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The contribution of optimism and hallucinations to grandiose delusions in individuals with schizophrenia

Catherine Bortolon [a,b,*], Hanan Yazbek [a], Joanna Norton [c,d], Delphine Capdevielle [a,c,d], Stéphane Raffard [a,e]

[a] University Department of Adult Psychiatry, Hospital La Colombière, CHU Montpellier, France
[b] Université Grenoble Alpes - Laboratoire Inter-universitaire de Psychologie: Personnalité, Cognition et Changement Social, Grenoble, France
[c] INSERM U1061, Montpellier, France
[d] University of Montpellier, Montpellier, France
[e] Univ. Paul Valéry Montpellier 3, Univ. Montpellier, EPSYLON EA 4556, F34000, Montpellier, France

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ABSTRACT

Grandiose delusions (GDs) are defined as false beliefs about having an inflated worth, power, or a special identity which are firmly sustained despite undeniable evidence to the contrary. Although it is the second most commonly encountered delusional beliefs, GDs have received little attention. Thus, in this study, we explored the role of future expectations and sensitivity to reward in GDs in schizophrenia (SZ) disorder. In total, 115 SZ patients completed measures of positive and negative symptoms, sensitivity to reward, depression, and a task in which individuals were asked to estimate the probability that positive, negative and neutral events will occur in the future. Correlation and Linear Regression analyses were performed in order to determine whether sensitivity to reward and future expectations are associated with GDs. Regressions showed that hallucinations and future positive expectations were significantly associated with GDs. In conclusion, the present study showed that higher optimism regarding the future might be important psychological processes associated with the maintenance of GDs in SZ patients. Moreover, it is possible that patients experiencing hallucinations may interpret this phenomenon as a kind of special ability or power, resulting in turn in GDs maintenance. Implications of these findings and directions for future research are discussed.

1. Introduction

A large body of psychological research has demonstrated that the formation and the maintenance of delusions can be conceptualized as an interaction between the environment and abnormal cognitive-affective processes. Cognitive-affective processes have received in the last few years increased attention in particular their role in persecutory delusions (PDs). However, and contrary to PDs, grandiose delusions (GDs) have received astonishingly less attention even though it is the second most commonly encountered delusional beliefs in both psychotic disorders (Stompe et al., 2006) and general population (Larøi and Van der Linden, 2005). Moreover, no psychological (e.g. cognitive behavioral therapy) or pharmacological interventions have been shown to be effective for treating individuals with GDs (Appelbaum et al., 1999). Despite the development of a preliminary model of GDs (Knowles et al., 2011), cognitive and emotional processes underlying the development and maintenance of GDs are poorly understood.

It has been proposed that GDs frequently occur alongside PDs and it is the main reason why its underlying mechanisms have been closely linked with those underlying PDs such as self-esteem (Ben-Zeev et al., 2011), jumping to conclusions, and reduced reasoning flexibility (Garety et al., 2012). Still, the role of other cognitive-affective processes remains to be explored. For instance, it has been suggested that aberrant optimistic bias (Schönfelder et al., 2017) and higher sensitivity to reward (Gruber, 2011; Gruber et al., 2009) may contribute to mania symptoms in bipolar disorders, which very often also includes GDs (Knowles et al., 2011). Considering that there is an important overlap between schizophrenia and bipolar disorder (Laursen et al., 2009), we may expect that similar processes would be associated with GDs in a sample of individuals with a diagnosis of schizophrenia (Knowles et al., 2011).

1.1. Optimism

Optimism tends to reflect the extent to which people hold generalized favorable expectancies for their future (Carver and Scheier, 2014). Individuals who constantly bring to mind positive and personally meaningful aspects of their past, tend to be more optimistic about the future (Cheung et al., 2013) and to hold more positive and even unrealistically

* Corresponding author at: Laboratoire Inter-universitaire de Psychologie: Personnalité, Cognition et Changement Social, University Grenoble Alpes, UFR SHS, 1251 Avenue Centrale, CS 40700, 38058 Grenoble Cedex 9, France.
E-mail address: catherine.bortolon@univ-grenoble-alpes.fr (C. Bortolon).

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self-views (Luo et al., 2016). This tendency to hold a positive self-perception that is not grounded in reality, namely, self-enhancement, can be considered as a concept related to GDs. Traditionally optimism has been seen as adaptive and associated with well-being. However, an inflated optimism could lead to problems when individuals fail to recognize what they cannot achieve in reality (Carver and Scheier, 2014), which may be the case for individuals holding GDs.

1.2. Sensitivity to reward

Optimist people also tend to expect more reward in future situations (Stankevicius et al., 2014). Sensitivity to reward is associated with the Behavioral Activation System (BAS), which is suggested to guide approach toward reward-relevant stimuli and thus lead to goal-direct behavior, confidence, optimism, and interest and pleasure in rewards (Alloy and Abramson, 2010; Gray, 1990). Individuals with higher sensitivity to reward search for experiences in which they are most likely to obtain rewards such as being praised by others and winning (money or games) easily. Heightened reward sensitivity has been described in bipolar disorder (Gruber, 2011; Gruber et al., 2009). In schizophrenia, lower sensitivity to reward is typically associated with negative symptoms (Gold et al., 2008). Here, however, we hypothesize that those individuals with grandiose ideas could be more likely to engage and focus on activities with higher probability to obtain rewards (higher sensitivity to reward) that confirms their beliefs.

1.3. Goals and hypothesis

The main goal of the present study was to explore the role of optimism and sensitivity to reward in GDs in a sample of patients diagnosed with schizophrenia. More specifically, we aim to evaluate whether optimism (Positive future expectations) and sensitivity to reward were independently associated with GD level. We also included other measures of positive and negative symptoms as well as a measure of depression. The second goal of the present study was to investigate whether these variables were specifically associated with GDs or whether they were also associated with PDs.

2. Method and materials

2.1. Participants

One hundred fifteen participants with a diagnosis of schizophrenia were recruited from full- and part-time hospitalization and ambulatory care services of the Departments of Adult Psychiatry in Montpellier, Marseille, and Nice (France). Diagnoses were made by a psychiatrist fully trained, using the structured clinical interview for DSM–IV (SCID). Patients were aged between 18 and 60 years old and had to understand, talk and read French. Exclusion criteria were: (a) known neurological disease (b) brain injuries, or (c) Axis II diagnosis of developmental disorders. Written informed consent was obtained from all participants and the local ethical committee approved the protocol.

2.2. Instruments

GDs and PDs were evaluating using items 5 and 6, respectively, from the **Positive and the Negative Syndrome Scale** (**PANSS**; (Kay et al., 1987)). Other clinical symptoms were also evaluated using the PANSS, as well as the **Scale for the Assessment of Negative Symptoms** (**SANS**; (Andreasen, 1989)) and the **Calgary Depression Scale** (**CDSS**; (Addington et al., 1993)).

Sensitivity to Punishment and Reward Questionnaire short version (SPSRQ) was used to evaluate sensitivity to punishment (SP) and reward (SR) were evaluated using the French version (Torrubia et al., 2001). The short French version (Lardi et al., 2008) of the SPSRQ includes 35 items, similar to that developed by O'Connor and colleagues (O'Connor et al., 2004), of which 17 assess SR and 18 SP. The ratings in this version are done on a 4-point Likert scale, ranging from 1 (totally no) to 4 (totally yes). Only the score of SR was used in the present study. The items in the SR subscale address individual differences regarding Behavioral Activation System activity including responses to stimuli that are rewarding or relieve punishment. Examples of questions include: "*Do you often do things to be praised?*" and "*Do you often take the opportunity to pick up people you find attractive?*"

2.2.1. Future expectancies task

This task was based on the Future Thinking Task developed by MacLeod & Byrne (MacLeod and Byrne, 1996). This task requires participants to think about the possibility of future experiences occurring over the next week. Participants were given a list of different situations and then asked to estimate the probability that they will occur in the future, ranging from 1 (not probable at all) to 7 (extremely probable). There are three types of situations: future positive (e.g., "You will accomplish something with success"), negative (e.g., "Someone criticizes you") and neutral situations (e.g., "You watch television"). In total, participants were presented with 18 situations, 6 of each type.

2.3. Statistical analyses

Mean, and standard deviation was calculated for the demographic and clinical variables (see Table 1). Subsequently, correlations and linear regression analysis were used to test the relationship between GDs and the variables (future expectations, sensitivity to reward, depression, negative and positive symptoms). The linear regression was performed in R with the *lm* (linear model) function. Moreover, three packages were employed to perform regression diagnostics analyses: *tseries* (Time Series Analysis and Computational Finance; Trapletti et al., 2018), *lmtest* (Testing Linear Regression Models; Hothorn et al., 2018) and *car* (Companion to Applied Regression; Fox & Weisberg, 2018) packages. More specifically, regression diagnostics included tests of Linearity (errors to be normally distributed; Normal Probability Plot), homoscedasticity (Plot of residuals versus predicted value), independence (Durbin-Watson statistic) of Residuals, the presence of outliers (Cook's distance), Non-linearity, and multicollinearity (VIF < 2). The function *Normalize( )* was employed to improve the model. The

Table 1
Mean and standard deviations for clinical and socio-demographic variables.

	M	SD
Age	36,91	9,98
Duration of the illness	15,10	9,80
Chlorpromazine equivalents	800,33	656,66
Positive symptoms (PANSS)	12,61	4,84
Hallucinations	2,17	1,49
Grandiosity	1,90	1,43
Suspiciousness/persecution	2,36	1,45
Negative symptoms (PANSS)	18,66	6,07
Negative symptoms (SANS)	39,00	16,61
General psychopathology (PANSS)	34,09	7,26
Depression (CDSS)	3,64	3,76
Sensitivity to reward	41,30	8,50
Positive future expectations	27,30	7,19
Negative future expectations	19,83	6,76
Neutral future expectations	30,00	6,20
	N	%
Gender (male)	88,00	76.5%
Education level		
Primary school	25,00	21.7
Secondary school	64,00	55.6
Higher education	26,00	22.6

Note: PANSS: Positive and Negative Symptoms Scale; SANS: Scale for the Assessment of Negative Symptoms.

significance level for our analyses was set at $p < 0.05$. All statistical analyses were performed using the R Studio version 1.1.

3. Results

3.1. Grandiose delusions

Significant correlations were found between GDs and Hallucinations ($r = 036$, $p = 0.0001$), Suspicious/Persecution ($r = 0.27$, $p = 0.003$), General Psychopathology ($r = 0.21$, $p = 0.03$), Future Positive Expectations ($r = 0.31$, $p = 0.0006$), and Sensitivity to Reward ($r = 0.30$, $p = 0.001$).

Following the previous analysis, multiple regression analysis was performed. In the first model, only the clinical variables (Hallucinations, Suspiciousness/Persecution, and General Psychopathology) were entered. Subsequently (model 2), Positive Future Expectations and Sensitivity to Reward were also entered as independent variables. In model 1 ($R^2 = 0.222$, $p < 0.0001$), only Hallucinations predicted GDs ($\beta = 0.328$, $SE = 0.082$, $t = 3.998$, $p = 0.0001$, 95%CI 0.172–0.510). In model 2, both Hallucinations ($\beta = 0.297$, $SE = 0.078$, $t = 3.789$, $p = 0.0002$, 95%CI 0.146–0.471) and Positive Future Expectations ($\beta = 0.04$, $SE = 0.013$, $t = 3.085$, $p = 0.006$, 95%CI 0.013–0.079) were associated with GDs ($R^2 = 0.315$, $p < 0.0001$). Statistically significant differences were found between the two models ($F = 7.417$, $p = 0.0009$).

3.2. Specificity of grandiose delusions: persecutory delusions

In order to determine whether our results were specific to GDs and would not be observed in PDs, we also analyzed the correlations between PDs and both Future expectations and Sensitivity to Reward. Significant correlations were found between PDs and Future Negative Expectations ($r = 0.20$, $p = 0.04$) and Sensitivity to Reward ($r = 0.26$, $p = 0.004$).

4. Discussion

Grandiose delusions have received astonishingly little attention in the past years even though it is the second most commonly encountered delusional beliefs (Stompe et al., 2006). Consequently, little is known regarding the psychological processes associated with the development and maintenance of GDs. Thus, this study's goal was to explore the role of future positive expectations or optimism and sensitivity to reward.

Evidence suggests that GDs seems to be a more stable state of mind influenced mostly by past experiences (unreal, imaged situations or biased memories; (Ben-Zeev et al., 2011; Connors et al., 2014; Kopelman, 2010), which may lead individuals with GDs to be more optimistic regarding their future. Indeed, people who are nostalgic, that is, individuals who have affection for atypically positive and subjective experiences (Morewedge, 2013), also tend to maximize the positivity of one's self-views (Luo et al., 2016) and to be more optimism about the future (Cheung et al., 2013). Accordingly, we found that having future positive expectations was associated with higher levels of GDs in individuals with schizophrenia. Conversely, no significant correlations were found between GDs and both future negative and neutral expectations. This is in agreement with previous studies showing that positive future expectations are not functionally equivalent to negative future expectations (MacLeod et al., 1998; O'Connor and Cassidy, 2007) and are not correlated with depression (O'connor and Sheehy, 2000). Thus, our results suggests that individuals with GDs may be more optimistic regarding their future suggesting that it might partly underlie the maintenance of these ideas together with other cognitive bias such as reasoning bias (Garety et al., 2012). Based on previous research on PDs (Startup et al., 2016), one could suggest that individuals with GDs could engage in a repetitive style/way of thinking about future positive expectations to strengthen a positive sense of self. This is in accordance with a recent study by Raffard et al. (2016) who showed in a sample of individuals diagnosed with schizophrenia that most of the episodic future thoughts were related to positive events such as achievements, significant relationships, and leisure contents. As postulated by the authors, this positive bias for the future could be interpreted as a way for individuals diagnosed with schizophrenia with GDs to create an idealized representation of one's future potential in the face of stress and adversity caused by the disease. Likewise, previous studies have shown that participants reported grandiose beliefs "as increasing their power which helped them to cope with difficult experience" (Renny, 2016) including negative experiences in which they have been unfairly treated just before the emergence of these beliefs, which in turn seems to have a positive effect on the mood (Grbic, 2013; Renny, 2016).

Another hypothesis tested in this study was that GDs would be associated with higher levels of sensitivity to reward. Our results partially corroborate this hypothesis. Indeed, we found significant correlations between GD level and sensitivity to reward. Nevertheless, sensitivity to reward was not associated with the level of GD in our sample when other variables were considered in our model. Our results suggest that although higher levels of sensitivity to reward may be associated with higher levels of GDs, other factors may better explain the variations in GD level. Indeed, our results showed significant correlations between the experience of hearing voices (hallucinations) and GDs in our sample. Positive symptoms are known to co-exist and to be correlated (Rückl et al., 2011) probably because they share some neurocognitive and cognitive-affective background processes such as reasoning biases (Garety et al., 2012), metacognitive beliefs (Larøi and Van der Linden, 2005) and source monitoring (Griffin and Fletcher, 2017), although there are also differences (Garety et al., 2012). In agreement, only 10–16% of people with a diagnosis of schizophrenia experience GDs in isolation (Knowles et al., 2011). Our results corroborate these findings by showing that higher levels of GDs are associated with higher levels of other positive symptoms such as suspicious/persecutory delusions and hallucinations. Nevertheless, hallucinations were the only symptoms that were associated with GDs when considering the other variables entered into the model. It is well known in the literature that unusual experiences such as hearing voices or seeing things are often associated with delusional interpretations. Thus, it is possible that patients experiencing hallucinations may interpret this phenomenon as a kind of special ability or power, resulting in turn in GDs maintenance.

Also considering this overlap of positive symptoms, we performed two separate sets of analysis: one for GDs and one for PDs. Regarding the second analysis, results indicated significant associations between high levels of PD and negative future expectations and sensitivity to reward. Thus, the role of positive future expectations might be specific to GDs.

Contrary to other studies, we found no significant correlations between GDs level and depression suggesting that GDs may not be associated with a positive mood or reduced negative mood as suggested by Garety and colleagues (Garety et al., 2012; Smith et al., 2005, 2006). Another study also e found that negative mood (sadness) was not associated with GDs (Ben-Zeev et al., 2011) suggesting that GDs is not related to mood. In fact, previous studies have found evidence for an association between GDs and higher levels of conviction (Appelbaum et al., 1999) and reasoning biases (Garety et al., 2012), which may explain why GDs seem to be a stable state of mind and are relatively independent of contextual triggers (Ben-Zeev et al., 2011).

The present study suffered from a few limitations. First, the data are cross-sectional, meaning that the causal links between variables are difficult to interpret. Longitudinal and/or experimental studies could help us to better determine whether optimism plays a role in the development and maintenance of GDs. Second, we did not include a sample of control participants, which prevented us from determining whether individuals with GDs suffered or not from exaggerated optimism bias. Third, our measure to evaluate future expectations only explained a small variation of grandiose delusions. It might be because our measure

was designed to evaluate general everyday situations. Evaluating more personal future expectations in future studies could be more valuable since these expectations may be related to the content of the GDs. On the other hand, factors such as cognitive bias and other positive symptoms may be more relevant contributors to grandiose delusions.

Strengths of this study include the large sample of patients diagnosed with schizophrenia. Also, to the best of our knowledge this is the first study to evaluate whether future expectations and sensitivity to reward are associated with GDs. This study opens new avenues to explore the psychological mechanisms associated with GDs beyond cognitive biases. It suggests that the way individuals think about their future or even the way they project themselves into the future may be relevant for further understating how GDs are maintained. Some authors suggested that GDs "may develop as a compensation for an underlying sense of loneliness, unworthiness, or powerlessness" ((Beck and Rector, 2005); p. 588). Creating a more optimistic view of the future or of themselves through GDs may be a way to regain control and power over their own lives after negative experiences (Grbic, 2013).

Conflict of interest

The authors have declared that there are no conflicts of interest in relation to the subject of this study.

Contributors

Authors CB, CD, HY and SR designed the study and wrote the protocol. Author CB managed the literature searches and analyses. Authors CB and JN undertook the statistical analysis, and author CB wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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