



# Deficits in reality and internal source monitoring of actions are associated with the positive dimension of schizotypy



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## ABSTRACT

People with schizophrenia have deficits in retrieving the source of memory information. Research has focused on two types of judgements: reality monitoring (discriminating internally-generated stimuli from external information) and internal source monitoring (distinguishing two different internal sources). The aim of the current study was to assess the relation between schizotypy and both types of source memory in healthy volunteers. One hundred and two participants completed two source memory tasks: one involved the completion of well-known word pairs (e.g. Fish and?) and the other was an action based task (e.g. nod your head). At test participants needed to indicate whether the act had been performed or imagined by themselves, performed by the experimenter, or was new. The positive dimension of schizotypy was positively correlated with errors in internal source monitoring i.e. confusing participant performed and imagined acts. Furthermore, the same dimension of schizotypy was also positively associated with reality monitoring errors i.e. confusing participant performed/imagined with experimenter performed items. However, these relationships were not found in the word pair task. Our findings suggest that there might be overlap in the processes required to retrieve source information from memory, particularly for actions, and the occurrence of unusual experiences in healthy volunteers.

## 1. Introduction

Occasional problems with retrieving the origin, or source, of information from our personal past can be seen in everyday life, from when we forget or confuse who told us a certain piece of information to wondering whether we just thought about replying to an email or whether we actually did it. However, in certain psychiatric disorders such as schizophrenia, these difficulties in episodic memory are far more prevalent. Indeed, they reflect a core cognitive impairment (Elvevag and Goldberg, 2000; Ragland et al., 2009), which is observed in young medication-naïve patients (MacDonald et al., 2005) and healthy first-degree relatives of those with schizophrenia (Snitz et al., 2006; Touloupoulou et al., 2003). These memory impairments are largely unaffected by antipsychotic medication (Vinogradov et al., 1997). Research which elucidates the nature of the memory impairment is of vital importance because memory performance is one of the strongest predictors of functional outcome (Green, 1996; Milev et al., 2005).

Within episodic memory there is an important distinction between knowing whether something has been encountered before or not and

being able to recover the specific details surrounding an event. The former task can be based upon familiarity, whereas the latter task requires the recollection of contextual details (Yonelinas, 2001). For example, recognising that you have met someone before but not being able to remember anything else would be consistent with the process of familiarity, whereas remembering their name or where you know them from would require recollection. Many experiments have been conducted to determine whether the deficit that individuals with schizophrenia exhibit in memory performance is a result of impairments in recollection and/or familiarity. Across a number of different paradigms a fairly consistent finding has been that individuals with schizophrenia have impairments in recollection, but it is less clear whether they are impaired on familiarity judgements (Anselmetti et al., 2007; Moritz et al., 2003; but also see Weiss et al., 2008). A recent paper conducted a quantitative review of studies on this issue, accounting for methodological differences between tasks (Libby et al., 2013). They found deficits in both processes in this group, but those in familiarity were more variable and smaller in size.

Recollection of contextual information can be delineated further into three different judgement types (Source-Monitoring Framework;

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Johnson et al., 1993): i) reality monitoring, which is the discrimination between internal and external sources of information, e.g. did I lock the door or did someone else do it? ; ii) internal source monitoring, which involves distinguishing memories from two internal sources, e.g. did I send that email or just think about it? ; and iii) external source monitoring which requires differentiating between different external sources, such as whether Jane or Grace told you an important fact.

A great deal of research has focussed on reality monitoring because it has been proposed that it may play a role in the pathogenesis of some of the positive symptoms of schizophrenia, such as hallucinations and delusions (Bentall et al., 1991; Frith, 1992; Frith and Done, 1988; Rankin and O'Carroll, 1995). Studies which have examined this capacity have typically involved presenting participants with either a complete sentence or one where they need to fill in the blank. In the test phase participants need to indicate whether they generated the word, it was given to them or is new (e.g. Vinogradov et al., 1997). There is now substantial evidence to suggest that people with schizophrenia have deficits in reality monitoring and, in particular, that they misattribute self-generated events to an external source (Johns et al., 2001; Keefe et al., 2002; Vinogradov et al., 2008). As anticipated, many of these studies found the deficit to be linked to the positive symptoms (Brébion et al., 2000, 2002). However other researchers have found poor reality monitoring to be associated with negative symptoms (Brébion et al., 2002; Moritz et al., 2003), thought disorder (Nienow and Docherty, 2004), and a lack of association with clinical symptoms has also been reported (Henquet et al., 2005).

More recently internal source monitoring has also been examined because the distinction between imagination and reality is often blurred in schizophrenia (Brébion et al., 2008; Mintz and Alpert, 1972). A wide variety of source monitoring tasks have been utilised to study the performance of patients with schizophrenia. For example, Gawęda et al. (2012) asked patients to either imagine or actually perform an action and found that they confused the source of these actions in a subsequent test phase.

A complementary strategy which other researchers have taken is to adopt a 'continuum approach' to psychosis (Claridge, 1997; Johns and Van Os, 2001; Van Os et al., 2000, 2009). According to this view many of the symptoms seen in schizophrenia, such as paranoid ideation and hearing voices, can also be found in the general population; albeit to a milder or attenuated degree which would normally cause much less distress to the experiencing individual (Freeman et al., 2008; Johns et al., 2014). This continuum of personality characteristics and experiences is known as schizotypy. Action tasks have also been used in healthy volunteers and performance on them related to schizotypal traits. Consistent with the findings in patients with schizophrenia, deficits have been found in an internal source monitoring action task in individuals who have high proneness to hallucinations (Collignon et al., 2005) and those high in schizotypy (Peters et al., 2007).

The aim of the current study was to provide a more detailed and integrated understanding of source memory and its relationship to schizotypy in a large sample of healthy volunteers. The first issue we wished to examine was whether individuals high in schizotypy would display deficits in familiarity. On the basis of the review by Libby et al. (2013) it would be anticipated that a deficit in discriminating old from new items would be seen in those high in schizotypal traits. However, research findings on this issue have been mixed: Peters et al. (2007) found evidence for a deficit, whereas Collignon et al. (2005) did not. Next, we investigated source memory by assessing in the same participants reality monitoring and internal source monitoring. Previous work reported only deficits in internal source monitoring but not in reality monitoring (Collignon et al., 2005). This is surprising given the wealth of work highlighting problems in reality monitoring in schizophrenia (Johns et al., 2001; Keefe et al., 2002; Vinogradov et al., 2008). Therefore, we wished to examine whether individuals scoring high on schizotypy would have a deficit in both of these types of memory.

It has been argued by some researchers that the generalisability of word based paradigms to real-world situations is limited (Henquet et al., 2005; Parks, 1997) and that action based tasks might be a more naturalistic method of examining source memory. However no study has given participants these two types of tasks and assessed whether they both lead to the same findings. Therefore in this study participants completed two source memory tasks: one where a word needed to be generated (e.g. Fish and? ) and an action based task (e.g. nod your head). In both of these tasks participants needed to indicate at test whether the action was i) performed, ii) imagined, iii) performed by the experimenter, or iv) was new. We hypothesised that source memory deficits would be related to the positive dimension of schizotypy and so focussed primarily on this dimension, due to the findings of previous studies in this area (e.g. Brébion et al., 2000, 2002; Collignon et al., 2005; Peters et al., 2007).

## 2. Methods

### 2.1. Participants

One hundred and ten individuals took part in this study for payment or course credit. All participants were aged between 18 and 35 years, reported no diagnosis of any psychiatric disorder, were not currently taking psychotropic medication or illicit substances and possessed a high level of fluency in English. Eight participants were excluded from the study because their performance on the memory task(s) failed to exceed a threshold of 0.1 above chance i.e. less than 0.1 for corrected recognition and source accuracy of less than 0.43. Thus 102 participants (mean age 22.30 years, 80 females) were included in the study. Ethical approval was received for the study from institutional review, and all participants provided informed consent to take part.

### 2.2. Materials and procedure

Participants completed two memory tasks as part of a larger battery (there were no other memory tasks). The order of completion of the tasks was fixed across participants. The whole testing session took a maximum of two hours and participants were all tested individually.

#### 2.2.1. Memory tasks

The action task involved one study-test block separated by 100 min. At study participants were asked to sit in a neutral position (arms and legs uncrossed) at a table opposite the experimenter. On the table were objects needed to complete some of the actions and a stack of cards with an action printed on it and above this who should complete it (Participant Perform, Participant Imagine, Experimenter Perform). Each card was turned over by the experimenter one at a time and the participant/experimenter was encouraged to complete the action in a timely manner (usually a maximum of 6 s). There were 75 actions with an equal number in each action condition. Approximately half required everyday objects (e.g. stretch the rubber band, staple pieces of paper together, draw a line with the ruler) and the others were actions without using objects (e.g. nod your head, stand up and sit down, look backwards). The majority of these actions were taken from Collignon et al. (2005). An additional 12 actions were used as practice trials at the start of the study and test phases. All objects were removed prior to the test phase. Here all actions presented in the study phase were randomly intermixed with 25 new actions. The action was presented on a computer screen for 2000 ms. Participants were asked to recall whether they performed the action in the study phase (Participant Perform, PP), did they imagine completing the action (Participant Imagine, PI), whether they watched the experimenter perform the action (Experimenter Perform, EP) or whether the action was New.

The word task also had one study-test block but with an interval of 45 min. It was completed on a computer. In the study phase 72 widely known but incomplete word pairs were presented in the centre of the

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