide attempters may be distorted. There is some evidence that they play a less important role in suicidal behavior for those subjects without BPD (Suominen *et al.* 1997; Horesh

* Address for correspondence: Dr J. G. Keilp, Box 42, NYSPI, 1051 Riverside Drive, New York, NY 10032, USA.
(Email: johnkeil@neuron.cpmc.columbia.edu)

et al. 2003). This is a crucial consideration for behavioral, biological and genetic studies of traits associated with suicidal behavior, as well as for treatment studies targeting risk-related behaviors.

Impulsiveness, hostility and aggressiveness are often treated interchangeably and subsumed within the composite behavioral dimension of 'impulsive aggression' in suicide research, but they are distinct concepts. While we assess traits such as impulsiveness and hostility as precursors to aggressive acts, they may not be sufficient as a cause of aggressive behavior, nor necessary conditions for all types of aggressive behavior. Impulsiveness is a broad personality trait defined by spontaneous, poorly planned or situationally inappropriate behaviors that may or may not include aggressive behaviors (Evdenden, 1999). Hostility is a mood state (Buss & Durkee, 1961) that, again, may or may not be reflected in actions directed against the self or others. Aggressive behavior, in turn, may be premeditated rather than impulsive (Barratt *et al.* 1999; Stanford *et al.* 2003), and premeditated aggression may play a role in suicidal behavior that is carefully planned and executed.

The purpose of this study was to evaluate the relative contributions of impulsiveness, hostility and aggressiveness to distinguishing between depressed suicide attempters and non-attempters, controlling for the effects of co-morbid BPD. Our goal was to determine whether these personality dimensions were equally important for differentiating attempters in samples with and without co-morbid BPD. The ultimate aim of this study was to identify those traits within each subgroup, or perhaps across subgroups, that are likely to be the most fruitful targets for behavioral, biological and genetic studies of suicide risk.

METHOD

Subjects

Two hundred and seventy-five unipolar depressed subjects were recruited at two academic medical centers between 1990 and 2003. Diagnosis of major depressive disorder (MDD) was established by the Structured Clinical Interview for DSM-IV, patient version (SCID-P; Spitzer *et al.* 1990) administered by trained, doctoral-level interviewers. The sample included 87

subjects with a co-morbid diagnosis of BPD, established by the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II, First *et al.* 1996). Demographic and clinical characteristics of the sample, divided by BPD diagnostic status, are presented in Table 1. The BPD sample included 69 subjects with a past history of suicide attempt (79.3%). The non-BPD sample included 76 subjects with a past attempt history (40.4%). Past history of attempt was established using a standard, structured interview developed in our center (Oquendo *et al.* 2003). To be classified as a suicide attempt, the subject must have engaged in behavior that either caused self-injury or had the potential to cause self-injury. The subject must also have had some intent to die as a result of the action. Risky behaviors where there was no intent to die were not classified as attempts. Severity of past attempts, defined in terms of actual medical damage caused, was rated on the eight-point scale devised by Beck *et al.* (1975). All classifications of suicide attempts are made by consensus of the entire clinical assessment team.

Assessment instruments

Subjects received a demographic and clinical history, and were characterized in terms of depression severity using the Hamilton Depression Rating Scale (Hamilton, 1960) and the Beck Depression Inventory (Beck *et al.* 1961), functional status (Global Assessment of Function, both including and excluding consideration of prior suicidal behavior), suicidal ideation (Scale for Suicidal Ideation; Beck *et al.* 1979, administered both at the time of study enrollment and retrospectively for the 2 weeks prior to enrollment), and hopelessness (Beck Hopelessness Scale; Beck *et al.* 1974).

Impulsiveness, hostility and aggressiveness were assessed using the Barratt Impulsiveness Scale (BIS; Barratt, 1985, 1994), the Buss–Durkee Hostility Inventory (BDHI; Buss & Durkee, 1961) and a modified version of the Brown–Goodwin Aggression History (AGGHx; Brown *et al.* 1979) respectively. The version of the BIS used in this study is the earliest version of the eleventh revision of the scale, provided to us by the scale's author and used in our center for 15 years. It is an intermediate version between the tenth and final eleventh version,

Table 1(a). Demographic and clinical characteristics of past suicide attempter and non-attempter groups, stratified by borderline personality disorder (BPD) status

	Non BPD				BPD			
	Attempters (n=76)		Non-attempters (n=112)		Attempters (n=69)		Non-attempters (n=18)	
	Mean/%	(S.D.)/n	Mean/%	(S.D.)/n	Mean/%	(S.D.)/n	Mean/%	(S.D.)/n
Age	38.41	(11.84)	40.75	(13.67)	31.17	(8.43)	33.94	(8.94)
Education	14.33	(2.99)	14.50	(3.36)	14.07	(3.04)	15.41	(2.50)
Gender (% male)	43.40%	33	48.20%	54	24.60%	17	11.10%	2
Race (% Caucasian)	72.40%	55	75.90%	85	71.00%	49	88.90%	16
Language (% English)	88.50%	54	82.70%	86	89.70%	52	88.90%	16
Age at first treatment	30.88	(11.84)	33.39	(12.18)	23.94	(7.66)	28.18	(8.61)
Major depressive episodes (log)	1.44	(0.80)	1.28	(0.62)	1.63	(0.97)	1.36	(0.59)
	median = 2		median = 2		median = 3		median = 3	
Hospitalizations (log)	0.88	(0.74)	0.39	(0.63)	1.34	(1.03)	0.36	(0.64)
	median = 1		median = 0		median = 2		median = 0	
Length current episode (weeks) (log)	2.95	(1.27)	3.26	(1.32)	2.89	(1.12)	3.41	(1.25)
	median = 16		median = 24		median = 17		median = 20	
Past suicide attempts	2.39	(2.40)	—	—	4.46	(11.71)	—	—
Maximum attempt lethality	3.22	(2.28)	—	—	3.49	(1.83)	—	—
Lethality of most recent attempt	2.79	(2.21)	—	—	2.88	(2.00)	—	—
Past history of substance dependence	38.70%	29	21.60%	24	46.40%	32	38.90%	7
Other PD (excluding BPD)	53.90%	41	37.50%	42	60.90%	42	44.40%	8
Cluster A	2.60%	2	5.40%	6	10.10%	7	11.10%	2
Cluster B	15.80%	12	10.70%	12	18.80%	13	5.60%	1
Cluster C	19.70%	15	16.10%	18	21.70%	15	22.20%	4
NOS	15.80%	12	5.40%	6	10.10%	7	5.60%	1
GAF (with suicide items)	41.48	(10.28)	45.88	(10.96)	41.62	(8.65)	46.56	(12.75)
GAF (without suicide items)	45.24	(9.87)	46.16	(10.98)	44.30	(9.02)	48.22	(12.78)
HDRS (24-item)	27.40	(7.65)	28.72	(7.90)	27.45	(7.00)	27.67	(6.15)
Beck Depression Inventory	28.32	(10.50)	26.78	(11.57)	31.74	(11.76)	28.56	(9.42)
Beck Hopelessness Inventory	12.14	(6.10)	10.96	(5.80)	13.89	(5.21)	14.88	(4.82)
Scale for Suicidal Ideation (prior)	17.51	(10.78)	8.45	(8.24)	17.63	(11.46)	16.88	(10.54)
Scale for Suicidal Ideation (current)	7.50	(8.13)	4.22	(5.82)	11.59	(9.85)	9.24	(8.45)
Barratt Impulsiveness Scale	49.77	(12.99)	48.42	(16.66)	57.13	(16.32)	56.87	(18.59)
Buss-Durkee Hostility Inventory	34.92	(11.08)	33.30	(11.37)	42.21	(12.24)	37.76	(11.99)
Brown-Goodwin Aggression History	18.59	(5.82)	16.26	(5.05)	21.48	(5.99)	17.89	(4.10)

Other PD, Other personality disorder; Clusters A, B and C, psychosis-related, affective and anxiety-related personality disorder clusters; NOS, not otherwise specified; GAF, Global Assessment of Functioning Scale; HDRS, Hamilton Depression Rating Scale.

and scores tend to be lower than those of either the earlier or later version (Manuck *et al.* 1998; Keilp *et al.* 2005). Our previously published revision of the AGGHx involves computing the total score as the sum of the maximum scores in the adolescent and adult age periods for each item, with the final item of the scale (self-injury) excluded due to its overlap with suicidal behavior (Mann *et al.* 1999).

Procedures

Subjects were recruited from the community by advertisement and physician referral. Study was approved by the university institutional review board, and all subjects signed informed consent prior to participation. All measures, except

the SCID-II, were administered at the time of admission to the study. The SCID-II, used for the assignment of personality disorder diagnoses, was administered at hospital discharge (for in-patients) or after clinical stabilization following at least 6 weeks of out-patient treatment, to minimize the effects of acute depressive symptoms on Axis II diagnoses.

Statistical analyses

Demographic and clinical data were compared between past suicide attempters and non-attempters stratified by BPD status, using two-way analyses of variance (ANOVA) for continuous variables, and χ^2 analyses for categorical variables (Table 1b). This analysis

Table 1(b). Statistical comparisons of demographic and clinical characteristics of past suicide attempter and non-attempter groups, stratified by borderline personality disorder (BPD) status

	Tests of main effects of BPD status, past attempt status, and their interaction						
	df	BPD status		Past attempt status		Interaction	
		F/χ^2	p	F/χ^2	p	F/χ^2	p
Age	1, 271	15.48	0.000	2.05	0.153	0.01	0.905
Education	1, 256	0.44	0.509	2.37	0.125	1.42	0.235
Gender (% male)	1	14.99	0.000	2.14	0.144		
Race (% Caucasian)	1	0.00	0.965	1.29	0.257		
Language (% English)	1	0.94	0.332	1.53	0.217		
Age at first treatment	1, 245	12.81	0.000	3.94	0.048	0.26	0.610
Major depressive episodes (log)	1, 254	1.23	0.268	3.29	0.071	0.19	0.665
Hospitalizations (log)	1, 264	3.45	0.065	38.73	0.000	4.21	0.041
Length current episode (weeks) (log)	1, 248	0.05	0.829	4.24	0.041	0.27	0.605
Number of attempts	1, 143	2.27	0.134	—	—	—	—
Maximum attempt lethality	1, 142	0.59	0.443	—	—	—	—
Lethality of most recent attempt	1, 142	0.07	0.793	—	—	—	—
Past history of substance dependence	1	7.08	0.008	10.23	0.001	—	—
Other PD (excluding BPD)	1	4.23	0.040	9.68	0.002	—	—
Cluster A	1	3.80	0.051	0.00	0.985	—	—
Cluster B	1	0.55	0.457	3.02	0.082	—	—
Cluster C	1	0.71	0.399	0.63	0.426	—	—
NOS	1	0.01	0.920	4.77	0.029	—	—
GAF (with suicide items)	1, 250	0.06	0.801	8.38	0.004	0.03	0.868
GAF (without suicide items)	1, 252	0.12	0.728	2.28	0.133	0.88	0.349
HDRS (24-item)	1, 265	0.19	0.660	0.45	0.503	0.23	0.632
Beck Depression Inventory	1, 239	2.19	0.140	1.81	0.180	0.22	0.640
Beck Hopelessness Inventory	1, 246	9.98	0.002	0.01	0.917	1.47	0.227
Scale for Suicidal Ideation (prior)	1, 265	7.63	0.006	10.02	0.002	7.21	0.008
Scale for Suicidal Ideation (current)	1, 264	14.11	0.000	5.40	0.021	0.15	0.702
Barratt Impulsiveness Scale	1, 223	8.93	0.003	0.09	0.759	0.04	0.837
Buss–Durkee Hostility Inventory	1, 235	10.13	0.002	2.69	0.102	0.59	0.443
Brown–Goodwin Aggression History	1, 264	7.38	0.007	12.63	0.000	0.58	0.448

Interaction not tested for categorical variables.

Other PD, Other personality disorder; Clusters A, B and C, psychosis-related, affective and anxiety-related personality disorder clusters; NOS, not otherwise specified; GAF, Global Assessment of Functioning Scale; HDRS, Hamilton Depression Rating Scale.

Bold values indicate $p < 0.05$.

enabled us to separate the effects of BPD status and past attempt status (or their possible interaction) on these demographic and clinical measures.

For our principal analyses, two-way analyses of covariance (ANCOVAs) were then run with past attempt status (attempter *versus* non-attempter) and BPD status (BPD *versus* non-BPD) as factors, and the BIS, BDHI and AGGHx as dependent variables. Age and sex were used as covariates in these analyses because of their known effects on these scores. To facilitate comparisons across scales, the BIS, BDHI and AGGHx scores were converted to z scores based on overall patient group means. Means used for the computation of these z scores were as follows: BIS (51.3 ± 16.1), BDHI (36.3 ± 12.1) and AGGHx (18.3 ± 5.8). These

scores are comparable to those obtained in other studies, especially for this version of the BIS (Mann *et al.* 1999). Planned contrasts were conducted for the attempter/non-attempter difference within the BPD and non-BPD groups when attempter status produced a significant main effect or interaction. Supplemental covariance analyses were run if any other baseline differences were found that might affect group differences (i.e. past substance dependence, presence of other personality disorders).

Two stepwise logistic regressions were then run to ascertain which of these variables was most important for the classification of past attempter status. First, only BPD status and the adjusted BIS, BDHI and AGGHx were included in the pool of predictors, and past attempter status was used as the target variable.

Second, all of the demographic and clinical variables in Table 1 (with the exception of number of past hospitalizations, which result from past attempts and is confounded with attempter status) were used in the pool of potential predictor variables. Each analysis was run on the total sample with missing values imputed by regression estimation using all available variables.

RESULTS

Characteristics of attempters and non-attempters in non-BPD and BPD subsamples

Demographic and clinical data for all subgroups are presented in Table 1*a*; statistical comparisons are presented in Table 1*b*. BPD subjects were younger than non-BPD subjects and were more likely to be female. BPD subjects were twice as likely to be past attempters (79.3% *v.* 40.4%, $\chi^2=36.1$, $p<0.001$) and BPD subjects differed clinically from non-BPD subjects in many of the same ways that past suicide attempters typically differ from non-attempters. Although depression severity was equivalent across the groups, the BPD subjects reported greater suicidal ideation, hopelessness, and impulsiveness, hostility and lifetime aggression. They had had their first psychiatric treatment at an earlier age, and had higher rates of past substance dependence, or other personality disorder. Thus, many of the characteristics of BPD subjects are those that typically distinguish past suicide attempters.

Main effects for the difference between attempters and non-attempters, however, were found on most of these same variables. Attempter status was related to a number of other clinical variables, however, including number of past hospitalizations, length of current depressive episode and likelihood of a personality disorder, not otherwise specified (NOS). A main effect for attempter status was absent on some of the variables on which BPD subjects differed from non-BPD subjects, including hopelessness, impulsiveness and hostility measures.

Interaction effects were found for number of past hospitalizations (BPD attempters differed from BPD non-attempters to a greater degree than non-BPD attempters differed from non-BPD non-attempters) and prior suicidal ideation (non-BPD attempters differed from

non-BPD non-attempters to a greater degree than BPD attempters differed from BPD non-attempters).

BPD attempters and non-BPD attempters were comparable in overall number of past attempts, and in the severity of their most lethal and most recent suicide attempts.

Attempter/non-attempter differences in impulsiveness, hostility and aggressiveness scores, stratified by BPD status

Mean values for adjusted BIS, BDHI and AGGHx scores in attempters and non-attempters, stratified by BPD status, are presented in Table 2, along with statistical analyses of each scale.

z scores adjusted for overall patient means reveal that, for each scale, non-BPD subjects consistently fall at or below overall mean values (e.g. negative *z* scores). This is true whether non-BPD subjects are suicide attempters or not. BPD subjects, by contrast, consistently have scores above overall patient means (positive *z* scores). This is most apparent for BPD subjects with a past history of suicidal behavior, where scores are approximately one-third to one-half standard deviation above mean patient values on each scale.

In the statistical analyses, age was a significant or near significant covariate for all three scales, with younger subjects having higher scores. Sex was a significant covariate for all three scales, with males obtaining higher scores.

The two-way ANCOVA on adjusted BIS scores produced a significant main effect for BPD status but not for past attempter status, or their interaction. The adjusted BIS scores in both BPD subgroups (attempters and non-attempters) were higher than those in both non-BPD subgroups. There were, however, no differences between BPD attempters and BPD non-attempters [contrast $t(223)=0.22$, $p=0.82$], nor between non-BPD attempters and non-BPD non-attempters [contrast $t(223)=0.47$, $p=0.64$] on impulsiveness.

A similar pattern of results was obtained for hostility. In the two-way ANCOVA on adjusted BDHI scores, a significant main effect for BPD status was found, but effects for attempter status and the BPD/attempter status interaction were non-significant. There were no differences between BPD attempters and BPD non-attempters

Table 2. Statistical comparisons of adjusted Barratt Impulsiveness Scale, Buss–Durkee Hostility Inventory and Brown–Goodwin Aggression History scores across past attempter groups stratified by borderline personality disorder (BPD) status

	Non-BPD				BPD			
	Attempters		Non-attempters		Attempters		Non-attempters	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
Z score transformation of impulsiveness, hostility and aggressiveness scores								
Barratt Impulsiveness Scale	−0.09	(0.81)	−0.18	(1.03)	0.36	(1.01)	0.35	(1.15)
Buss–Durkee Hostility Inventory	−0.11	(0.92)	−0.25	(0.94)	0.49	(1.01)	0.12	(0.99)
Brown–Goodwin Aggression History	0.05	(1.00)	−0.35	(0.87)	0.55	(1.03)	0.07	(0.71)
Analysis of covariance (ANCOVA)	df	F	p					
Barratt Impulsiveness Scale								
Age (covariate)	1, 221	3.62	0.058					
Sex (covariate)	1, 221	7.9	0.005					
BPD status	1, 221	9.89	0.002					
Attempter status	1, 221	0.02	0.896					
Borderline × attempter interaction	1, 221	0.23	0.634					
Buss–Durkee Hostility Inventory								
Age (covariate)	1, 233	8.67	0.004					
Sex (covariate)	1, 233	13.07	< 0.001					
BPD status	1, 233	11.25	0.001					
Attempter status	1, 233	1.74	0.189					
Borderline × attempter interaction	1, 233	0.26	0.613					
Brown–Goodwin Aggression History								
Age (covariate)	1, 262	8.42	0.004					
Sex (covariate)	1, 262	29.57	< 0.001					
BPD status	1, 262	10.77	0.001					
Attempter status	1, 262	10.96	0.001					
Borderline × attempter interaction	1, 262	0.11	0.745					

s.d., Standard deviation.
Bold values indicate $p < 0.05$.

[contrast $t(235) = 1.03$, $p = 0.30$] nor between non-BPD attempters and non-BPD non-attempters [contrast $t(235) = 0.62$, $p = 0.54$] on hostility.

In the two-way ANCOVA on lifetime aggression severity scores, however, main effects were obtained for both BPD status and attempter status, with no interaction. BPD attempters had higher AGGHx scores than BPD non-attempters [contrast $t(264) = 2.06$, $p = 0.04$] and non-BPD attempters had higher AGGHx scores than non-BPD non-attempters [contrast $t(264) = 2.88$, $p = 0.004$].

Aggression history, therefore, was the only trait measure that differed between attempters and non-attempters in both BPD and non-BPD subgroups, even though the three trait measures are intercorrelated. In this sample, AGGHx correlated with both BIS ($r = 0.23$, $p < 0.001$) and BDHI ($r = 0.45$, $p < 0.001$); BIS correlated with BDHI ($r = 0.46$, $p < 0.001$).

Supplemental covariance analysis

Because BPD subjects had higher rates of substance dependence and other personality disorders, these variables were included as covariates, along with age and sex, in an additional ANCOVA. Results of these analyses were comparable to those using only age and sex as covariates. A significant main effect for BPD status was found for all three scales [BIS: $F(1, 217) = 8.02$, $p = 0.005$; BDHI: $F(1, 229) = 8.40$, $p = 0.004$; AGGHx: $F(1, 258) = 6.19$, $p = 0.01$], but a significant main effect for attempter status was only found for AGGHx [$F(1, 258) = 7.64$, $p = 0.006$], with no significant interactions.

Classification of attempters and non-attempters

Stepwise logistic regression using impulsiveness, hostility and aggression scores and BPD status produced a function containing two variables,

Table 3. Summary of logistic regressions classifying past suicide attempters

Retained variables	Coefficient	Wald statistic	OR	95% CI	p
Entered: BPD status, Barratt Impulsiveness Scale, Buss–Durkee Hostility Inventory, Brown–Goodwin Aggression History					
BPD status	1.53	24.1	4.6	2.5–8.5	<0.001
Brown–Goodwin Aggression History	0.53	11.6	1.7	1.3–2.3	0.001
Entered: all demographic and clinical variables					
BPD status	1.30	15.6	3.7	1.9–7.0	<0.001
Number past depressive episodes (log)	0.53	6.9	1.7	1.1–2.5	0.009
Brown–Goodwin Aggression History	0.44	7.1	1.6	1.1–2.1	0.008
Scale for Suicidal Ideation (prior)	0.07	23.2	1.1	1.0–1.1	<0.001

BPD, Borderline personality disorder; OR, odds ratio; CI, confidence interval.

BPD status and the AGGHx score (Table 3). This function correctly classified 70.5% of all subjects.

In the logistic regression in which all demographic and clinical predictors were included, BPD status, log of number of past depressive episodes, AGGHx score and suicide ideation prior to admission were the variables retained in the final equation. Classification accuracy improved to 73.1% with these additional predictors.

The BIS and BDHI may have been excluded from these logistic regression equations due to multicollinearity, that is because AGGHx was slightly better correlated with the dependent variable but accounted for the same variance. For this reason, logistic regressions were rerun, excluding AGGHx from the set of predictors. In neither case was BIS or BDHI included in the final model. Variables in the final equations were the same as those in Table 2, without AGGHx.

DISCUSSION

BPD subjects in this study were significantly more impulsive, hostile and aggressive than non-BPD subjects, consistent with prior research (Zisook *et al.* 1994; Soloff *et al.* 2000). In addition, BPD status was strongly associated with past attempt status in our logistic regressions, also consistent with prior studies (Corbitt *et al.* 1996; Hawton *et al.* 2003). Odds ratios for BPD status in logistic regressions were approximately twice as high as for any other classification variables. However, trait characteristics of BPD did not uniformly differentiate past attempters when BPD and non-BPD subjects were considered separately. Predictive models of suicidal behavior based on a

concatenation of these trait measures may therefore be very effective at identifying subjects with BPD, but may systematically miss non-BPD attempters. Soloff *et al.* (2000) had earlier reported that BPD diagnosis and lifetime aggression history postdicts past attempt status. As in this study, neither impulsiveness nor hostility ratings were significantly related to past attempt status once BPD was accounted for. However, this earlier study did not emphasize the fact that impulsiveness and hostility had very little discriminating power outside of their association to BPD. In both the BPD and non-BPD samples here, mean scores for impulsiveness and hostility were comparable for past attempters and non-attempters. It is therefore possible that at least one of the defining characteristics of BPD (impulsiveness), a condition with high risk for suicide attempt, is not the trait most relevant for the prediction of suicidal behavior—in either BPD subjects themselves or subjects without BPD.

The absence of a general association between impulsiveness and suicide attempt, or between hostility and suicide attempt, seems at variance with much of the literature (Fawcett *et al.* 1997; Plutchik & van Praag, 1997; Mann *et al.* 1999; Conner *et al.* 2001). However, very few earlier studies have accounted for the systematically higher scores of BPD subjects on these trait measures. Aggressiveness, by contrast, is a distinguishing characteristic of past attempters with bipolar disorder (Oquendo *et al.* 2000) and mixed diagnostic groups (Mann *et al.* 1999). Dumais *et al.* (2005), using a psychological autopsy method (interview of family members), found that lifetime aggressiveness was the most distinctive individual characteristic of a group of violent suicide completers. Aggression is

also related to suicide attempt risk in BPD adolescents; depression severity and hopelessness appear to play a more prominent role in non-BPD adolescents (Hoesch *et al.* 2003). In our sample of depressed adults, aggressiveness was related to past attempt status regardless of BPD status, while chronicity of depression rather than severity contributed to classification accuracy. Impulsiveness, hostility and aggressiveness correlated with one another, but only one of these traits appears to be directly related to past attempts.

Our findings have implications for behavioral, biological and genetic studies of suicidal behavior. The close association between past attempt status and impulsiveness reported in previous clinical studies has led to its being considered as a behavioral endophenotype, or trait marker for suicidality (Courtet *et al.* 2005). Associations between serotonergic dysfunction and impulsiveness, for example, are thought to be directly relevant to the neurobiology of suicidal behavior and to provide a rational basis for treatment of these behaviors. However, we have repeatedly found that assays of the serotonin system are most likely to be associated with aggressiveness rather than the broader traits of impulsiveness or hostility (Stanley *et al.* 2000; Placidi *et al.* 2001; Parsey *et al.* 2002). Although there are strong associations among impulsiveness, hostility and aggressiveness measures (up to 50% shared variance among various scales in prior studies; Mann *et al.* 1999), our findings suggest that a narrower trait manifest in a past history of aggressive behaviors may be a more appropriate target for suicide research.

In addition, other types of aggression may contribute to suicidal behavior. Barratt and colleagues have drawn a distinction between impulsive and premeditated aggression (Barratt *et al.* 1999; Stanford *et al.* 2003) that may relate to the risk for spontaneous *versus* more carefully planned suicide attempts. Many completed suicides and higher lethality attempts, for example, are associated with persistent suicidal thinking, strong subjective intent and objective evidence of planning (Haw *et al.* 2003; Joiner *et al.* 2003).

In clinical practice, impulsiveness and hostility may function as suicide attempt risk indicators because they indicate the likelihood

of BPD, which itself carries a heightened risk for suicidal behavior. Subjects meeting the BPD diagnostic criterion for impulsive behavior on SCID-II have a higher number of lifetime attempts, although this criterion does not distinguish attempt status itself or lethality (Brodsky *et al.* 1997). However, all subjects in this study had elevated scores on impulsiveness, hostility and aggressiveness relative to published non-patient values (Manuck *et al.* 1998; Keilp *et al.* 2005), as reported previously in acutely depressed samples (Corruble *et al.* 2003). Assessment of these traits alone may be insufficient for the determination of suicide risk without additional information about Axis II pathology.

Although this study is retrospective in nature, variables identified in retrospective analyses of past attempters are effective for identifying risk factors for future suicidal behavior (Oquendo *et al.* 2004). This study is limited, however, by its reliance on rating scale instruments for the assessment of targeted traits. For example, our self-report measures of impulsiveness and hostility, although well-established and widely used, rely to a significant degree on accurate self-awareness. The aggression history, by contrast, is a clinician-administered inventory of specific past instances of aggressive behavior. Although subject to recollection biases, it may provide a more valid accounting of specific past behaviors that are relevant to the prediction of other types of aggressive behavior such as suicide. Behavioral performance measures of impulsiveness and aggression are now more commonly used in research on suicidal behavior (Dougherty *et al.* 2004; Swann *et al.* 2005) and may provide more accurate, concurrent assessments of these behavioral tendencies. Further research using alternative methods of assessing these traits is needed.

ACKNOWLEDGMENTS

This research was supported by National Institute of Mental Health grants MH-062185 and MH-062155, and the American Foundation for Suicide Prevention.

DECLARATION OF INTEREST

None.

REFERENCES

- Barratt, E. S. (1985). Impulsiveness defined within a system model of personality. In *Advances in Personality Assessment* (ed. C. D. Spielberger and J. N. Butcher), vol. 5, pp. 113–132. Earlbaum: New York.
- Barratt, E. S. (1994). Impulsivity and aggression. In *Violence and Mental Disorder: Developments in Risk Assessment* (ed. J. Monahan and H. J. Steadman), pp. 61–80. University of Chicago Press: Chicago.
- Barratt, E. S., Stanford, M. S., Dowdy, L., Liebman, M. J. & Kent, T. A. (1999). Impulsive and premeditated aggression, a factor analysis of self-reported acts. *Psychiatry Research* **86**, 163–173.
- Beck, A. T., Beck, R. & Kovacs, M. (1975). Classification of suicidal behaviors: I. Quantifying intent and medical lethality. *American Journal of Psychiatry* **132**, 285–287.
- Beck, A. T., Kovacs, M. & Weissman, A. (1979). Assessment of suicidal ideation: the scale for suicidal ideation. *Journal of Consulting and Clinical Psychology* **47**, 343–352.
- Beck, A. T., Ward, C. H., Mendelson, M., Mock, J. & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry* **4**, 53–63.
- Beck, A. T., Weissman, A., Lester, D. & Trexler, L. (1974). The measurement of pessimism: the hopelessness scale. *Journal of Consulting and Clinical Psychology* **46**, 861–865.
- Brent, D. A. & Mann J. J. (2005). Family genetic studies, suicide, and suicidal behavior. *American Journal of Medical Genetics, Part C (Seminars in Medical Genetics)* **133**, 13–24.
- Brodsky, B. S., Malone, K. M., Ellis, S. P., Dulit, R. A. & Mann, J. J. (1997). Characteristics of borderline personality disorder associated with suicidal behavior. *American Journal of Psychiatry* **154**, 1715–1719.
- Brown, G. L., Goodwin, F. K., Ballenger, J. C., Goyer, P. F. & Major, L. F. (1979). Aggression in humans correlates with cerebrospinal fluid amine metabolites. *Psychiatry Research* **1**, 131–139.
- Buss, A. R. & Durkee, A. (1961). An inventory for assessing different kinds of hostility. *Journal of Consulting Psychology* **21**, 343–349.
- Conner, K. R., Duberstein, P. R., Conwell, Y., Seidlitz, L. & Caine, E. D. (2001). Psychological vulnerability to completed suicide: a review of empirical studies. *Suicide and Life-Threatening Behavior* **31**, 367–385.
- Corbitt, E. M., Malone, K. M., Haas, G. L. & Mann, J. J. (1996). Suicidal behavior in patients with major depression and comorbid personality disorders. *Journal of Affective Disorders* **39**, 61–72.
- Corruble, E., Beyamina, A., Bayle, F., Falissard, B. & Hardy, P. (2003). Understanding impulsivity in severe depression? A psychometrical contribution. *Progress in Neuropsychopharmacology and Biological Psychiatry* **27**, 829–833.
- Courtet, P., Jollant, F., Castelnaud, D., Buresi, C. & Malafosse, A. (2005). Suicidal behavior: relationship between phenotype and serotonergic genotype. *American Journal of Medical Genetics, Part C (Seminars in Medical Genetics)* **133**, 25–33.
- Dougherty, D. M., Mathias, C. W., Marsh, D. M., Papageorgiou, T. D., Swann, A. C. & Moeller, F. G. (2004). Laboratory measured behavioral impulsivity relates to suicide attempt history. *Suicide and Life-Threatening Behavior* **34**, 374–385.
- Dumais, A., Lesage, A. D., Lalovic, A., Seguin, M., Tousignant, M., Chawky, N. & Turecki, G. (2005). Is violent method of suicide a behavioral marker of lifetime aggression? *American Journal of Psychiatry* **162**, 1375–1378.
- Evenden, J. L. (1999). Varieties of impulsivity. *Psychopharmacology* **146**, 348–361.
- Fawcett, J., Busch, K. A., Jacobs, D., Kravitz, H. M. & Fogg, L. (1997). Suicide: a four-pathway clinical biochemical model. *Annals of the New York Academy of Sciences* **836**, 288–301.
- First, M. B., Spitzer, R. L., Gibbon, M., Williams, J. B. W. & Loma, B. (1996). *Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II), Version 2.0*. Biometric Research Department, New York State Psychiatric Institute: New York.
- Hamilton, M. (1960). A rating scale for depression. *Journal of Neurology, Neurosurgery and Psychiatry* **23**, 56–62.
- Haw, C., Hawton, K., Houston, K. & Townsend, E. (2003). Correlates of relative lethality and suicidal intent among deliberate self-harm patients. *Suicide and Life-Threatening Behavior* **33**, 353–364.
- Hawton, K., Houston, K., Haw, C., Townsend, E. & Harriss, L. (2003). Comorbidity of axis I and axis II disorders in patients who attempted suicide. *American Journal of Psychiatry* **160**, 1494–1500.
- Horesh, N., Orbach, I., Gothelf, D., Efrati, M. & Apter, A. (2003). Comparison of the suicidal behavior of adolescent inpatients with borderline personality disorder and major depression. *Journal of Nervous and Mental Disease* **191**, 582–588.
- Joiner, T. E., Jr., Steer, R. A., Brown, G., Beck, A. T., Pettit, J. W. & Rudd, M. D. (2003). Worst-point suicidal plans: a dimension of suicidality predictive of past suicide attempts and eventual death by suicide. *Behavior Research and Therapy* **41**, 1469–1480.
- Keilp, J. G., Sackeim, H. A. & Mann, J. J. (2005). Correlates of trait impulsiveness in performance measures and neuropsychological tests. *Psychiatry Research* **135**, 191–201.
- Mann, J. J., Waternaux, C., Haas, G. L. & Malone, K. M. (1999). Toward a clinical model of suicidal behavior in psychiatric patients. *American Journal of Psychiatry* **156**, 181–189.
- Manuck, S. B., Flory, J. D., McCaffrey, J. M., Matthews, K. A., Mann, J. J. & Muldoon, M. F. (1998). Aggression, impulsivity, and central nervous system reactivity in a non-patient sample. *Neuropsychopharmacology* **19**, 287–299.
- Oquendo, M. A., Galfalvy, H., Russo, S., Ellis, S. P., Grunebaum, M. F., Burke, A. & Mann, J. J. (2004). Prospective study of clinical predictors of suicidal acts after a major depressive episode in patients with major depressive disorder or bipolar disorder. *American Journal of Psychiatry* **161**, 1433–1441.
- Oquendo, M. A., Halberstam, B. & Mann, J. J. (2003). Risk factors for suicidal behavior: the utility and limitations of research instruments. In *Standardized Evaluation in Clinical Practice. Review of Psychiatry* (ed. M. First), vol. 22, pp. 103–130. American Psychiatric Publishing: Washington, DC.
- Oquendo, M. A., Waternaux, C., Brodsky, B., Parsons, B., Haas, G. L., Malone, K. M. & Mann, J. J. (2000). Suicidal behavior in bipolar mood disorder: clinical characteristics of attempters and nonattempters. *Journal of Affective Disorders* **59**, 107–117.
- Parsey, R. V., Oquendo, M. A., Simpson, N. R., Ogden, T., Van Heertum, R., Aranog, V. & Mann, J. J. (2002). Effects of sex, age, and aggressive traits in man on brain serotonin 5-HT_{1A} receptor binding potential measured by PET using [C-11]WAY-100635. *Brain Research* **954**, 173–182.
- Placidi, O. P., Oquendo, M. A., Malone, K. M., Huang, Y. Y., Ellis, S. P. & Mann, J. J. (2001). Aggressivity, suicide attempts, and depression: relationship to cerebrospinal fluid monoamine metabolite levels. *Biological Psychiatry* **50**, 783–791.
- Plutchik, R. & van Praag, H. M. (1997). Suicide, impulsivity and antisocial behavior. In *Handbook of Antisocial Behavior* (ed. D. M. Stoff, J. Breiling and J. D. Maser), pp. 101–108. John Wiley & Sons: New York.
- Soloff, P. H., Lynch, K. G., Kelly, T. M., Malone, K. M. & Mann, J. J. (2000). Characteristics of suicide attempts of patients with major depressive episode and borderline personality disorder: a comparative study. *American Journal of Psychiatry* **157**, 601–608.
- Spitzer, R. L., Williams, J. B. W., Gibbon, M. & First, M. B. (1990). *Instruction Manual for the Structured Clinical Interview for the DSM-IV (SCID-P)*. American Psychiatric Press: Washington, DC.
- Stanford, M. S., Houston, R. J., Mathias, C. W., Villemarette-Pittman, N. R., Helfritz, L. E. & Conklin, S. M. (2003). Characterizing aggressive behavior. *Assessment* **10**, 183–190.
- Stanley, B., Molcho, A., Stanley, M., Winchel, R., Gameraff, M. J., Parsons, B. & Mann, J. J. (2000). Association of aggressive behavior with altered serotonergic function in patients who are not suicidal. *American Journal of Psychiatry* **157**, 609–614.
- Suominen, K., Isometsa, E., Henriksson, M., Ostamo, A. & Lonnqvist, J. (1997). Hopelessness, impulsiveness and intent among suicide

- attempters with major depression, alcohol dependence, or both. *Acta Psychiatrica Scandinavica* **96**, 142–149.
- Swann, A. C., Dougherty, D. M., Pazzaglia, P. J., Pham, M., Steinberg, J. L. & Moeller, F. G. (2005). Increased impulsivity associated with severity of suicide attempt history in patients with bipolar disorder. *American Journal of Psychiatry* **162**, 1680–1687.
- Zisook, S., Goff, A., Sledge, P. & Schuchter, S. R. (1994). Reported suicidal behavior and current suicidal ideation in a psychiatric outpatient clinic. *Annals of Clinical Psychiatry* **6**, 27–31.