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The intentionality bias in schizophrenia

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ABSTRACT

The tendency to over-interpret events of daily life as resulting from voluntary or intentional actions is one of the key aspects of schizophrenia with persecutory delusions. Here, we ask whether this characteristic may emerge from the abnormal activity of a basic cognitive process found in healthy adults and children: the intentionality bias, which refers to the implicit and automatic inclination to interpret human actions as intentional (Rosset, 2008, Cognition 108, 771–780). In our experiment, patients with schizophrenia and healthy controls were shown sentences describing human actions in various linguistic contexts, and were asked to indicate whether the action was intentional or not. The results indicated that people with schizophrenia exhibited a striking bias to over attribute intentionality regardless of linguistic context, contrary to healthy controls who did not exhibit such a general intentionality bias. Moreover, this study provides some insight into the cognitive mechanisms underlying this bias: an inability to inhibit the automatic attribution of intentionality.

1. Introduction

The tendency to interpret the events of daily life as intentional or voluntary is one the central elements of schizophrenia with persecutory delusions. This trait is depicted in representations of the disease in popular culture (as in the film *A Beautiful Mind*), and is regularly found in the discourse of patients who describe accidental or common events, such as a mistake on the telephone or the laughter of others, as involving extra (i.e. illusory) layers of intentionality. Deficits of people with schizophrenia in Theory of Mind are now well documented (Harrington et al., 2005; Sprong et al., 2007; Bora et al., 2009) and, in the relevant scientific literature, numerous studies have highlighted this impairment in tasks particularly targeting intention recognition (Sarfati et al., 1997a, 1997b; Sarfati and Hardy-Baylé, 1999; Brunet et al., 2003). Nevertheless, authors reported in some patients, notably those having paranoid symptoms, not a lack to ability to infer others' mental states, but an excessive attribution of intentions to others (Abu-Akel and Bailey, 2000; Montag et al., 2011). The origins of this over-attribution of intentionality remain poorly understood.

The present work asks whether this important characteristic of schizophrenia may emerge from the abnormal activity of a more basic cognitive process. In particular, we examine the possibility that a primitive bias to attribute intentionality. Corollaries of such a bias are found in young children, who promiscuously over-attribute purpose and function to non-living natural kinds (Kelemen, 1999; DiYanni and Kelemen, 2005) as well as in healthy adults who over-attribute intentionality under time pressure (Rosset, 2008) or under alcohol intoxication (Bègue et al., 2010). This basic intentionality bias may be the root cause of this deficit in schizophrenia.

Rosset (2008) had healthy adults read simple sentences that were somewhat ambiguous with regards to their intentionality, or were even read as being prototypically unintentional (e.g. "He set the alarm off"). Upon reading the sentence, participants were asked to indicate whether or not the person acted intentionally. Rosset (2008) found that participants who were asked to respond quickly (compared to a condition in which they were given more time to think carefully about the sentence) displayed an "intentionality bias", i.e. a bias to treat unintentional actions as being intentional. According to this intentionality bias hypothesis, when someone evaluates the behaviour of an agent engaged in an action, an intentional interpretation is automatically activated. Only through the use of additional knowledge acquired over time with experience (e.g. understanding of social norms, and of behaviour cues) is someone able to inhibit the intentional explanation to

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interpret the action as unintentional or accidental. Note that the existence of the purported intentionality bias hypothesis is nevertheless controversial and Hughes et al. (2012b) by using the same material as Rosset (2008) did not replicate these data.

For the first time (to our knowledge) we adopt a similar methodology to ask how this basic bias may manifest in schizophrenia. We predicted that if schizophrenia includes a general overfiring of the mental mechanism for attributing intentionality, schizophrenics should function similarly to healthy adults under time pressure by showing a bias to treat actions that are frequently unintentional as having been carried out intentionally. This prediction was motivated in part by the well known observations mentioned at the beginning of the introduction and in part by the work of Bara et al. (2011), who proposed a potential mechanism that might underlie hyper-intentionality in schizophrenia: a lack of deactivation of the intentional detector. This hypothesis has received some indirect empirical support in studies by Frith (1979, 1992) who proposed that several behavioural symptoms as well as cognitive deficits in schizophrenia could be explained by a lack of inhibition. Thus here we additionally postulated that any overactive intentionality bias we might observe should be linked to a failure of inhibitory processes.

In order to ensure that ours was the strongest possible test, we modified the basic design from the Rosset study due to recent research showing that the intentionality bias is heavily influenced by the grammatical structure of the linguistic stimuli employed. Strickland et al. (2011) have shown that French speaking healthy adults show the intentionality bias under time pressure for verbs that take "avoir" (i.e. "have") as an auxiliary in the past tense but do not do so for verbs that take "être" (i.e. "to be"). Thus participants under duress of time pressure were more likely to falsely say that Jean acted intentionally in (1) than in (2) despite the fact that in the absence of time pressure, virtually all participants claimed that these sentences referred to accidents.

1. Jean a glissé. (John has slipped)
2. Jean est tombé. (Jean has (is) fell)

Here we were interested in investigating the fundamental Theory of Mind processes present in schizophrenia. However, given that with French-speaking populations, Strickland et al. found that the intentionality bias is so heavily modified by grammatical structure, it is important to test the full spectrum of relevant grammatical contexts in order to ask about the generality of the intentionality bias in schizophrenia. We therefore tested participants' intuitions about the intentionality of both verb types. The central question is whether, even in conditions involving no time pressure, people with schizophrenia would display a general intentionality bias across a wide range of linguistic contexts.

2. Methods

2.1. Participants

Seventy-six native French-speaking volunteers participated in the study. Thirty-eight people meeting DSM-IV-TR criteria (American Psychiatric Association, 2000) for schizophrenia were recruited from Saint Jean de Dieu Hospital and Le Vinatier Hospital in Lyon (France). All schizophrenic patients received antipsychotic medication with a mean chlorpromazine equivalent dose (CPZ; Woods, 2003) of 329.78 mg per day (S.D.=229.24). Thirty-eight healthy controls, with no history of psychiatric disorders and no first-degree relatives with psychotic illnesses were recruited from the general community. These participants were gathered from around Lyon, France. Subjects in all groups were aged between 18 and 65 years and control subjects were matched to subjects with schizophrenia on age, sex and years of education. Individuals with a history of head injury, comorbid psychiatric or neurological illness, substance abuse (tobacco excepted) or learning disabilities were excluded.

The investigation was carried out in accordance with the Declaration of Helsinki and was approved by the local Ethical Committee (CPP Lyon—Sud Est IV, no. 11/030, AFSAPPS no. 2010-A01403-36). All subjects gave written informed consent.

2.2. Clinical evaluation

Each patient from Le Vinatier Hospital (N=28) was evaluated by an experienced psychiatrist with the French version (Lépine et al., 1989) of the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987). We used the five-dimensional structure of the PANSS (Lançon et al., 1998) initially derived from the work of Kay and Sevy (1990) and completed by Lindenmayer et al. (1994). This five-factor model involves the selection of only 24 items that encompass five main components: positive, negative, excitation, depression and cognitive. We chose this dimensional structure because we were particularly interested by the following items: P4 "excitation" which involves an increased response to stimuli, G4 "tension" which implies physical manifestations of excitation, and G14 "poor impulse control", which entails defective regulation and control of internal impulses. These items could be some of clinical markers of the deregulation of inhibitory processes and constitute the excitation dimension of the PANSS' five-dimensional structure of Lançon et al. (1998).

The demographic and clinical characteristics of participant groups are shown in Table 1.

2.3. Task

The task was devised to test the ability of patients with schizophrenia compared with control subjects to decide as accurately as possible (without time pressure) if a character acted intentionally or unintentionally in an action described by a short sentence. A set of 72 sentences was constructed. We manipulated two main factors: (1) the intentionality of the action (intentional vs. unintentional), and (2) the grammatical structure of the sentence ("to have" (avoir) or "to be" (être) verbs). We therefore built four groups of 18 sentences: (1) "to be"/intentional, (2) "to have"/intentional, (3) "to be"/unintentional, and (4) "to have"/unintentional. Each sentence described a simple action or event carried out by a single character, and was built according to the same structure: (1) the character, identified by either a male or a female French name (François, Lise), or a type of profession or qualification (the engineer, the burglar, the singer), or a type of relationship using either the first person singular (my neighbour, my aunt) or the third person singular (her/his son, her/his employee). In each group of 18 sentences there were: five or six male names, three female names, five professions or qualification, one or two types of relationships using the first person singular and two using the third person singular; (2) a verb conjugated in the "past tense" (for half of the sentences we chose "to have" verbs and for the other half we used "to be" verbs), and finally (3) a circumstantial complement of time, space, or manner. We ensured that each group of 18 sentences contained the same number of positive, negative and neutral events.

Examples of sentences:

(1) "to be"/intentional: "Charles est allé à l'enterrement"—"*Charles* (*is*) *went to the funeral*".
(2) "to have"/intentional. "Le client a signé ce matin"—"*The* (*has*) *client signed this morning*".
(3) "to be"/unintentional: "François est tombé sur la glace"—"*François* (*is*) *fell on the ice*".
(4) "to have"/unintentional: "Marc a glissé sur la chaussée"—"*Marc* (*has*) *slipped on the walkway*".

Table 1
Demographic and clinical data for healthy controls, and patients with schizophrenia (means and standard deviations).

	Healthy controls (N=38)	Patients (N=38)
Sex (M/F)	24/14	26/12
Age (Years;Months)	40;8 (± 13;5)	37;0 (± 7;10)
Education (years)	12.7 (± 2.9)	11.6 (± 2.4)
PANSS negative	N/A	19.64[a] (± 6.73)
PANSS positive	N/A	15.61[a] (± 6.38)
PANSS excitation	N/A	9.25[a] (± 4.08)
PANSS depression	N/A	7.5[a] (± 3.07)
PANSS cognitive	N/A	7.61[a] (± 2.92)
Chlopromazine equivalent dose (mg)	N/A	329.8 (± 229.2)

[a] (N=28).