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Impairment in event sequencing in disorganised and non-disorganised patients with schizophrenia

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Abstract

It has been suggested that thought disorder in schizophrenia is associated with impaired executive functions and with a defective understanding of others' behaviour. Action sequence knowledge processing and goal detection are considered as crucial components of executive functioning. Here, we used a picture-sequencing task to assess the ability of schizophrenic patients ($n = 40$) with and without disorganisation symptoms to arrange different types of action sequence representations. Disorganisation symptoms appear to be associated with a general sequencing impairment, while patients without disorganisation symptoms displayed difficulties in ordering sequences requiring subjects to infer mental states in story characters along with a relatively preserved performance in correctly arranging mechanical or behavioural event sequences. These results reveal that only schizophrenic patients without disorganisation symptoms show a selective deficit in *mentalising* abilities whereas disorganisation symptoms are associated with a more severe event sequencing impairment probably reflecting basic failures of inferential reasoning.

Keywords: Thought disorder; Theory of mind; Executive functions; Scripts; Goal detection

1. Introduction

As assessed by a number of clinical reports and neuropsychological studies, schizophrenia is often characterised by the breakdown of cognitive control of action and by the presence of disorganised and socially inappropriate behaviour. Disturbances of action production in patients with schizophrenia have been observed in various forms: poverty of action, disorganised behaviour, stereotyped and incoherent actions, omissions or commission errors. Frith et al. [14–18] have proposed that different symptoms of schizophrenia may be associated with specific deficits in the internal monitoring of self-generated actions and one's own intentions. According to this view, disorganisation symptoms or delusions of control reflect a defective central monitoring of willed actions. This impairment is characterised either as failure to monitor the intention to act, or as difficulties in initiating an action.

According to Frith's model [14], a defective ability to attribute intentions and mental states to other people, termed "Theory of Mind" (ToM), could explain social and interpersonal dysfunctioning in schizophrenic individuals affected by reality distortion or paranoid symptoms [16]. Further behavioural studies have supported the notion of an underlying defective mechanism of intention attribution and mentalising abilities in patients with schizophrenia [22–28]. Mazza et al. [23] observed that patients with psychomotor poverty symptom performed worse than patients with disorganisation and reality distortion symptoms on first and second order ToM stories. Pickup and Frith [24] found that patients with behavioural signs performed poorly on second order false belief tasks even when memory and IQ, severity of psychopathology and duration of illness were controlled. Only in schizophrenic patients with paranoid symptoms poor ToM performance was associated with low IQ. Sarfati et al. [25] presented schizophrenic patients with short comic strips showing a character performing an action. Participants were asked

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to select the appropriate and congruous card among four proposed on the basis of the character's volitional states, such as desires and intentions. The authors reported that schizophrenic patients with thought and language disorder were impaired in completing the task and concluded that only these patients manifested a deficit in action planning and ToM abilities, whereas schizophrenic patients without disorganisation symptoms or depressed and manic subjects do not [25–27]. By using two control tasks consisting in understanding physical events, Brunet et al. [9] showed that schizophrenic patients with formal thought disorders were selectively impaired in attributing intentional states to others. Although these findings strongly suggest the idea of a link between action disorders and mentalising impairments in schizophrenia, they do not help disentangling performance in planning (*means-end analysis* and *goal detection*; see [13]) and in ToM (attribution of mental states) abilities in patients with disorganisation symptoms. Therefore, it is still unclear whether poor performance of these patients would reflect a specific deficit in ToM or a defective ability in representing goal-directed action.

In Langdon et al.'s [22] study, a picture-sequencing task was used to test the hypothesis of a selective impairment of schizophrenic patients in understanding ToM stories. The results showed that impaired ToM abilities are associated with negative behavioural signs of schizophrenia, such as flat affects, social withdrawal and alogia, rather than reality distortion, as previously found by Frith and Corcoran [16] or thought disorganisation as in Sarfati et al.'s studies [25–27] and Brunet et al.'s study [9]. In contrast, patients with psychomotor poverty and reality distortion symptoms manifested a general sequencing impairment. According to these authors, general sequencing difficulties result from two distinct mechanisms: the inability to manipulate symbolic representations, associated with psychomotor poverty symptoms, which would lead to difficulties in planning behaviour, and failures to evaluate plausible cause–effect relations, which is related to reality distortion.

Taken together, these studies have discounted the hypothesis of a general mentalising deficit in schizophrenia since only a subgroup of patients appears to show ToM difficulties. Moreover, there is little consensus about the relation between ToM and symptomatology as well as about the specificity of this deficit. As pointed out by Brüne [8], in most studies assessing ToM abilities, the effect of IQ and the duration of disorder remain ambiguous. According to this author, ToM dysfunction in schizophrenia might reflect a general intellectual retardation or increased working memory demands, rather than a selective impairment in mentalising abilities.

In a previous study [34], we investigated the ability of patients with schizophrenia to organise action knowledge and elaborate a plan of action, as compared to normal subjects and to patients with frontal lobe lesions. The study consisted in two experiments: an action verbal generation task and an action-sequencing task. In the first experiment, similar to a word fluency task, participants were asked to verbally generate in the appropriate order a list of component actions that one usually performs to accomplish a familiar activity. Schizophrenic patients performed significantly worse than both normal subjects and frontal lobe patients in the semantic retrieval of action knowledge. Similarly to patients with frontal lobe lesions, they encountered difficulties in action sequencing and in setting priorities among action events with regard to the stated goal. The second experiment did not involve learning novel sequences or monitoring sequentially presented stimuli in working memory. Subjects had to arrange in the appropriate order cards on which component actions belonging to different familiar sequences were written. Interestingly, although the number of sequence errors increased in the presence of distractor elements or when the headers (the themes' sequence) were not available, performance of schizophrenic patients did not substantially improved when context information was provided and working memory demands were minimised. These findings suggested that patients with schizophrenia are impaired in the sequential organisation of action events and that this impairment is relatively independent of working memory loads. However, while patients with frontal lobe lesions were generally impaired in action sequence processing, only a subgroup of schizophrenic patients committed sequencing errors in the verbal generation task. Unfortunately, because of the small sample of our schizophrenic group, no relation was observed between syndrome scores and task performance.

In a more recent study [35], we asked schizophrenic patients to segment two video-taped sequences of familiar actions in meaningful event units by pressing a button when they thought that a perceived event was ending and another one was beginning. While watching the tape, subjects' attention was monitored toward small or large events of the action hierarchy. Disorganisation symptoms and formal thought disorders correlated with a defective performance in the perceptual organisation of large segments of dynamic action while the ability to discern small acts, in which the temporal dimension is considerable reduced, was relatively preserved. The same patients recalled the event scenes in a detailed and fragmentary manner as compared to normal controls. These findings indicated that patients' difficulties in identifying large action units would reflect an impairment in perceiving human goal-directed behaviour as sequences of structured and cohesive actions. A defective ability to represent complex events may also contribute to explain disturbances of action monitoring, social inadequacies and mentalising deficits in schizophrenic patients with disorganisation symptoms.

The aim of the present study was to clarify some findings in this area: (1) to examine the relation between the disorganisation symptoms and performance on sequencing tasks related to different domains of knowledge; (2) to disentangle disorganised schizophrenic patients' performance in representing goal-directed action and mentalising abilities.

As showed in previous studies [29,30,33] successful performance in planning and monitoring a coarse of actions depends on the preserved ability to manipulate action knowledge. Action representation typically follows a script or a story syntax structure, e.g. a temporally organised sequence of events contained within boundaries defining the beginning and end points. Such properties that scripts are thought to possess can be used to provide a framework for the analysis of selective impairments in action knowledge following brain lesions or dysfunction [20,29,30,33].