Published in final edited form as:

Compr Psychiatry. 2014 August ; 55(6): 1337–1341. doi:10.1016/j.comppsy.2014.04.018.

Impulsivity In Children And Adolescents With Mood Disorders And Unaffected Offspring Of Bipolar Parents

Marsal Sanches, M.D., PhD.¹, Kathy Scott-Gurnell, M.D.¹, Anita Patel, M.D.¹, Sheila C. Caetano, M.D., PhD.², Giovana B. Zunta-Soares, M.D.¹, John P. Hatch, Ph.D.³, Rene Olvera, M.D.³, Alan C. Swann, M.D.¹, and Jair C. Soares, M.D.¹

¹UT Center of Excellence on Mood Disorders, Department of Psychiatry and Behavioral Sciences, The University of Texas Health Science Center at Houston, Houston, Texas, U.S.A

²Department of Psychiatry, Federal University of São Paulo, Sao Paulo, Brazil

³Department of Psychiatry, The University of Texas Health Science Center at San Antonio, San Antonio, Texas, U.S.A

Abstract

Objective—Increased impulsivity seems to be present across all phases of bipolar disorder (BD). Impulsivity may therefore represent an endophenotype for BD, if it is also found among normal individuals at high genetic risk for mood disorders. In this study, we assessed impulsivity across four different groups of children and adolescents: patients with BD, major depressive disorder (MDD) patients, unaffected offspring of bipolar parents (UO), and healthy controls (HC).

Subjects and Methods—52 patients with BD, 31 with MDD, 20 UO, and 45 HC completed the Barratt Impulsiveness Scale (BIS-11), an instrument designed to measure trait impulsivity.

Results—UO displayed significantly higher total BIS-11 impulsivity scores than HC ($p=0.02$) but lower scores than BD patients ($F=27.12$, $p<0.01$). Multiple comparison analysis revealed higher BIS-11 total scores among BD patients when compared to HC ($p<0.01$) and UO ($p<0.01$). MDD patients had higher BIS-11 scores when compared to HC ($p<0.01$). Differences between MDD patients and UO, as well as between MDD and BD patients, were not statistically significant.

Conclusion—Our findings suggest that trait impulsivity is increased among children and adolescents with mood disorders, as well as in unaffected individuals at high genetic risk for BD.

© 2014 Elsevier Inc. All rights reserved.

Corresponding author: Marsal Sanches, M.D., PhD. UT Center of Excellence on Mood Disorders, Department of Psychiatry and Behavioral Sciences, UT Houston Medical School, 1541 East Rd. Houston, TX 77054; Phone: (713) 486-2638; FAX: (713)486-2553, Marsal.Sanches@uth.tmc.edu.

Conflicts of interests: M.S. has received research grants from Janssen Pharmaceuticals; A.C.S serves on a DSMB for Teva Pharmaceuticals, has received research support from Elan Pharmaceuticals, and has acted as a consultant and speaker for Merck and Sanofi-Aventis. J.C.S. has received research grants from BMS, Forest, Merck; he received speaker's fees from Pfizer and Abbott. None of these sources directly supported or influenced this project. No other authors received financial support relevant to this project.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Keywords

Bipolar Disorder; Major Depressive Disorder; Impulsivity; Barratt Impulsiveness Scale; offspring

Introduction

Impulsivity is a multidimensional construct that can be defined and measured in many ways [1]. It includes, among other domains, motor impulsivity (acting before thinking), inability to delay gratification, and the tendency to shift attention quickly, with inadequately rapid actions and decisions [2].

Previous findings suggest that impulsivity plays an important role in the course of bipolar disorder (BD) and its comorbidities [3]. Poor impulse control is commonly found during manic states and is listed among the criteria required for the diagnosis of mania [4]. Furthermore, various aspects of impulsivity can be found across the different phases of the illness, suggesting that poor impulse control, although exacerbated during the acute mood episodes, may represent a trait feature among bipolar patients [2], possibly contributing to some of the most common complications associated with BD, such as suicidal attempts and substance abuse. It has also been hypothesized that increased trait impulsivity may represent an endophenotype for mood disorders and suicidality, and may therefore be found among normal subjects at high genetic risk for mood disorders [5].

In children and adolescents, impulsivity is of particular importance in attention-deficit-hyperactivity disorder (ADHD) patients, and seems to contribute to the marked difficulties in social, academic or occupational settings found in that disorder [6,7]. However, limited literature data regarding impulsivity in children and adolescents with mood disorders is currently available. Similarly, no studies have previously analyzed trait impulsivity among unaffected offspring of bipolar parents.

In this study, we assessed trait impulsivity across four different groups: children and adolescents with BD and major depressive disorder (MDD), unaffected offspring of bipolar parents (UO), and healthy controls (HC). We hypothesized that the mood disorder patients and the UO would show higher levels of trait impulsivity than the healthy controls.

Subjects and Methods

Sample

The present study utilized data collected at two different centers: The University of Texas Health Science Center at San Antonio and The University of North Carolina at Chapel Hill. The sample consisted of 52 patients with BD (31 males, 21 females, mean age $\pm$ SD= 15.93 $\pm$ 3.97, 20 euthymic, 18 manic or hypomanic, 12 depressed, 2 mixed), 31 with MDD (12 males, 19 females, mean age $\pm$ SD= 16.25 $\pm$ 3.14, 10 euthymic, 21 depressed), 20 UO (10 males, 10 females, mean age $\pm$ SD= 11.01 $\pm$ 3.12), and 45 HC (18 males, 27 females, mean age $\pm$ SD= 16.29 $\pm$ 4.02). Twenty-two bipolar patients met DSM-IV criteria for BD type I, 8 for BD type II, and 22 for BD NOS (defined as meeting the number of criteria required for the diagnosis of manic or hypomanic episodes but not the minimum duration criteria).

Eighteen subjects (9 in the BD group and 9 in the MDD group) had comorbid ADHD. The subjects were recruited through newspaper and television advertisements and flyers posted in the communities where the study was carried out (San Antonio, TX, and Chapel Hill, NC). In addition, some patients were referred by local psychiatrists.

For patients, controls, and UO, the inclusion criteria were: age between 8 and 21 years and absence of serious medical issues (including neurological disorders and history of head trauma). Patients were included if they met diagnostic criteria for BD or MDD according to the DSM-IV-TR criteria [1]. Patients with a history of substance abuse or dependence in the six months preceding study enrollment were excluded, as well as patients with a history of schizophrenia, developmental disorders, eating disorders, and mental retardation. In addition, only patients who were not on psychotropic medications for at least 2 weeks were enrolled. HC were excluded if they had any lifetime Axis I psychiatric disorder and history of mental disorder in first-degree relatives (assessed through a detailed family history assessment). UO were enrolled if they did not meet criteria for any lifetime Axis I diagnosis and had at least one parent who met criteria for BD (see below).

The study was approved by the respective institutional review boards. Informed consent was obtained from all subjects or their legal guardians.

Assessments

All subjects less than 18 years old and their parents were interviewed separately using the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime version (K-SADS-PL) [8], in order to confirm the diagnosis of mood disorder according to the DSM-IV criteria (among patients) or rule out any axis I mental disorder (in the offspring and HC). For subjects who were 18-21 years old, the Structured Clinical Interview for DSM Disorders (SCID) was utilized [9]. Additionally, the SCID was also administered to at least one parent of the UO, in order to confirm the diagnosis of BD. All interviews were administered to participants by trained evaluators, and were later reviewed by a board-certified psychiatrist.

Impulsivity was assessed using the Barratt Impulsiveness Scale (BIS-11), a self-report instrument designed to measure impulsivity on three different domains: motor impulsivity, defined as acting without thinking; attentional impulsivity, defined as making quick decisions, and non-planning impulsivity, defined as a lack of concern for the future [10]. Although the BIS-11 was originally created for use among adult subjects, it has previously been successfully used for the measurement of impulsivity among children and adolescents [11-14].

Statistical analysis

The BIS-11 total and subscale scores were normally distributed (Shapiro-Wilk test, $p > 0.05$), but variances were heterogeneous across groups. Therefore, we analyzed data using robust ANOVA based methods. We compared the UTHSCSA and UNC populations using one way ANOVA and Welch test. Impulsivity scores across the four diagnostic groups (BD patients, MDD patients, UO, and HC) were compared using oneway ANOVA with the Games-Howell test for protected pair wise multiple comparisons. The interaction of the mood

disorders and ADHD diagnosis was assessed using two-way factorial ANOVA. In addition, we calculated effect sizes in order to better characterize the significant differences in the BIS-11 scores between different groups.

Results

The participants from the two study sites (San Antonio and Chapel Hill) were compared with respect to their BIS-11 total and subscale scores (total score: $F=2.08$, $df=1/175$, $p=0.15$; attentional: $F=0.583$, $df=1/175$, $p=0.45$; motor: $F=3.13$, $df=1/175$, $p=0.08$; non-planning: $F=0.86$, $df=1/175$, $p=0.35$), and no significant differences were found. Therefore, subjects from the two centers were pooled for the final analysis. No differences were found across the four study groups with respect to gender distribution (chi-square=5.49, $df=3$, $p=0.14$), but UO were significantly younger than the remaining groups ($F=12.10$, $df=3/148$, $p<0.01$). We evaluated age, gender, and mood state as possible covariates but, since these were not significantly correlated with BIS-11 scores, they were omitted from the final models.

As displayed in Table 1, subjects with BD showed higher BIS-11 scores (total = 78.13 ± 11.41 , motor = 25.93 ± 5.47 , attentional = 21.97 ± 6.31 , non-planning = 30.23 ± 4.56) in all impulsivity domains when compared to HC (total = 60.14 ± 8.05 , motor = 19.26 ± 3.92 , attentional = 16.45 ± 3.25 , non-planning = 24.43 ± 3.73), and these differences were statistically significant (total: $F=27.12$, $df=3/145$, $p<0.01$; I-J=17.98, SE=1.98, $p<0.01$; motor: $F=13.86$, $df=3/145$, $p<0.01$; I-J=6.67, SE=1.05, $p<0.01$; attentional: $F=24.32$, $df=3/145$, $p<0.01$; I-J=5.52, SE=0.67, $p<0.01$; non-planning: $F=15.25$, $df=3/145$, $p<0.01$; I-J=5.79, SE=0.84, $p<0.01$). Similarly, BIS-11 scores among MDD patients (total = 75.69 ± 12.00 ; motor = 24.57 ± 3.39 , attentional = 21.55 ± 4.02 , non-planning = 29.57 ± 5.84) were significantly higher when compared to HC (total: I-J=15.54, SE=4.46, $p<0.01$; motor: I-J=5.31, SE=1.14, $p<0.01$; attentional: I-J=5.10, SE=0.86, $p<0.01$; non-planning: I-J=5.14, SE=1.18, $p<0.01$). However, the difference between BD and MDD patients was not statistically significant in regard to any of the domains (total: I-J=2.44, SE=2.67, $p=0.79$; motor: I-J=1.36, SE=1.31, $p=0.73$; attentional: I-J=0.42, SE=0.86, $p=0.96$; non-planning: I-J=0.65, SE=1.22, $p=0.95$), although impulsivity scores were slightly lower among the latter. Similarly, no statistically significant differences were found between mood disorder patients with and without comorbid ADHD.

Finally, UO displayed statistically significant lower BIS-11 values (total = 68.16 ± 10.19 , motor = 22.72 ± 4.80 , attentional = 18.56 ± 3.35 , non-planning = 26.89 ± 3.81) on all of the impulsivity domains compared to bipolar patients, except for motor impulsivity (total: I-J=-9.97, SE=2.77, $p<0.01$; motor: I-J=-3.21, SE=1.38, $p=0.11$; attentional: I-J=-3.41, SE=0.88, $p<0.01$; non-planning: I-J=-3.35, SE=1.06, $p<0.05$). Similarly, although the impulsivity scores were lower among the UO than in the MDD group, only the differences with respect to the attentional impulsivity domain was statistically significant (total: I-J=-7.52, SE=3.14, $p=0.09$; motor: I-J=-1.84, SE=1.45, $p=0.58$; attentional: I-J=-2.98, SE=1.04, $p<0.05$; non-planning: I-J=-2.69, SE=1.35, $p=0.20$). Similarly, all impulsivity values were higher among UO than HC (Figure 1), but only the differences regarding the total BIS-11 score and the motor impulsivity subscore were statistically significant (total: I-

J=8.02, SE=2.57, $p<0.05$; motor: I-J=3.46, SE=1.22, $p<0.05$; attentional: I-J=2.11, SE=0.89, $p=0.10$; non-planning: I-J=2.45, SE=1.01, $p=0.09$).

Discussion

To our knowledge, this is the first study to address trait impulsivity among unaffected children of bipolar parents. Our findings suggest that unaffected offspring of bipolar patients show higher impulsivity scores than healthy children, but less impulsivity than children with bipolar disorder. Overall, BD patients were found to be more impulsive than HC and UO, but differences between BD and MDD patients were not significant. The BIS scores displayed by our mood disorder subjects are of the same magnitude as the ones reported by other studies with clinical populations (for a review, see Stanford et al, 2009)[15]. Further, the difference in impulsivity displayed by unaffected offspring when compared to HC was translated into large effect sizes, suggesting that increased impulsivity in that population, rather than an incidental finding, may be relevant from a clinical standpoint.

These results are in agreement with the findings from similar studies carried out among adult subjects [2, 16-18], which point to increased impulsivity in mood disorder patients. Furthermore, our findings are similar to those addressing impulsivity in children and adolescents with mood disorders. In one of them, the authors compared 23 adolescents with BD and 23 HC, and found higher BIS-11 total and subscale scores among patients than controls [12]. Moreover, a post-hoc analysis comparing only euthymic patients and HC revealed similar findings, but the difference in the non-planning BIS-11 subscale were not statistically significant. Another study (11) demonstrated higher impulsivity scores among adolescents with BD when compared to HC with respect to all BIS-11 subscores.

In our study, UO showed lower impulsivity than BD patients, and higher impulsivity than HC. These findings are consistent with the hypothesis that trait impulsivity may represent a marker of vulnerability, which seems to be present in an attenuated form in unaffected subjects at high genetic risk for mood disorders. Other groups have previously described poor impulse control among unaffected relatives of patients with ADHD [19] and obsessive-compulsive disorder [20]. Further, acute tryptophan depletion has been showed to increase impulsivity among unaffected first-degree relatives of bipolar patients, but not among controls [21]. It is important to emphasize that, in our analysis, the lack of significant differences between UO and HC in regard to the attentional and non-planning subscales may be in part secondary to limitations in regard to the BIS-11 factor structure, suggesting that the differentiation between non-planning, attentional and motor aspects of impulsivity in adolescents may not be completely reliable and that the total scores should be preferred [22].

Additionally, BD and MDD patients showed higher impulsivity scores than HC, whereas no significant differences were found between BD and MDD patients, although the impulsivity scores were lower among MDD than BD subjects. While the small size of our sample may have contributed to the lack of significant differences, these findings suggest that increased trait impulsivity may represent a non-specific feature for mood disorders and not necessarily a marker of bipolarity. A previous study by our group obtained similar results among adult subjects [16].

On the other hand, we found no significant differences between the UO and the MDD groups regarding the total score of the BIS-11. This lack of differences may point to the existence of a continuum between BD, MDD, and UO in terms of impulsivity, with MDD patients occupying an intermediate position between BD patients and UO. Additional studies with larger samples are necessary to clarify these issues.

Moreover, we found no differences between mood disorder subjects with and without comorbid ADHD. Although increased trait impulsivity has been reported in adults and adolescents with ADHD [7, 23], evidence suggests that the additional diagnosis of ADHD did not seem to affect the impulsivity scores among adolescent BD patients [7]. In our study, the small number of patients with ADHD may have contributed to the lack of statistically significant differences between the subgroups. It is also possible that the high rates of trait impulsivity among the mood disorder patients might have masked the additive effect of comorbid ADHD.

Our study has some methodological limitations that must be addressed. First, our patient groups were entirely outpatients, all unmedicated and free from substance abuse or dependence for at least six months. Therefore, some of our findings may be distinct from the ones obtained from more severely ill patients. In addition, the fact that we had a less severe sample of BD patients may explain the lack of differences between bipolar and MDD patients in our study.

Second, the analysis pooled subjects from two geographically distinct centers with different racial and ethnic compositions. However, the comparison between subjects from the two centers did not point to significant differences, so it is unlikely that this issue might have affected our results. Third, we did not have a group of unaffected offspring of MDD parents, which could have provided additional information in regard to the specificity of trait impulsivity as a marker of vulnerability for BD versus mood disorders in general.

In summary, our findings suggest that trait impulsivity is increased among children and adolescents with mood disorders, as well as in unaffected individuals at high genetic risk for mood disorders. These findings may have important implications for a better understanding of the psychopathology of pediatric mood disorders, as well as of its pathophysiology. Finally, the dimensional nature of impulsivity as a construct and its quantitative differences across distinct psychiatric conditions make our results of high interest for initiatives addressing non-categorical approaches in psychiatry, such as the Research Domain Criteria (RDoC) [24].

Acknowledgments

This research was partly supported by NARSAD, MH 69774, RR 20571.

References

1. Dougherty DM, Bjork JM, Harper RA, Marsh DM, Moeller FG, Mathias CW, Swann AC. Behavioral impulsivity paradigms: a comparison in hospitalized adolescents with disruptive behavior disorders. *J Child Psychol Psychiatry*. 2003; 44:1145–57. [PubMed: 14626456]

2. Strakowski SM, Fleck DE, DelBello MP, Adler CM, Shear PK, Kotwal R, Arndt S. Impulsivity across the course of bipolar disorder. *Bipolar Disord.* 2010; 12:285–97. [PubMed: 20565435]
3. Najt P, Perez J, Sanches M, Peluso MA, Glahn D, Soares JC. Impulsivity and bipolar disorder. *Eur Neuropsychopharmacol.* 2007; 17:313–20. [PubMed: 17140772]
4. American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-IV-TR. American Psychiatric Association; Washington, DC: 2000. Task force on DSM-IV.
5. Mann JJ, Arango VA, Avenevoli S, Brent DA, Champagne FA, Clayton P, Currier D, Dougherty DM, Haghighi F, Hodge SE, Kleinman J, Lehner T, McMahon F, Mo cicki EK, Oquendo MA, Pandey GN, Pearson J, Stanley B, Terwilliger J, Wenzel A. Candidate endophenotypes for genetic studies of suicidal behavior. *Biol Psychiatry.* 2009; 65:556–63. [PubMed: 19201395]
6. Birchwood J, Daley D. The impact of Attention Deficit Hyperactivity Disorder (ADHD) symptoms on academic performance in an adolescent community sample. *J Adolesc.* 2012; 35:225–31. [PubMed: 20880572]
7. Paloyelis Y, Asherson P, Mehta MA, Faraone SV, Kuntsi J. DAT1 and COMT effects on delay discounting and trait impulsivity in male adolescents with attention deficit/hyperactivity disorder and healthy controls. *Neuropsychopharmacology.* 2010; 35:2414–26. [PubMed: 20736997]
8. Kaufman J, Birmaher B, Brent D, Rao U, Flynn C, Moreci P, Williamson D, Ryan N. Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL): initial reliability and validity data. *J Am Acad Child Adolesc Psychiatry.* 1997; 36:980–8. [PubMed: 9204677]
9. First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JBW. Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version. Patient Edition. New York: Biometrics Research, New York State Psychiatric Institute; Nov. 2002 SCID-I/P
10. Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. *J Clin Psychol.* 1995; 51:768–74. [PubMed: 8778124]
11. Nandagopal JJ, Fleck DE, Adler CM, Mills NP, Strakowski SM, DelBello MP. Impulsivity in adolescents with bipolar disorder and/or attention-deficit/hyperactivity disorder and healthy controls as measured by the Barratt Impulsiveness Scale. *J Child Adolesc Psychopharmacol.* 2011; 21:465–8. [PubMed: 22040191]
12. Gilbert KE, Kalmar JH, Womer FY, Markovich PJ, Pittman B, Nolen-Hoeksema S, Blumberg HP. Impulsivity in Adolescent Bipolar Disorder. *Acta Neuropsychiatr.* 2011; 23:57–61. [PubMed: 21483649]
13. Paaver M, Kurrikoff T, Nordquist N, Orelund L, Harro J. The effect of 5-HTT gene promoter polymorphism on impulsivity depends on family relations in girls. *Prog Neuropsychopharmacol Biol Psychiatry.* 2008 Jul 1; 32(5):1263–8. [PubMed: 18495314]
14. Burdick JD, Roy AL, Raver CC. Evaluating the Iowa Gambling Task as a Direct Assessment of Impulsivity with Low-Income Children. *Pers Individ Dif.* 2013; 55(7):771–776. [PubMed: 24072950]
15. Stanford MS, Mathias CW, Dougherty DM, Lake SL, Anderson NE, Patton JH. Fifty years of the Barratt Impulsiveness Scale: An update and review. *Personality and Individual Differences.* 2009; 47:385–395.
16. Peluso MA, Hatch JP, Glahn DC, Monkul ES, Sanches M, Najt P, Bowden CL, Barratt ES, Soares JC. Trait impulsivity in patients with mood disorders. *J Affect Disord.* 2007; 100:227–31. [PubMed: 17097740]
17. Swann AC, Anderson JC, Dougherty DM, Moeller FG. Measurement of inter-episode impulsivity in bipolar disorder. *Psychiatry Res.* 2001; 101:195–197. [PubMed: 11286822]
18. Swann AC, Pazzaglia P, Nicholls A, Dougherty DM, Moeller FG. Impulsivity and phase of illness in bipolar disorder. *J Affect Disord.* 2003; 73:105–111. [PubMed: 12507743]
19. Himpel S, Banaschewski T, Grüttner A, Becker A, Heise A, Uebel H, Albrecht B, Rothenberger A, Rammsayer T. Duration discrimination in the range of milliseconds and seconds in children with ADHD and their unaffected siblings. *Psychol Med.* 2009; 39:1745–51. [PubMed: 19265568]
20. Chamberlain SR, Fineberg NA, Menzies LA, Blackwell AD, Bullmore ET, Robbins TW, Sahakian BJ. Impaired cognitive flexibility and motor inhibition in unaffected first-degree relatives of

- patients with obsessive-compulsive disorder. *Am J Psychiatry*. 2007; 164:335–8. [PubMed: 17267798]
21. Quintin P, Benkelfat C, Launay JM, Arnulf I, Pointereau-Bellenger A, Barbault S, Alvarez JC, Varoquaux O, Perez-Diaz F, Jouvent R, Leboyer M. Clinical and neurochemical effect of acute tryptophan depletion in unaffected relatives of patients with bipolar affective disorder. *Biol Psychiatry*. 2001; 50:184–90. [PubMed: 11513817]
 22. Melanko S, Leraas K, Collins C, Fields S, Reynolds B. Characteristics of psychopathy in adolescent nonsmokers and smokers: Relations to delay discounting and self reported impulsivity. *Exp Clin Psychopharmacol*. 2009; 17:258–265. [PubMed: 19653791]
 23. Malloy-Diniz L, Fuentes D, Leite WB, Correa H, Bechara A. Impulsive behavior in adults with attention deficit/hyperactivity disorder: characterization of attentional, motor and cognitive impulsiveness. *J Int Neuropsychol Soc*. 2007; 13:693–8. [PubMed: 17521490]
 24. Berlin GS, Hollander E. Compulsivity, impulsivity, and the DSM-5 process. *CNS Spectr*. 2014; 19:62–8. [PubMed: 24229702]

Figure 1. Barrat Impulsivity Scale Scores Across Study Groups

Unaffected offspring (UO) showed higher impulsivity scores than healthy controls (HC), but lower scores than bipolar disorder (BD) and major depressive disorder (MDD) patients.

Table 1
Barrat Impulsivity Scale (BIS-11A) scores across the different study groups

	Group				F*	p*
	BD	MDD	UO	HC		
BIS-11 scores (mean ± SD)	Total ^a	78.13 ± 11.41	75.69 ± 12.00	68.16 ± 10.19	60.14 ± 8.05	<0.01
	Motor Impulsivity ^b	25.93 ± 6.31	24.57 ± 5.47	22.72 ± 4.80	19.26 ± 3.92	<0.01
	Attentional Impulsivity ^c	21.97 ± 3.39	21.55 ± 4.02	18.56 ± 3.35	16.45 ± 3.25	<0.01
	Non-planning Impulsivity ^d	30.23 ± 4.56	29.57 ± 5.84	26.89 ± 3.81	24.43 ± 3.73	<0.01

BD=bipolar disorder, MDD=major depressive disorder, UO=unaffected offspring, HC=healthy controls

* ANOVA

^a Games-Howell test for multiple comparisons revealed significant differences between HC and BD (p<0.001), HC and MDD (p<0.001), HC and UO (p<0.05), and BD and UO (p<0.01). Differences between BD and MDD and between MDD and UO were not statistically significant.

^b Games-Howell test for multiple comparisons revealed significant differences between HC and BD (p<0.001), HC and MDD (p<0.001), and HC and UO (p<0.05). Differences between BD and MDD, BD and UO, and MDD and UO were not statistically significant.

^c Games-Howell test for multiple comparisons revealed significant differences between HC and BD (p<0.001), HC and MDD (p<0.001), MDD and UO (p<0.05), BD and UO (p<0.01). Differences between BD and MDD and between HC and UO were not statistically significant.

^d Games-Howell test for multiple comparisons revealed significant differences between HC and BD (p<0.001), HC and MDD (p<0.001), HC and UO (p=0.02), BD and UO (p=0.02). Differences between BD and MDD and between HC and UO were not statistically significant.