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Research report

# Increased impulsivity as a vulnerability marker for bipolar disorder: Evidence from self-report and experimental measures in two high-risk populations ☆

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ABSTRACT

*Background:* Heightened impulsivity has been suggested as a possible risk factor for bipolar disorder (BD). However, studies on high-risk populations are scarce and have mainly focused on individuals with a genetic risk. The present study investigated two high-risk samples for BD with regard to several aspects of the impulsivity construct.
*Methods:* Unaffected relatives of BD patients (genetically defined high-risk group, $N=29$) and participants scoring high on the Hypomanic Personality Scale (psychometrically defined high-risk sample, $N=25$) were being compared to respective control groups ($N=27$ and $N=25$) using a multi-method approach. Participants were accessed on the Barratt Impulsiveness Scale-11 (BIS-11, trait impulsivity), the Stop Signal Task (response inhibition), and the Cambridge Gambling Task (impulsive behavior in decision-making processes).
*Results:* Both high-risk groups reported heightened impulsivity on the BIS-11, as well as impulsive decision-making, whereas no significant group differences in response inhibition were observed.
*Limitations:* Limitations were the lack in specificity of the results for BD and the cross-sectional study design, which does not allow conclusions about the influence of impulsivity on the development of or resilience for BD in risk groups.
*Conclusions:* Our findings support the assumption that increased trait impulsivity and impulsive decision-making are a vulnerability marker for and an endophenotype of BD.


## 1. Introduction

Bipolar disorder (BD) is a highly heritable disease (Smoller and Finn, 2003), characterized by a chronic course and accompanying affective, cognitive, and somatic impairments. Besides the genetic vulnerability it appears important to identify psychological mechanisms that convey risk to develop BD. This would allow detecting the disorder earlier and more reliably, thus enabling preventive means (Keener and Phillips, 2007). As for the concept of genetic vulnerability, the notion of endophenotypes might also be a highly efficient route towards the identification of psychological risk factors. Endophenotypes should be quantifiable measures that are associated with the disorder in the population, heritable, state-independent, i.e., manifest in an individual whether or not the illness is active, and more prevalent in individuals at risk to develop the disorder than in the general population (Gottesman and Gould, 2003). Similarly, the definition of vulnerability markers includes a different distribution in patients versus healthy controls, higher prevalence in family members, an association with spectrum disorders in family members, presence of the marker before the manifestation of clinical symptoms, and reliability and stability over time (Garver, 1987).

Although not yet meeting all of the above mentioned criteria, elevated impulsivity has the potential to represent an endophenotype and vulnerability marker for BD. First, increased impulsivity is associated with BD on a diagnostic level, as impulsive behavior characterizes manic and hypomanic episodes (American Psychiatric Association, 2000) and has been shown to correlate positively with symptom severity and a detrimental course of illness (Lewis et al., 2009; Swann et al., 2009a). More precisely, impulsivity was shown to

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have an effect on overall functioning and autonomy, but also on aspects such as cognitive functioning and financial issues in euthymic bipolar patients (Jimenez et al., 2012). In addition, heightened scores on the Barratt Impulsiveness Scale-11 (BIS-11, Patton et al., 1995) and, on a behavioral level, impaired inhibition and deficient abilities to delay responses for larger rewards have been shown in symptomatic and euthymic BD patients, underlining the state-independence of impulsivity in the course of BD (Gruber et al., 2007; Murphy et al., 2001; Peluso et al., 2007; Rubinsztein et al., 2006; Strakowski et al., 2010; Swann et al., 2009a, 2009b). While both, symptomatic and euthymic bipolar patients showed equally elevated levels of impulsivity on a behavioral level in the Iowa Gambling Task (IGT), symptomatic patients reported even higher trait impulsivity on the BIS-11 than euthymic ones, reflecting the multi-faceted nature of the impulsivity construct (Powers et al., 2013) and emphasizing the importance of using both, self-report and behavioral measures when investigating impulsivity. Second, several studies reported that unaffected first-degree relatives of BD patients committed more response inhibition errors than controls without a family member with BD in tasks measuring impulsive behavior, such as the Stroop Word Colour Test or the Hayling Sentence Completion Test (Christodoulou et al., 2011; Frangou et al., 2005; Schulze et al., 2011; Zalla et al., 2004). Further, they also displayed more trait impulsivity as measured on the BIS-11, scoring on an intermediate level between BD patients and healthy controls (Lombardo et al., 2012). In addition, Bora et al. (2009) demonstrated in their meta-analysis that deficient response inhibition is the most prominent endophenotype of BD compared to several other executive functions.

Additionally, there are several studies on the identification of risk groups for developing BD from the general population, which point to the role of impulsivity as vulnerability marker. In individuals scoring high on the Hypomanic Personality Scale (HPS), elevated scores on the Impulsive Nonconformity Scale predicted greater rates of BD in a 13 year follow-up (Kwapil et al., 2000). Interestingly, a high HPS score correlated with the BIS-11 not thinking before acting items among other personality traits in a study measuring a large student sample, linking a hypomanic personality style to trait impulsivity (Johnson and Jones, 2009). Likewise, higher self-reported impulsivity scores, measured with the impulsive nonconformity scale in a large university students sample prone to develop BD as indicated by scores in the range of a bipolar spectrum disorder on the General Behavior Interview, predicted a progression to BD I but not BD II at 4.5 years follow-up (Alloy et al., 2012). Hence, impulsivity does not only result in a more detrimental form of BD in patients and a progression along the bipolar spectrum to a form of BD with more severe episodes of elevated mood (i.e. mania), but might also predispose healthy individuals to develop the disorder. In line with these findings, Chamorro and colleagues showed that more impulsive actions correlated with the occurrence of bipolar disorder in a community sample (Chamorro et al., 2012).

Nevertheless, studies exploring impulsivity in individuals at high risk for BD are still rare, and mainly focus on the genetic risk. However, as was outlined above, vulnerability can also be defined on the basis of particular personality traits. This approach does not only allow for cost-efficient screening of large samples, but more importantly offers the possibility of extending our etiological knowledge regarding non-familial forms of BD (Meyer and Maier, 2006). In addition, impulsivity is a multi-faceted construct including deficits in motor inhibition, insufficient planning and impulsive decision-making (Swann, 2010). These different aspects can be assessed by self-report questionnaires such as the BIS-11, measuring motor inhibition and non-planning, and through behavioral measures. Deficient inhibition is often assessed with stop signal tasks (SST) or go/no-go tasks, whereas impulsive decision-making is investigated using gambling tasks (e.g., Iowa Gambling Task, Cambridge Gambling Task (CGT)). Studies on impulsivity as a risk factor for BD usually investigate just one aspect of impulsivity in one high-risk group, making comparisons between studies and the extraction of conclusions rather difficult.

In the present study, we sought to investigate increased impulsivity as a potential endophenotype of and a vulnerability marker for BD in two high-risk samples defined on a genetic and a psychometric basis, respectively. The first sample consisted of healthy first-degree relatives of BD patients. The second sample comprised participants high in a “hypomanic personality” trait (HP), which is characterized by a chronic mild manic state (Eckblad and Chapman, 1986) and has been shown to be associated with an increased risk to develop BD (Kwapil et al., 2000). Since the two high-risk samples differed in age, two separate studies were performed in order to prevent a confounding effect of age (see also Section 4). To account for the multi-faceted nature of the impulsivity construct (Dougherty et al., 2005), we assessed impulsivity with a self-report measure (BIS-11) and two behavioral tasks (SST, CGT) measuring motor impulsiveness (impaired response inhibition) and impulsive risky decision-making, respectively. Importantly, the applied gambling task allowed disentangling impulsive and risky decision-making.

Based on the reported literature, both groups of high-risk individuals were expected to score significantly higher on the

**Table 1**
Descriptive data of the self-report measures (BIS-11) and the CANTAB subtests SST and CGT for the two high-risk samples (hypomanic personality and unaffected first-degree relatives of BD patients) and their respectively matched control groups.

| | **HP** (*N*=25) | **nonHP** (*N*=25) | **BD-Rel** (*N*=27) | **HC** (*N*=29) |
|---|---|---|---|---|
| | ***N*** | ***N*** | ***N*** | ***N*** |
| Sex (male/female) | 10/15 | 10/15 | 13/14 | 14/15 |
| | **M (SD)** | **M (SD)** | **M (SD)** | **M (SD)** |
| **Age** | 22.64 (3.07) | 23.04 (3.54) | 31.79 (14.40) | 32.90 (15.16) |
| **IQ** | 116.36 (6.76) | 120 (7.86) | 116.33 (12.86) | 122.19 (10.79) |
| **Beck depression inventory** | 2.48 (2.37)* | 0.68 (1.76) | 2.59 (2.97)* | 1.05 (1.83) |
| **State- trait-anxiety inventory—trait score** | 32.32 (7.54) | 31.68 (10.11) | 32.05 (7.57)* | 27.76 (6.06) |
| **Hypomanic personality scale** | 33.64* (2.64) | 11.04 (4.98) | 9.04 (6.19) | 8.89 (6.42) |
| **BIS-11: total score** | 65.80** (7.19) | 57.44 (8.55) | 58.04* (5.31) | 54.26 (6.43) |
| **Stop signal task (SST)** | | | | |
| *SSRT* | 141.49 (25.69) | 154.94 (28.04) | 175.45 (38.90) | 163.80 (44.70) |
| **Cambridge gambling task (CGT)** | | | | |
| *Delay aversion* (%) | 0.27* (0.13) | 0.19 (0.13) | 0.27* (0.15) | 0.19 (0.12) |

SSRT: Stop-signal reaction time.

* Significance at $p < .05$.

** Significant at $p < 001$.