Running title: Nonverbal behaviour: Schizophrenia

Title: Nonverbal behaviour during face-to-face social interaction in schizophrenia: A review.

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Patients with a diagnosis of schizophrenia display nonverbal deficits in social cognitive assessments. However, little is known about patients' nonverbal communication during social encounters. This review identified seventeen studies investigating nonverbal communication in patients' unscripted face-to-face interactions addressing: (i) nonverbal differences between patients and others; (ii) nonverbal behaviour of patients' partners; associations between nonverbal behaviour and (iii) symptoms and (iv) social outcomes. Patients displayed fewer nonverbal behaviours inviting interaction, with negative symptoms exacerbating this pattern. Positive symptoms were associated with heightened nonverbal behaviour. Patients' partners changed their own nonverbal behaviour in response to the patient. Reduced pro-social behaviours, inviting interaction, were associated with poorer social outcomes. Patients' increased gestures, signaling communication difficulty, were associated with poorer rapport. The evidence suggests that patients' nonverbal behaviour during face-to-face interaction is influenced in different ways depending on their symptom profile, in particular negative symptoms, and this impacts the success of their social interactions.

Key words: Nonverbal communication; schizophrenia; social interaction; conversation.

Introduction

One of the most debilitating features of schizophrenia is social dysfunction. Patients with schizophrenia have very low rates of employment (Marwaha et al, 2004) and are one of the most socially excluded groups (Social Exclusion Unit, 2004). Compared to matched healthy controls, or patients with other psychotic disorders, patients have fewer social networks and fewer people to turn to in a crisis (Erickson et al, 1989; Macdonald et al, 2000). Social deficits are present prior to the onset of positive symptoms, such as hallucinations and delusions (Addington et al, 2008), remain stable over time and predict poorer patient prognosis (Monte et al, 2008). However, the precise nature of patients' social deficits remains unknown.

During face-to-face interaction the majority of communication is conveyed nonverbally through cues such as; facial expressions, posture, head and body movement, and hand and arm gestures (Burgoon et al, 1989). Nonverbal cues have specific communicative meanings, which can be identified and classified. They convey critical information about the dynamics of the interaction, including; when a speaker will start and end their turn, the role of each partner in the conversation (e.g. as speaker or listener) and the level of engagement, shared understanding and affiliation between partners (Bavelas et al, 2007; Kendon, 1970). The ability to coordinate and communicate nonverbally is critical to successful interaction and associated with better interpersonal relationships such as better rapport (Lakin et al, 2003; Miles et al, 2009).

Nonverbal communication is thought to be problematic in schizophrenia. The phrase 'Praecox feeling' was part of the working language of early psychiatrists describing the intuitive feeling of a lack of rapport or connection with a person with schizophrenia (Rümke, 1941). This feeling was based on the patient's nonverbal behaviour (Rümke, 1941). More recently, social cognitive research reveals that patients with schizophrenia display difficulty perceiving and interpreting social information, including nonverbal cues, when assessed using social cognitive assessments (Penn et al, 2007). However, such tests are far removed from real-life social interaction, and it is unclear if

patients' task performance reflects the social deficit present in their daily lives. Although much research has been conducted on verbal communication in schizophrenia (DeLisi, 2001), comparatively little is known about patients' nonverbal communication during face-to-face social interactions with others. Identifying the pattern of nonverbal behaviours manifest in patients' social encounters is a crucial first step in specifying the nature of patients' social deficits and their potential impact on patients' wider social functioning.

Hence, the aim of this paper was to identify studies investigating nonverbal communication during actual social interactions between patients with a diagnosis of schizophrenia and others in order to identify the methods employed to assess social interaction and review and synthesize the findings.

Methods

This was a nonsystematic review. The bibliographic databases PubMed (Medline) and Ovid (PsycINFO) were searched to identify studies published over the last three decades between January 1979 and July 2012. The following two groups of search terms were used: (1) Schizophrenia/ schizoaffective disorder/ schizo*, psychosis/psychotic and (2) nonverbal/non-verbal, communicat*, social interaction, interpersonal, motion. Terms in group 2 were searched in combination with the terms in group 1. Searches were adapted for each database and performed independently. Titles and abstracts were identified that potentially fulfilled the inclusion criteria of:

1. Unscripted face-to-face social interactions involving patients with a diagnosis of schizophrenia, schizoaffective disorder or schizophreniform disorder.

2. Nonverbal behaviour of the schizophrenia patient, their partner(s) or both was audio-visually recorded or motion captured.

3. Nonverbal assessment was a main focus of the study

4. Where patient samples were mixed, at least 50 percent of the patients had to meet the diagnostic criteria defined above or the results needed to be reported separately by diagnostic group.

As the focus of this review was to assess nonverbal communication in patients' free, unscripted, face-to-face interaction, studies involving scripted role-play tasks (e.g. (Kupper et al, 2010) or interactions that were not conducted face-to-face (e.g. (Gaebel et al, 2004) were excluded.

Results

Seventeen articles were identified that met the inclusion criteria (table 1). Studies were geographically diverse spanning Europe, America and Australia. Sample sizes ranged from 3-78 (M=41.50, SD=22.35). The studies investigated nonverbal communication in schizophrenia inpatients and outpatients. Interactions were recorded in clinical settings with health care professionals, or in non-clinical settings, with familiar or unfamiliar others. The studies assessed nonverbal communication on one of three levels: (1) nonverbal behaviour of the patient only, (2) nonverbal behaviour of the patient and their interacting partner(s) and (3) nonverbal communication of the patient and their partner as a single unit.

Measuring nonverbal communication

The methods used to measure nonverbal behaviour fall into two broad categories: (1) Ethological methods, which interpret nonverbal behaviours in terms of their function and meaning in social communication (Geerts et al, 2009; Troisi, 1999) and (2) Motion-based methods, which measure precise movements of interacting partners.

Ethological methods

The majority of studies reviewed (n=15) used ethological methods. In these studies, observers used ethograms to catalogue and quantify discrete elements of nonverbal behaviour (e.g. head tilt to side or smile), which are grouped into behavioural categories (e.g. affiliation behaviours) conveying communicative meaning. Six studies applied the Ethological Coding System for Interview (ECSI)

(Troisi, 1999) to dyadic clinical interactions (Annen et al, 2012; Brüne et al, 2009; Brüne et al, 2008; Dimic et al, 2010; Troisi et al, 2007; Troisi et al, 1998). The ECSI consists of 37 behaviours (such as eye blink, gaze direction, facial movements, body posture and hand and arm gesture during speech), which vary in their complexity. These behaviours are grouped into nine behavioural categories: eye contact (looking at the interviewer); gesture (hand and arm movements using during speech signaling communicative effort); affiliation behaviours (expressions of friendliness); submission behaviours (signals of appeasement of the other, preventing hostile contact); flight behaviours (signaling avoidance of social stimuli); assertion behaviours (expressions of aggression); displacement behaviours (signaling tension, conflict or emotive arousal); relaxation (signaling low level of emotional arousal); and pro-social behaviours (made up of a combination of affiliation behaviours [expressing friendliness] and submission behaviours [expressing the appeasement of others to prevent hostile contact]).

One study investigated patients' eye contact during clinical interactions (Troisi et al, 1991). Three studies employed individually designed ethograms to assess patients' head and facial nonverbal behaviour during dyadic clinical interactions (Davison et al, 1996; Jones et al, 1979; Pitman et al, 1987). Jones & Pansa (1979) also assessed patients' displacement behaviours, such as patients touching their face or body with their hands. Studies conducted by Pitman et al (1987) and Davison et al. (1996) also rated patients' nonverbal behaviour in the context of whether the patient was speaking or silent when the behaviour was produced.

Two small exploratory studies employed individually designed ethograms to assess head and body nonverbal behaviour (Hardin, 1980; Pounds, 2010). Pounds (2010) assessed behaviour of patients and their nurse during dyadic, clinical interactions. Observers rated eye contact, body posture, head and limb movements. The temporal relationship between the behaviour of the patient and their partner was investigated in order to identify behavioural responsiveness. Hardin (1980) recorded patients' dyadic interactions with other patients, or trainee nurses. Hardin's coding system assessed

full body nonverbal behaviours, grouped into five ethological categories: engagement, inclusiveness, defensiveness, congruence and rhythmicity. In this study nonverbal behaviours were rated if they occurred during the interaction but not attributed to either partner.

Three ethological studies were conducted outside of a clinical setting. Meilijson et al. (2004) employed the pragmatics protocol, developed by Prutting & Kirchner (1987), to assess the appropriateness of patients' behaviour, including nonverbal behaviour such as facial expressions, gestures, body posture and eye gaze, during interactions with familiar and unfamiliar others. Two experimental studies employed variants of the Facial Action Coding (FAC) system, developed by Ekman & Friesen (1978), to assess the facial expressivity of patients and their interacting partners (Ellgring, 1986; Steimer-Krause et al, 1990). Ellgring et al. (1986) experimentally assessed the degree of coordination between speech and facial expressivity in patients' interactions with relatives. Patients and their partners' facial expressions were coded in the context of whether they were speaking or silent when the behaviour was produced. Steimer-Krause et al. (1990) objectively examined transference and counter-transference in patients' interactions, with unfamiliar others who were unaware of their diagnosis, through assessment of facial affect in patients and their interacting partners.

Motion-based methods

Two studies investigated head and body motion during patients' non-clinical, three-way interaction (Altorfer et al, 1992; Lavelle et al, 2012). Altorfer and colleagues (1992) assessed patients' interactions with two parents. Observers rated the frequency, degree and duration of patients' head, arm and body movements, including the duration of head nods and hand gestures from 2D video recordings of patients' interactions. Patients' behaviour was assessed at specific events in the interaction when a parent directed either a positive or negative attributional comment towards the patient. The relationship between patients' behaviour and the comment was investigated.

Lavelle et al. (2012) employed simultaneous 3-dimension motion-capture technology and audio-visual cameras to record patients' three-way interactions with two unfamiliar healthy controls. The head and hand movements of patients and their partners were automatically detected in 3D. They investigated nonverbal behaviour of patients and their partners in the role of listener and speaker.

Patients' communication

Studies employing ethograms to investigate patients' facial behaviours found that, compared to control participants, patients displayed less variability and complexity in their facial expressions and less upper facial movements, including those used to convey positive affect such as smiling (Jones et al, 1979; Steimer-Krause et al, 1990; Troisi et al, 2007). Patients displayed facial expressions conveying negative emotions, including those to promote distance such as anger (Steimer-Krause et al, 1990). Patients' nonverbal facial expressivity was also found to be less coordinated with speech (Ellgring, 1986): controls displayed more than 70% of their facial expressivity as speaker, compared to 50% for patients.

Studies investigating patients' head and body behaviours found that, compared to controls, patients display less pro-social behaviours, designed to invite and maintain social interaction (Brüne et al, 2009; Brüne et al, 2008; Troisi et al, 1991; Troisi et al, 1998). Schizophrenia inpatients and outpatients have displayed less speaking hand gesture, signaling communicative effort (Lavelle et al, 2012; Troisi et al, 1998) and fewer displacement behaviours, signaling tension, conflict or emotive arousal (Troisi et al, 1998). Schizophrenia inpatients taking second-generation anti-psychotic medication displayed less flight behaviour, signaling avoidance of social stimuli, and less relaxation behaviours, thought to convey lower levels of emotional arousal (Brüne et al, 2008).

Comparison to patients with depression, patients with schizophrenia showed less head movement (Davison et al, 1996; Jones et al, 1979) and less hand gestures when speaking (Annen et al, 2012). Although comparisons with control subjects reported a reduction in schizophrenia patients'

displacement and flight behaviours (Brüne et al, 2008; Troisi et al, 1998), comparisons with other patient groups reported an increase in displacement and flight behaviours in schizophrenia (Annen et al, 2012; Dimic et al, 2010).

A limiting feature reported by all studies reviewed was large variation in patients' nonverbal behaviour, with some patients displaying behaviours within the region displayed by controls. Reflecting this variation, Meilijson et al. (2004) identified three nonverbal behaviour clusters in schizophrenia patients: (1) appropriate nonverbal behaviour, (2) minimally impaired nonverbal behaviour and (3) high degree of inappropriate nonverbal behaviour and turn taking. Clusters 2 and 3 displayed particular impairment in body posture, facial expression and gesture use. The patient sample included both inpatients and outpatients, differences were not investigated (Meilijson et al, 2004).

Interpersonal communication

Six studies assessed nonverbal aspects of interpersonal communication between patients *and* their interacting partners. Three studies investigated the impact of the presence of the patient on the nonverbal behaviour of non-clinical partners (Ellgring, 1986; Lavelle et al, 2012; Steimer-Krause et al, 1990). Pounds (2010) assessed the impact of the patient on their clinical partner, Hardin (1980) provided a nonverbal assessment patients and their partners in an interactional unit and Altorfer (1992) assessed patients' behaviour in response to specific verbal comments from their interacting partners. These studies will be discussed in turn.

Steimer-Krause et al. (1990) assessed the behaviour of patients and unfamiliar partners who were unaware of the patient's diagnosis. Partners of schizophrenia inpatients displayed facial behaviours similar to that of the patient, such as reduced displays of pro-social affect (e.g. smiling). However, partners of schizophrenia outpatients displayed an increase in their affective expressions of happiness. The authors suggest that the different patterns of behaviour displayed by patients'

partners are due to the discrepancy between how they expect the patient to behave and how the patient actually behaves. If the discrepancy is small (i.e. patients are less symptomatic, thus display fewer nonverbal manifestations of their symptoms e.g. outpatients) patients' partners' overcompensate to reduce the difference and normalize the interaction. However, when the discrepancy is larger (i.e. patients are more symptomatic, thus display more pronounced nonverbal manifestations of their symptoms e.g. inpatients) patients' partners adopt the pattern of behaviour displayed by the patient (Steimer-Krause et al, 1990).

Ellgring (1986) investigated the coordination between an individuals' verbal (speech) and their facial expressions. Schizophrenia inpatients showed reduced coordination between their own speech and facial expressivity. Their partners (relatives) also displayed less coordination between their own speech and facial expressivity when interacting with the patient, which was not present during their interactions with others (Ellgring, 1986). Thus, patients' interacting partners appeared to adopt patients' reduced coordination pattern.

In a study of patients' three-way interactions, Lavelle et al. (2012) found that schizophrenia outpatients, with more negative symptoms, displayed less nodding as a listener and more gesture as a speaker. Their unfamiliar partners, who were unaware of their diagnosis, displayed the same behavioural pattern in response to the patient. The authors suggest that patients' partners' increased speaking gesture use may reflect the greater communicative effort needed in response to the patients' reduced feedback (i.e. listener nodding) and the more demanding interaction conditions (Lavelle et al, 2012).

Pounds (2010) investigation of three patients' dyadic interactions with their nurse revealed different interactional styles. One patient had a reciprocal, mutual exchange with nurse where they shared gaze, laughter events and synchronous changes in body position. The other two patients, who were more symptomatic, displayed less eye contact with the nurse. In response to the patients' reduced

gaze, the nurse employed exaggerated verbal and nonverbal behaviours, including hand gestures, to gain the patients' attention and engagement.

Hardin (1980) recorded patients' interactions with (i) other schizophrenia patients and (ii) trainee nurses. Patient-nurse interactions displayed more frequent and durable periods of engagement, congruent body position and synchronous body and leg movements. Nonverbal communication in the patient-patient interactions were unique in that they displayed very little engagement and no synchronization of leg or body movement (Hardin, 1980). As nonverbal behaviours were coded as a unit it is impossible to say if the highly engaging and congruent pattern in the patient-nurse interaction is due to the behaviour of both participants or just one. However, based on the findings of Steimer-Krause et al. (1990), Lavelle et al. (2012) and Pounds (2010), one hypothesis is that patients' partners are displaying more engaging and congruent behaviours to compensate for, and attempt to engage with, the patient.

Altorfer and colleagues (1992) analysed patients' nonverbal responses to positive and negative comments that were directed towards them by others during interaction. Overall patients displayed more movement when receiving a positive comment and less when receiving a negative comment.

Clinical Symptoms

Seven ethological studies investigated the association between patients' clinical symptoms and their nonverbal behaviour during clinical interactions. The findings across theses studies are mixed.

Patients' increased negative symptoms were associated with: reduced pro-social behaviours, including affiliative and submissive behaviours designed to invite social interaction though the expression of friendliness (e.g. smiling, and eye gaze and head tilting) and the prevention of hostile contact (e.g. head nodding) (Annen et al, 2012; Troisi et al, 1991; Troisi et al, 2007; Troisi et al, 1998); reduced use of hand gesture when speaking, signaling communicative effort (Annen et al, 2012; Brüne et al, 2008; Troisi et al, 1998); reduced flight behaviours, signaling avoidance of social

stimuli (e.g. looking away), and reduced assertive behaviours, signaling an expression of anger (e.g. frowning or head shaking) (Brüne et al, 2008; Troisi et al, 1991).

Inpatients' increased positive symptoms were associated with: increased affiliative behaviours, expressing friendliness (Annen et al, 2012); increased eye contact with the interviewer, signaling engagement (Troisi et al, 1998); increased use of hand gesture when speaking, signaling communicative effort (Brüne et al, 2008; Troisi et al, 1998); increased flight behaviours, signaling an avoidance of social stimuli and a reduction in submissive behaviours designed to appease their interacting partner and prevent hostile contact (Brüne et al, 2008). Patients' increased overall symptom severity has been associated with an increase in patients' flight behaviours (Annen et al, 2012; Dimic et al, 2010) and a reduction in their pro-social behaviours, assertive behaviours and speaking hand gesture (Brüne et al, 2008).

Pitman et al. (1987) assessed nonverbal patterns in schizophrenia patients classed as 'paranoid' and 'non-paranoid' subtypes. Paranoid sub-type patients display more positive symptoms such as hallucinations and delusions and minimal negative symptoms. Compared to non-paranoid patients, paranoid patients spoke more and, when speaking, displayed more eye contact with the clinician and less facial expressions. This finding agrees with the increased eye contact in patients with positive symptoms found by Troisi et al. (1998). Non-paranoid patients spoke less, displayed less eye contact with the interviewer and displayed facial behaviours that appeared to be unusual in their timing and unrelated to the interaction context (Pitman et al, 1987). Linking these behaviours to their ethological meaning, the authors suggest that patients with paranoid subtype displayed more assertive behaviours, signaling hostility, whereas non-paranoid patients displayed more flight behaviour, signaling social avoidance (Pitman et al, 1987).

Lavelle et al., (2012) assessed the relationship between patients' symptoms and the nonverbal behaviour (i.e. speaker gesture and listener nodding) displayed by patients and their partners. Patients' increased positive symptoms were associated with patients displaying more listener

nodding, thought to signal increased nonverbal feedback to the speaker, and their partners displaying less. Patients' increased negative symptoms were associated with patients and their partners gesturing more when speaking, signaling increased communicative effort, and less nonverbal feedback to the speaker. (i.e. reduced listener nodding). Thus, all partners appeared to display more communicative effort when speaking and less when listening. The association between patients' negative symptoms and hand gesture differs from the findings of ethological studies discussed previously (Annen et al, 2012; Troisi et al, 1998). The different methodologies used in these studies may explain the discrepancy. Firstly, Lavelle et al. (2012) assessed patients' three-way interactions rather than dyadic. Three-way interaction is more communicatively demanding as two interacting partners must be monitored instead of just one. Increased gesture use may reflect the increased communicative effort needed by interacting partners, particularly in these circumstances where the nonverbal feedback from listeners is reduced. Secondly, this study assessed patients' interactions with unfamiliar others rather than clinical professionals. Thus, removing the elements of shared history, knowledge of diagnosis and therapeutic relationship, which may influence the behaviour of both interacting partners. Thirdly, this study measured nonverbal behaviour using motion detection rather than observational methods. As such, some behaviours identified as gestures through motion detection may not be identified through observational analysis.

Three studies investigated the relationship between nonverbal behaviour and clinical improvement without specifying symptom type. In an observational case study Pounds (2010) reported that patients displayed less eye contact with their nurse when they were more symptomatic. Jones & Pansa (1979) found patients' frequency of displacement behaviours, conveying discomfort, tension or emotional arousal increased with clinical improvement. The authors point out that this finding was unexpected and difficult to interpret, as it would be anticipated that such behaviours would reduce with clinical improvement. Steimer-Krause et al. (1990) found that compared to

schizophrenia outpatients, schizophrenia inpatients (i.e. more symptomatic) displayed more intense expressions of facial affect with a greater reduction in their pro-social facial expressions (e.g. smiling), and an increase in their negative expressions of affect (e.g. anger). Patients' partners' expression of facial affect was also dependent on patients' symptom severity. Specifically, outpatient partners displayed more pro-social expressions of facial affect such as smiling, whereas inpatient partners displayed reduced pro-social facial affect, similar to that of the patient. As discussed previously (section: Interpersonal processes), authors suggest that patients' partners nonverbal responses are predicted by the discrepancy in patients' expected and actual behaviour.

Social outcomes

Three studies investigated relationships between patients' nonverbal behaviour and social outcomes including: functional outcome (Troisi et al, 2007), social cognition, social competence (Brüne et al, 2009) and interpersonal rapport (Lavelle et al, 2012)

Troisi et al. (2007) assessed patients' functional outcome using the Sheehan Disability Scale (Sheehan et al, 1996). This is a self-report measure where patients' rate the degree of disruption their symptoms have on their work, social life/leisure activities or family life/home responsibilities. Patients' reduced pro-social facial expression was associated with patients rating their symptoms as having a greater disruption on their work and social life. Furthermore, patients' pro-social nonverbal behaviour explained a greater variance in patients' social and occupational disability than negative symptoms (Troisi et al, 2007).

Based on the assumption that nonverbal expressivity is associated with social functioning (Troisi, 2007) and the evidence for a robust deficit in social cognition in patients with schizophrenia (Penn, 2007), Brüne et al. (2009) investigated the relationship between patients' nonverbal expressivity, their social competence and social and neurocognition. Patients' social competence was rated by nursing staff on the ward using the Social Behaviour Scale (Wykes et al, 1986), which assesses

patients' communicative skills, affective symptoms, socially inappropriate behaviours, skills and movement disorders. Nonverbal expressivity did not correlate with any social or neurocognitive measures. The authors suggested that this was due to patient heterogeneity. To account for this, patients in the highest and lowest quartile of pro-social nonverbal expressivity were compared on the social measures. Compared to high pro-social patients, low pro-social patients had poorer social competence and social cognition. Neurocognition was not associated with any measure of patients' nonverbal expressivity. A limitation of this study was that the method used to assess patients' social competence and their nonverbal behaviour share many similarities, which may lead to inflated associations.

Lavelle et al. (2012) conducted an experimental study to assess the links between patients' nonverbal communication, social cognition and others' experience of interpersonal rapport with the patient. Similar to the findings of Brüne et al. (2009) patients' social cognition was not associated with patients' nonverbal behaviour. However, patients' increased use of hand gestures when speaking was associated with others experiencing less rapport with the patient. Indeed, patients' speaking gestures accounted for the greatest variance in others' experience of rapport with the patient. This finding appears counter intuitive as it would be expected that increased gesture use would signal greater communicative effort when speaking and as such this would be a positive feature for interpersonal rapport. One explanation is that patients' increased speaking communicative effort is reflective of an increased communicative difficulty between patients and their partners. Indeed, patients increased gesture use coincides with a similar pattern in their partners and both displaying less nodding when listening, signaling reduced listener feedback. Perhaps both partners are experiencing difficulty communicating resulting in a poorer experience of interpersonal rapport.

Discussion

Seventeen studies investigating nonverbal behaviour in face-to-face social interaction were identified. The majority of these studies employed ethological methods, based on the evolutionary study of behaviour, to assess inpatients' nonverbal behaviour during clinical interactions.

A number of studies found that, during both clinical and non-clinical interactions, inpatients with schizophrenia displayed a reduction in nonverbal behaviours designed to invite social interaction, particularly pro-social facial expressions (Brüne et al, 2009; Brüne et al, 2008; Jones et al, 1979; Steimer-Krause et al, 1990; Troisi et al, 1991; Troisi et al, 2007; Troisi et al, 1998). Studies investigating the nonverbal behaviour of patients' interacting partners found that they change their nonverbal behaviour in response to a patient, both when aware (Ellgring, 1986; Pounds, 2010) and unaware of their diagnosis (Lavelle et al, 2012; Steimer-Krause et al, 1990). Patients' symptoms appear to influence the behaviour of both the patient and their interacting partners. Specifically, patients' increased negative symptoms were associated with patients' reduced nonverbal behaviour, particularly pro-social displays (Annen et al, 2012; Brüne et al, 2009; Brüne et al, 2008; Dimic et al, 2010; Lavelle et al, 2012; Steimer-Krause et al, 1990; Troisi et al, 1991; Troisi et al, 2007; Troisi et al, 1998) whereas, increased positive symptoms were associated with patients' heightened displays of nonverbal behaviour (Annen et al, 2012; Brüne et al, 2008). This trend differed under the more demanding three-way interaction conditions, where patients with more negative symptoms gestured more when speaking (Lavelle et al, 2012). Partners of schizophrenia patients appear to display a compensatory increase in pro-social expressions, designed to engage the patient, when patients are less symptomatic (Steimer-Krause et al, 1990) and a reduced nonverbal profile, similar to that of the patient, when patients symptoms are more severe (Ellgring, 1986; Steimer-Krause et al, 1990). However, the evidence is insufficient to determine a conclusive pattern. Studies investigating the relationship between patients' nonverbal behaviour and their social outcomes revealed that patients' reduced pro-social nonverbal expression designed to invite interaction, was associated with

patients' reporting greater difficulty in their work and social lives (Troisi et al, 2007) and poorer clinician rated social competence (Brüne et al, 2009). In three-way interactions, patients gesturing more when speaking, signaling increased communicative effort, were rated by others as having poorer interpersonal rapport (Lavelle et al, 2012), suggesting that, in three interactions, patients' increased hand movement when speaking may be an indicator of an interactional difficulty (Lavelle et al, 2012).

The review identified some conflicting findings between studies. Employing similar ethological methods, some studies reported an increase in patients' flight behaviours (Dimic et al, 2010; Pitman et al, 1987), which intensified with increased symptoms (Annen et al, 2012; Dimic et al, 2010). Others reported a reduction in flight behaviour, which was further reduced with increased symptoms (Brüne et al, 2008) and others reported no difference (Troisi et al, 1998). Findings on displacement behaviours, such as self-touching and grooming, which signal emotional arousal or tension, were also contradictory. Compared to controls, Troisi et al. (1998) found schizophrenia patients to display less displacement behaviours, whereas Brüne et al. (2008) reported no difference. Compared to patients with affective disorders, such as depression, schizophrenia patients displayed more displacement behaviours (Annen et al, 2012; Jones et al, 1979).

The variation between studies may be due to differences in study methodologies such as the duration and phase of the interaction or patient heterogeneity. Indeed, a common feature of the reviewed studies was patient heterogeneity, with many studies reporting that some patients displayed nonverbal behaviour within control participant ranges. Schizophrenia is a clinically heterogeneous disorder (Picardi et al, 2012). One method of reducing heterogeneity, for the study of nonverbal deficits, is to re-classify patients based on their specific symptom profiles (i.e. positive and negative symptoms). However, as nonverbal behaviour is an objective measure of patients' social deficits, re-classifying patients based on their nonverbal profile, as has been achieved by

Meilijson et al (2004), could potentially be more advantageous and beneficial in specifying clinical and biological subgroups of schizophrenia.

Overlapping clinical and nonverbal characteristics between diagnostic groups may also impair the ability to identify patterns of behaviours that are specific to schizophrenia. For example, the pattern of reduced pro-social expression, which has been identified as a marker of schizophrenia in this review, has also been identified in patients with depression (Geerts et al, 2009). Furthermore increased displacement behaviours seen in schizophrenia also act as a marker of anxiety (Troisi, 2002). Studying patients in terms of the nonverbal classifications, as an alternative to diagnostic group, could increase the specificity with which we can study a range of psychiatric disorders.

The ethological studies reviewed focused predominantly on the behaviour of the patient and, as such, provide rich information on patients' behavioural repertoires. Ethological measures assign nonverbal behaviours to pre-defined categories that convey communicative meaning, e.g., a laugh is assigned to the category 'relaxed'. However, the same nonverbal behaviour has different functions depending on specific contextual factors such as whether someone is speaking or listening and what the behaviour is being produced in response to. For example, in addition to signaling relaxation, laughter is frequently also used to display interactional discomfort (Haakana, 2002) and disagreement (Osvaldsson, 2004). While removing the interactional context is necessary and advantageous for coding and quantitative analytic purposes, it also limits the ability to infer meaning about the communicative functions of particular nonverbal behaviours. Furthermore, the majority of studies reviewed assessed clinical interactions. Although this is an important interactional context, it introduces the potentially confounding features of shared history, knowledge of the diagnosis and the clinical relationship. As such, the generalizability of such findings to patients' social encounters beyond clinical settings may be limited. Thus, future research should investigate patients' interactions, as an interpersonal process, both within and beyond

clinical settings, in order to develop a clearer picture of patients' nonverbal deficits, which are important both for understanding the nature of the illness and designing targeted interventions.

An overarching aim of research within this field is to develop a better understanding of patients' social difficulties. The majority of research investigating patients' social deficits do so using social cognitive assessments (Penn et al, 2007). However, the relationship between patients' social cognitive performance and the deficits they experience in their social encounters is unclear. The reviewed studies provide some evidence of a link between patients' nonverbal behaviour during interaction and their occupational and social disabilities (Troisi et al, 2007), social competence (Brüne et al, 2009) and interpersonal rapport (Lavelle et al, 2012). However, the relationship with social cognition requires further exploration (Brüne et al, 2009; Lavelle et al, 2012). Thus, an important direction for future research is to bridge the gap between patients' social cognition, nonverbal behaviour and real world social functioning.

The origin of patients' nonverbal deficits is unclear. It has been hypothesized that nonverbal deficits may represent a core cognitive deficit, although the evidence for this is insufficient (Brüne et al, 2007; Lavelle et al, 2012). The studies in this review suggest an association between patients' nonverbal behaviour and symptoms. However, patients' nonverbal deficits are present as early as childhood (Schiffman et al, 2004), prior to the onset of any positive or negative symptoms, and show limited improvement with drug treatments that improve patients' symptoms (Goldberg et al, 2007). Thus, the relationship between patients' nonverbal behaviour, cognition and symptoms is likely to be complex. Recent findings suggest that, mirror neuron activity, which is activated in the understanding, action and observation of behaviour, is anomalous in patients with schizophrenia and associated with patients' clinical symptoms (Enticott et al, 2008; McCormick et al, 2012). Future studies should combine the analysis of patients' nonverbal patterns with brain imaging techniques to provide a more comprehensive picture of the etiology of nonverbal deficits in schizophrenia.

Conclusion

In face-to-face interaction, patients with schizophrenia display fewer nonverbal behaviours inviting social interaction. Negative symptoms appear to further reduce these behaviours while positive symptoms may heighten nonverbal behaviours. Others, interacting with patients, change their own nonverbal behaviour, even when unaware of a patient's presence. Finally, patients' nonverbal behaviour is associated with their wider social functioning and others' experience of rapport with them. Targeting specific nonverbal behavioural deficits in actual social encounters may need to be considered in interventions, such as social skills training, aimed at improving patients' social functioning.

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Table

Table 1. Studies investigating nonverbal communication in patients' social interactions

Author & year	Study aim	Interaction type	Nonverbal assessment (person(s) assessed)	Length (min)	Sample size	Nonverbal Findings
Lavelle et al, 2012	(i) To compare patients and their partners with controls To assess links with: (ii) patients' symptoms (iii) interpersonal rapport	2 Controls-patient	Motion detection hand & hand (patient & partners)	5	40 Three-way interactions N=20 SZ outpatients N=100 Controls	(i) SZ patients:↓speaking gesture. (ii)↑Negative sym. – all partners display ↓listener nodding,↑speaking gesture. Positive sym.– patients display ↑listener nodding, partners display↓listener nodding. (iii) Patients'↑speaking gesture -↓rapport.
Annen et al, 2012	(i) To compare with affective disorders. (ii) To assess links with symptoms.	Doctor-patient	ECSI – full body (patient only)	10	50 Two-way interactions N=26 SZ inpatients N=24 Affective disorder	(i) SZ patients: ↑displacement, ↓gesture. (ii)↑Negative sym.- ↓pro-social ↓gesture. ↑positive sym.-↑affiliation, ↑gesture. ↑general sym.- ↓eye contact,↑flight. ↑overall sym.- ↑flight.
Pounds, 2010	To investigate clinical interactions.	Nurse-patient	Ethological –full body (patient & partner)	12-19	9 Two-way interactions N=3 SZ outpatients	Different interaction profiles emerged: 1:↑movement synchrony, ↑eye contact. 2: no movement synchrony, ↓eye contact.
Brüne et al, 2009	(i) To compare with other disorders. (ii) To assess links with	Doctor-patient	ECSI - full body (patient only)	10	50 Two-way interactions N=50 SZ inpatients	(i) SZ patients: ↓pro-social behaviours. (ii) ↓Pro-social behaviours - ↓social competence, ↓social cognition.

	social competence and social cognition.					
Dimic et al, 2010	(i) To compare with depression. (ii) To assess links with symptoms.	Doctor-Patient	ECSI – reduced version (patient only)	2	78 Two-way interactions N=39 SZ outpatients N=39 Depression	(i) SZ patients: ↑flight. (ii)↑positive, negative and general sym.: ↑flight.
Brüne et al, 2008	(i) To compare with controls (ii) To assess links with negative symptoms	Doctor-patient	ECSI - full body (patient only)	10	73 Two-way interactions N=44 SZ inpatients N=29 Controls	(i) SZ patients: ↓affiliation, ↓pro-social, ↓flight, ↓relaxation. (ii) ↑Negative sym.- ↓gesture, ↓affiliation, ↓flight, ↓assertion. ↑Positive sym. -↓submission. ↑Excitement sym. –↑flight.
Troisi et al, 2007	To assess links with functional outcome	Doctor-patient	ECSI – face (patient only)	30	28 Two-way interactions N=28 SZ inpatients	↓pro-social facial expression -↑work and ↑social disability.
Meilijson et al, 2004	To identify patient clusters	Control-patient	Pragmatic protocol – full body (patient only)	15	73 Two-way interactions N=43 SZ in/outpatients N=15 Depression N=15 Controls	3 patient clusters: 1- minimal impairment; 2-lexical impairment; 3-interactional impairment of body posture, facial expression & gesture.

Troisi et al, 1998	(i) To compare with controls (ii) To assess links with symptoms	Doctor-patient	ECSI – full body (patient only)	20	53 Two-way interactions N=28 SZ inpatients N=25 Controls	(i) SZ patients: ↓pro-social, ↓gesture, ↓displacement. (ii) ↑anxiety/depression sym.-↑eye contact.
Davison et al, 1996	To compare with other disorders	Doctor-patient	Head & face (patient only)	4	51 Two-way interactions N=21SZ in/outpatients N=30 Parkinsons	SZ patients: ↓head movement, ↓frowning, ↑eye contact when speaking.
Altorfer et al, 1992	To assess links with stressful events	2 Parents–patient	Head & arm movement (patient only)	-	18 Three-way interactions N=7 SZ outpatients N=11 Bipolar N=36 Controls	Positive comments – ↑patient movement. Negative comments –↓patient movement.
Troisi et al, 1991	(i) To compare patients with good and poor prognosis (ii) To assess links with negative symptoms	Doctor-patient	Eye contact/eyes shut (patient only)	30	18 Two-way interactions N=18 SZ inpatients	SZ patients poor prognosis: (i) :↓eye contact, ↑eye closures. (ii) ↑ negative symptoms.
Steimer-Krause et al, 1990	(i) To compare with controls and other disorders (ii) To compare schizophrenia inpatients and outpatients.	Control-patient	EMFACS - face (patient & partner)	20	50 Two-way interactions N=10 SZ inpatients N=10 SZ outpatients N=10 Psyhosomatic N=50 Controls	(i) SZ patients: ↓variable and complex expressions, ↓upper face movements. SZ inpatient partners:↓pro-social. SZ outpatient partners:↑smiling. (ii) SZ inpatients:↓upper face movements, ↓smiling, ↑anger.

Pitman et al, 1987	To compare: (i) between SZ types. (ii) patients with others.	Doctor-patient	Head & face behaviour (Patient only)	5	27 Two-way interactions N=15 SZ inpatients N=12 Controls	SZ paranoid patients: ↑eye contact, ↓facial expressions when speaking. [Aggression] SZ non-paranoid patients:↓eye contact when speaking. [Flight]
Ellgring, 1986	(i) To compare patients and their partners with others.	Control-patient	FACS –Face & speech coordination (Patient & partner)	-	20 Two-way interactions N=10 SZ inpatients N=20 Controls	SZ patients:↓speech and face coordination. Partners:↓face and speech coordination when interacting with a patient, ↑coordination interacting with others.
Hardin, 1980	To compare patients' interactions with controls.	Patient-patient /Control-patient	Ethological coding –full body (interaction unit)	30	6 Two-way interactions N=6 SZ inpatients N=6 Nurse trainees	SZ patient-SZ patient: ↓engagement, ↓congruency, no movement synchrony. Control-SZ patient:↑engagement, ↑congruency, ↑movement synchrony.
Jones et al, 1979	To compare with: (i) controls, (ii) depression (iii) To assess links with symptom severity	Doctor-patient	Head, face & displacement (Patient only)	2	38 Two-way interactions N=12 SZ inpatients N=13 Depression N=13 Controls	(i) SZ patients:↓smiling. (ii) SZ patients:↓head movement, ↑displacement. (iii) ↑Clinical improvement-↑displacement.

KEY: SZ-Schizophrenia; ECSI-Ethological Coding System for Interview; FACS-Facial action coding system; EFACS-Emotional Facial Action Coding System; Sym.-Symptoms; ↑-Increased; ↓-Reduced.

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