Helping hands? Gesture and self-repair in schizophrenia

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Abstract

Successful social encounters require mutual understanding between interacting partners, and patients with schizophrenia are known to experience difficulties in social interaction. Several studies have shown that in general people compensate for verbal difficulties by employing additional multimodal resources such as hand gesture. We hypothesise that this will be impaired in patients with schizophrenia, and present a preliminary study to address this question. The results show that during social interaction, schizophrenia patients repair their own speech less. In addition, although increased hand gesture is correlated with increased self-repair in healthy controls, there is no such association in patients with schizophrenia, or their interlocutors. This suggests that multimodal impairments are not merely seen on an individual level but may be a feature of patients' social encounters.

Keywords: Gesture, Self-repair, Schizophrenia

1. Introduction

Many patients with schizophrenia experience difficulty engaging in successful social interaction. This difficulty presents prior to the onset of defining symptoms of schizophrenia, such as hallucinations or delusions, is persistent and stable over time, and is associated with patients' poorer prognosis (Addington and Addington, 2008; Monte et al., 2008).

Successful social encounters require mutual understanding between interacting partners. To achieve this, conversational partners must monitor their own and their interlocutors' behaviour for potential misunderstandings, and attempt to address them as they arise. One way in which this can be done is self-repair (Schegloff et al., 1977), where the speaker identifies, and repairs or revises, their own speech as it is being produced.

The presence and amount of repair used by patients with schizophrenia may be indicative of some of the specific difficulties patients have in interacting with others. Research shows that, for non-clinical participants, the presence of repair can aid comprehension (Brennan and Schober, 2001) and that when verbal difficulties are encountered people may compensate by using additional multimodal resources such as hand gesture (Seyfeddinipur and Kita, 2014; Healey et al., 2015) and head nods (Healey et al., 2013).

In the psychiatric domain, levels of repair have been found to be associated with verbal hallucinations, and patient adherence to treatment (Leudar et al., 1992; McCabe et al., 2013). In addition, patients with schizophrenia are known to use fewer repairs in their talk (Leudar et al., 1992; Caplan et al., 1996), however, these findings are based on instruction giving or narrative tasks. Although these tasks ostensibly involve interaction in that the talk is designed for a listener, they tend to be monologic in practice. It is unclear if patients' performance on such tasks reflects their ability to interpret and respond to others during more typical social interactions.

Self-repair is often characterised as being a response to noticing and correcting errors via a self-monitoring process (Levelt, 1983), and patients with schizophrenia are known to have difficulty monitoring their own behaviour (Johns et al., 2001). However, some self-repair is interactive, triggered by feedback from one's interlocutors or indicative of audience design (Goodwin, 1979). Self-repairs of this type may be an indicator of a person's engagement in a task, or need for clarity, for example, there are known to be more self-repairs from instruction givers in the Map Task (Colman and Healey, 2011) who have to describe a route carefully for a follower who does not have visual access to the route, but must draw it as accurately as possible on their own map. It is unclear whether one or both of these factors are responsible for the reduced levels of self-repair seen in patients.

Patients with schizophrenia are also known to display fewer hand gestures when speaking (Lavelle et al., 2013a), and have mismatched gesture use and speech (Millman et al., 2014). Furthermore, studies have identified that the presence of a patient with schizophrenia in an interaction influences the nonverbal behavior of their interacting partners, both in clinical contexts (Lavelle et al., 2015) and during first meetings with healthy controls, when the patient's diagnosis is undisclosed (Lavelle et al., 2013a; Lavelle et al., 2014). This suggests that patients' atypical patterns of participation in social interactions involve deficits in the interaction of verbal and non-verbal behaviours, with interaction itself playing a crucial role. We are therefore interested in investigating whether patients with schizophrenia compensate for verbal difficulties by using gesture in the same ways as healthy controls (Seyfeddinipur and Kita, 2014; Healey et al., 2013), and whether their interlocutors also modify their own verbal and non-verbal behaviours in interactions with patients.

This study aims to address the following questions.

1.1. Research questions

Compared to healthy control conversational groups and their healthy conversational partners:

1. Do patients with schizophrenia use less self-repair and gesture during conversation?
2. Is their use of self-repair associated with their use of gesture?

2. Methods

2.1. Participants

The data analysed in this study consists of transcripts and motion captured data of twenty patient interactions, involving one patient conversing with two healthy controls who were unaware of the patient's diagnosis, and twenty control interactions (with 3 healthy participants). Due to technical issues one patient interaction and one control conversation could not be transcribed and are excluded from the analysis.

Patients were taking anti-psychotic medication which fell within the low dose range (Chlorpromazine equivalents 50-200mg/day). Patients presenting with motor side effects from antipsychotic medication were excluded based on clinicians' assessment. Patients' symptoms were assessed using the Positive And Negative Symptom Scale for Schizophrenia (Kay et al., 1987).

Patients displayed relatively low PANSS scores for both positive symptoms ($M = 15.8; sd = 6.76$), which are additional features that occur with the onset of the disorder such as hallucinations or delusional beliefs, and negative symptoms ($M = 9.95; sd = 3.36$), which represent a reduction in usual function such as social withdrawal, diminished affect, apathy and anhedonia.

2.2. Ethics

All procedures were approved by a NHS Research Ethics Committee in the UK (07/H0711/90). All participants gave written informed consent and were free to withdraw at any time. Patients were recruited at routine psychiatric outpatient clinics under supervision of their psychiatrist, on the basis of a diagnosis of schizophrenia. 25% of all patients approached agreed to participate. Patients presenting with motor side effects from antipsychotic medication were excluded based on a clinician's assessment. Non-fluent English speakers were also excluded.

2.3. Procedure

Participants were brought into the laboratory in threes and seated in a triangular formation so that each participant had good visual access to each of the others (see Figure 1). The researcher read aloud a fictional moral dilemma, the 'balloon task' (see section 2.4. for details), which has been used for studying many aspects of dialogue, and is known to stimulate discussion (Howes et al., 2011). The group was provided with an opportunity to ask questions before the researcher left the interaction space and the task began. Interactions ended when participants reached a joint decision. Groups that failed to reach agreement had their interaction terminated at approximately 450 seconds (7 minutes 30 seconds).

All interactions were recorded in a human interaction laboratory fitted with an optical based Vicon motion-capture system, consisting of 12 infrared cameras and Vicon iQ software. Participants wore a top and a cap with 27 reflective markers attached. Cameras detected the markers at 60 frames per second, resulting in a highly accurate 3D representation of participants' movements over time (see Figures 1 and 2).

Figure 1: 2-dimensional image of participants engaged in triadic interaction, wearing the reflective markers

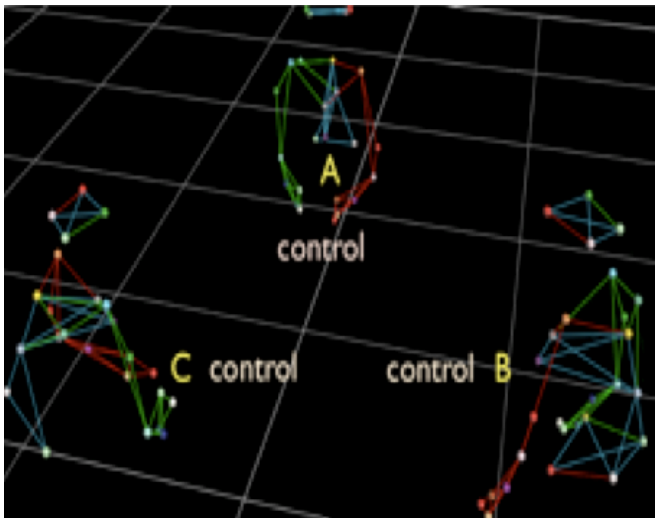

Figure 2: The wire frame representation of the interaction in 3-dimensional space

2.4. Task

The *balloon task* is an ethical dilemma requiring agreement on which of four passengers should be thrown out of a hot air balloon, which is losing height and about to crash into some mountains killing all on board unless one of them jumps to their certain death in order to save the other three. The four passengers are described to the participants as follows:

Dr. Robert Lewis - a cancer research scientist, who believes he is on the brink of discovering a cure for most common types of cancer.

Mrs. Susanne Harris - who is not only widely tipped as the first female MP for her area, but is also over the moon because she is 7 months pregnant with her second child.

Mr. William Harris - husband of Susanne, who he loves very much, is the pilot of the balloon, and the only one on board with balloon flying experience.

Miss Heather Sloan - a 14 year-old music prodigy, considered by many to be a "twenty first century Mozart".

Participants were instructed to debate the reasons for and against each person being saved, and reach mutual agreement about who should jump.

2.5. Analysis

2.5.1. Self-repair

Participants' speech was transcribed in ELAN. Self-repairs were annotated using STIR (STrongly Incremental Repair detection) (Hough and Purver, 2014); which automatically detects speech repairs on transcripts. STIR, which is trained on the Switchboard corpus (Godfrey et al., 1992) has previously been shown to be applicable to therapeutic dialogue, with high rates of correlation to human coders in terms of self-repair rate (Howes et al., 2014). The self-repair rate per word was calculated for each individual participant as the total number of self-repairs produced divided by the total number of words spoken.

2.5.2. Gesture

An index of gesture was derived from participants' hand movements using the 3D motion capture data. Gestures were identified as hand movement speeds greater than one standard deviation above an individual's mean hand movement speed thus giving a measure that was sensitive to individual variation in baseline hand movement (following (Lavelle et al., 2012)). The presence of gesture was assessed on a frame by frame basis and the percentage of frames spent gesturing was identified for each individual. This means we are looking at overall levels of hand movement (calculated for each individual), and not specific gestures or gesture types. This has the advantage of being calculable automatically from the motion capture data, but may also include movements that are not typically counted as gestures, such as brushing one's hair out of one's eyes.

3. Results and Discussion

3.1. Self-repair

	N	M (sd)	β	SE	χ^2	p
Patient	19	0.01 (0.01)	-0.02	0.004	12.59	<0.001
HP partner	38	0.02 (0.02)	-0.01	0.004	2.78	0.1
Controls	57	0.03 (0.02)				

Table 1: Repair rate

A mixed models regression analysis, adjusting for triadic group, age and gender, identified that healthy participants in the control groups used significantly more self-repair than schizophrenia patients (χ^2_1=12.59, 95% CI -0.02 to -0.01, p<0.001), as shown in Figure 3. The amount of self-repair produced by the healthy participants in the patient groups was numerically higher than that of their patient interlocutors and lower than that of the participants in the control groups, suggesting that there may be some modification of self-repair behaviour when interacting with a patient. However, neither of these differences were statistically significant (see Table 1), possibly due to lack of power in looking only at the mean figure per participant, and the variability of repair rates by person. Future work would investigate the levels of self-repair in a more fine-grained way, at the level of the utterance, which would allow us to look at these potentially relevant differences more precisely.

That patients repair their own speech less in a social interactive setting could be down to a number of factors, which cannot be decided between based on the current results. Deficits in both self-monitoring and audience design may be factors for patients. However, self-monitoring cannot explain the somewhat lower frequency of self-repair exhibited by patients' healthy partners, so is likely to be only part of the story. The possibility that patients' healthy partners have reduced self-repair (though not reaching significance in this study) could indicate that they are less engaged in the interaction – consistent with the finding that interacting with a patient (whilst unaware of their diagnosis) also affects subsequent ratings of rapport (Lavelle et al., 2014).

3.2. Gesture

Mixed models regression analyses, adjusting for triadic group age and gender, reveled that patient did not significantly differ from control participants in terms of their overall rates of gesture during the interaction (see Table 2). However, patients did use significantly fewer hand gestures when speaking (Table 3).

	N	M (sd)	β	SE	χ^2	p
Patient	19	7.2 (2.8)	0.21	0.84	0.06	0.8
HP partner	38	7.7 (3.0)	0.55	0.63	0.77	0.38
Controls	57	7.2 (3.0)				

Table 2: Overall gesture rate

	N	M (sd)	β	SE	χ^2	p
Patient	19	12.5 (2.8)	-5.84	2.91	4.01	0.05
HP partner	38	13.1 (3.0)	-3.29	1.99	2.78	0.1
Controls	57	16.5 (3.0)				

Table 3: Gesture rate while speaking

3.3. Gesture and self-repair

Partial correlations, adjusting for the amount of speech (see Figure 4), revealed that, in control group participants, increased self-repair was associated with increased overall gesture ($Rho_{48} = 0.33, p = 0.02$). In contrast, self-repair rates were not associated with gesture use in patients with schizophrenia ($Rho_{15} = -0.03, p = 0.91$), or their conversational partners ($Rho_{33} = -0.16, p = 0.40$).

These results indicate that in normal conversation between healthy participants, the amount of self-repair is positively correlated with gesture. Participants who are doing more repair, which may be due to discovering potential errors

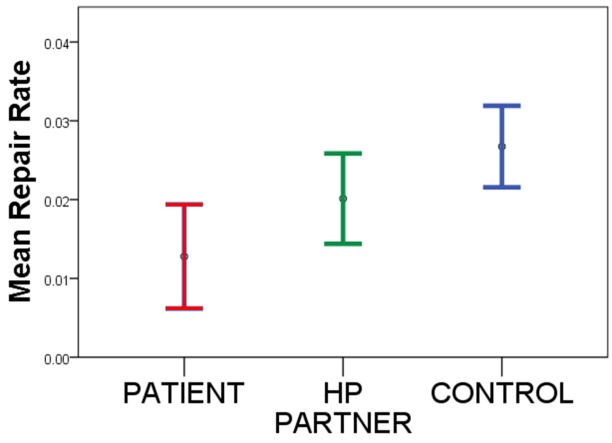

Figure 3: Mean repair rate per participant

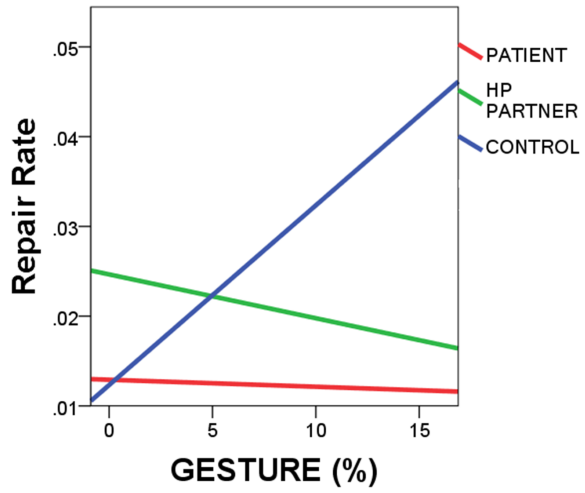

Figure 4: Correlation of mean repair rate and proportion of time spent gesturing

by self-monitoring or because they are tailoring their talk to their audience, are also utilising more multimodal resources in their interactions. Although this is at the level of the participant, so is a broad brush measure, it is consistent with previous findings (Seyfeddinipur and Kita, 2014; Healey et al., 2013). Contrarily, and in addition to the overall reduced levels of self-repair, there is no such relationship between self-repair levels and gesture in the dialogues including a patient. This holds both for patients, for whom a disconnect between communication modalities has been previously observed (Millman et al., 2014), but also, more surprisingly, also for their healthy interlocutors for whom no such disconnect would be expected.

4. Conclusions

During social interaction, schizophrenia patients repair their own speech less, and make less use of hand gesture when repair is required. In line with previous studies (Johns et al., 2001), these findings may reflect patients' difficulty monitoring their own behaviour. However, when self-repair does occur, patients are not employing other compensatory nonverbal modalities to assist with the difficulty. This may reflect a disconnect between communication modalities in patients with schizophrenia, however, this may not be entirely explained by impairments in self-monitoring, as patients' healthy interlocutors seem to also display reduced association between self-repair and gesture. Previous studies have identified that the degree of coordination between speech and nonverbal behaviour is impaired in schizophrenia. Furthermore this impairment is also visible in those interacting with the schizophrenia patient (Ellgring, 1986; Lavelle et al., 2013b). This suggests that the relationship between self-repair and gesture is also affected by elements of interaction, such as audience design or engagement, which may or may not also contribute to the difficulties displayed by patients.

Although the impact of patients symptoms were not explored in the current study previous findings suggest that they may have an influence on patients' gesture use (Lavelle et al., 2013a). This should be explored in studies with larger sample sizes where patients could be distinguished in terms of their symptom profiles.

Even though this is a very broad brush picture of the relationship between self-repair and gesture in patients with schizophrenia, as it is by participant over the whole conversation, this preliminary study indicates that combining automatically derivable data from transcripts and motion capture data offers a fruitful line of research in investigating the difficulties experienced by patients in social interaction. These automatic measures, while crude, do give an indication that these are areas in which patients' behaviours do not follow typical patterns which may be picked up on – if unconsciously – by their interlocutors, and contribute to the social exclusion experienced by patients. In future work, we will extend the existing study to look at the data at the level of the utterance, using cross-correlational techniques such as those in Healey et al (2013). This study also suggests looking more closely at both gesture and repair. In both cases, this may involve using more time intensive annotation methods to identify differences in the types of gesture and repair used (Colman and Healey, 2011; Healey et al., 2015), but the workload could be reduced by using automatic methods such as those outlined here to target particular utterances where the differences are apparent.

Overall, the ability to self-monitor and flexibly modify speech during conversation appears to be impaired in schizophrenia. This may make achieving mutual-understanding more difficult, contributing to the debilitating social deficits experienced by this patient group.

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