A longitudinal investigation of Binocular Rivalry Rate (BRR) in major psychiatric disorders

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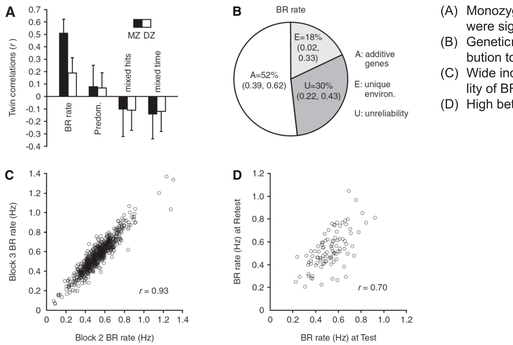
Background

Binocular rivalry is a visual phenomenon in which conflicting images are presented to corresponding locations of the two eyes, resulting in perceptual alternation or rivalry between the two images (see Figure 1). The rate of switching between the images, or binocular rivalry rate (BRR), has been found to be slow in bipolar disorder (BD) but not in other psychiatric disorders such as schizophrenia (SZ) and major depressive disorder (MDD) (Miller et al., 2003; Nagamine et al., 2009; Pettigrew & Miller, 1998). Most recently, slow BRR was demonstrated in a sample of nearly 100 BD subjects, in which the trait was also found to not be affected by medication, depressive state or level of cognitive functioning (Vierck et al., 2013). Furthermore, a recent large twin study showed that additive genetic factors account for around 50% of individual variation in BRR (Miller et al., 2010, see Figure 2). Together these findings suggest slow BRR may have clinical diagnostic and endophenotype utility in BD (Ngo et al., 2011). However, there remains insufficient data on the extent to which BRR remains stable over time in clinical subjects, or is influenced by current clinical state, specific symptomatology and medication (though a slowing effect of benzodiazepines on BRR was recently reported; van Loon et al., 2013). The aim of this study was to therefore examine the specificity of slow BRR to BD and investigate BRR longitudinally in BD, SZ and healthy controls. Preliminary data on BD and SZ subjects are presented.

Figure 1: Binocular rivalry paradigm



When two different images are presented simultaneously, one to each eye, perception alternates between perceiving one image for a few seconds, followed by the other image for a few seconds and so on (with occasional mixed percepts). This switching rate is called binocular rivalry rate (BRR).

Figure 2:Twin study of BRR

(A) Monozygotic (MZ) vs dizygotic (DZ) twin correlations for BRR were significant but not for other BR measures.
(B) Geneticmodellinganalysesindicatedasubstantialgeneticcontribution to individual variation in BRR.
(C) Wide individual variation and very high within-session reliability of BRR.
(D) High between-session (retest) reliability of BRR.

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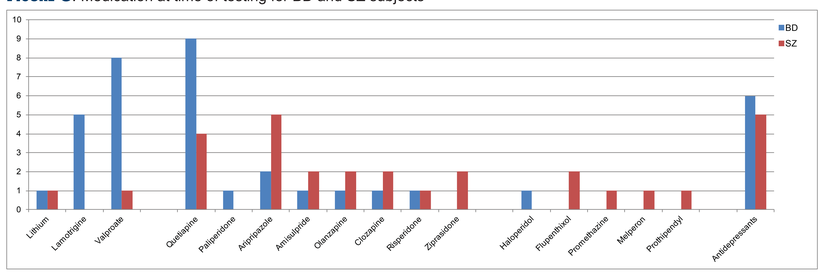
Methods

Participants:

Thirty-eight patients from mental health services at the University Medical Centre of Goettingen participated in this study. Twenty-one of these individuals were diagnosed according to DSM-IV criteria with BD I or BD II and seventeen with SZ. Current symptomatology and medication were assessed on the day of testing (for medication details see Figure 3). At the time of testing, ten of the BD patients were euthymic (fully remitted for at least 2 months), 4 depressed, 3 manic, 1 hypomanic, 1 had a mixed state and 1 was rapid-cycling. All subjects were part of an ongoing large-scale longitudinal study in Goettingen (KFO 241, http://www.kfo241.de). Exclusion criteria were: (i) a history of brain injury or other relevant medical conditions; (ii) strabismus and/or amblyopia; and (iii) visual acuity (corrected or uncorrected) worse than 6/9 in either eye.

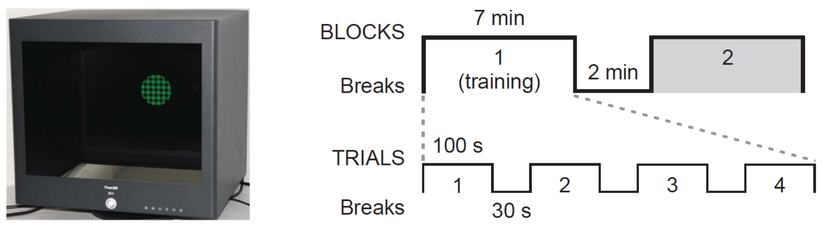
Figure 3: Medication at time of testing for BD and SZ subjects



Procedure:

Written, informed consent was obtained from all subjects according to a protocol approved by the Ethics Committee of the University Medical Centre Goettingen. All procedures were in accordance with the Helsinki declaration of 1975. Subjects were asked to abstain from ingesting tea, coffee, coca cola and alcohol for 4 hours prior to testing. The binocular rivalry stimuli were presented on a specialised monitor (Figure 4A) and viewed with passive polarised glasses. Subjects were instructed to report their perceptions by pressing designated keys on a keyboard: one for vertical, one for horizontal and the space bar for mixed percepts or incorrect responses (see Figure 4B for recording protocol).

Figure 4:



(A) Dual-screen passive polarised filter monitor (True3Di™) used to present binocular rivalry stimuli. (B) The binocular rivalry task takes about 20 min to complete. There are two blocks of testing, each consisting of 7 min of rivalry viewing with interspersed rest breaks. Only the second block is used for analysis because BRR requires the first block of testing to stabilise. The stimuli were drifting vertical and horizontal square-wave gratings (with a high spatial frequency). Binocular rivalry measures were rate (Hz) and predominance (ratio of time spent perceiving one image relative to the other).

Disclosure

The authors declare no conflict of interest.

Acknowledgements
This work is supported by the Deutsche Forschungsgemeinschaft (DFG) via the Clinical Research Group 241'Genotype-phenotype relationships and neurobiology of the longitudinal course of psychosis' (http://www.kfo241.de; grant number WP1 (SCHU 1603/5-1)).

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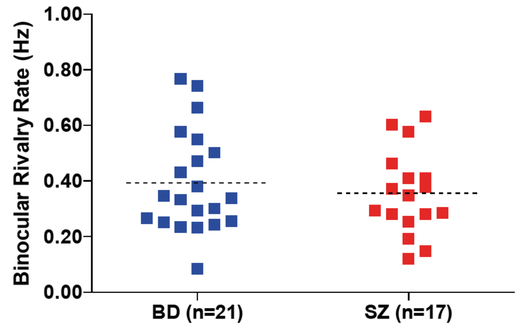
Results

As depicted in Figure 5, preliminary BRR data collected from BD and SZ subjects suggest no significant difference between the two groups (t (35) = 1.061, p = 0.296).

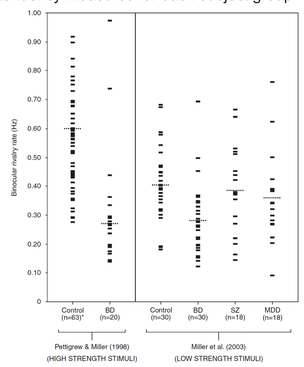
For comparison, Figure 6 presents the BRR data in psychiatric disorders from previous studies (Miller et al., 2003; Pettigrew & Miller, 1998), in which BD subjects were found to show significantly slower BRR compared to other subject groups.

Figure 5:
Distribution of individual BRR data in BD and SZ subjects



The dotted line indicates the group mean.

Figure 6:
BRR central tendency measures for each subject group



BRR central tendency measures for each subject group are indicated by the dotted line in the respective previous study (medians in Pettigrew & Miller, 1998; means in Miller et al., 2003).
*Four control outliers are not shown: 1.11, 1.11, 1.19, and 1.48 Hz.

Table 1: Subject group summary characteristics

	BD	SZ	Statistical tests
Male: Female Ratio	5 : 16	10 : 7	χ^2 (1) = 4.821, p = .28
Mean age (SD)	43.52 (13.87)	42.72 (14.36)	t (37) = .177, p = .860
PANSS positive	15.55	24.38	U = 95.0, p = .014
PANSS negative	18.95	20.18	U = 167.0, p = .750
PANSS general	18.36	20.91	U = 154.5, p = .486
YMRS	18.79	20.38	U = 146.5, p = .727
IDS-C	17.67	21.76	U = 140, p = .268

Discussion

We did not find a significant difference in BRR between BD and SZ, in contrast to previous findings (Miller et al., 2003). However, as the results presented are only preliminary and based on small sample sizes, the current findings need to be interpreted with caution.

The preliminary results of this study suggest slow BRR may not be unique to BD and that the trait may also be apparent in subjects with SZ. If so, the similarity in BRR found between SZ and BD in the current study may be due to the high genetic overlap between these psychiatric disorders (Consortium*, 2013) (Lichtenstein et al., 2009). Evidence that BRR is slower in BD compared to controls continues to emerge (Vierck et al., 2013). However, given the discrepancy between the results of Miller et al. (2003) and those of the present study regarding BRR in BD and SZ, investigation of the slow BRR trait and its specificity to BD will require large-scale clinical and genetic studies (Law et al., in press; Ngo et al., 2011). Toward this end, larger samples of BD and SZ subjects are currently being tested along with healthy controls. In addition, longitudinal data collection involving retesting subjects on BRR over the course of their illness is also in progress. This work will enable examination of whether BRR remains stable over time in clinical subjects, and further assessment of the trait's clinical diagnostic and endophenotype utility in BD.