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Social consequences of subclinical negative symptoms: An EMG study of facial expressions within a social interaction

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ABSTRACT

Background and objectives: The negative symptoms of schizophrenia are related to lower social functioning even in non-clinical samples, but little is known about the distinct social consequences of motivational and expressive negative symptoms. In this study we focused on expressive negative symptoms and examined how these symptoms and varying degrees of pro-social facial expressiveness (smiling and mimicry of smiling) relate to the social evaluations by face-to-face interaction partners and to social support.

Methods: We examined 30 dyadic interactions within a sample of non-clinical participants ($N = 60$) who were rated on motivational and expressive negative symptoms with the Clinical Assessment Interview for Negative Symptoms (CAINS). We collected data on both interaction partners' smiling-muscle (zygomaticus major) activation simultaneously with electromyography and assessed the general amount of smiling and the synchrony of smiling muscle activations between interaction partners (mimicry of smiling). Interaction partners rated their willingness for future interactions with each other after the interactions.

Results: Interaction partners of participants scoring higher on expressive negative symptoms expressed less willingness for future interactions with these participants ($r = -0.37$; $p = 0.01$). Smiling behavior was negatively related to expressive negative symptoms but also explained by motivational negative symptoms. Mimicry of smiling and both negative symptom domains were also associated with participants' satisfaction with their social support network.

Limitations: Non-clinical sample with (relatively) low levels of symptoms.

Conclusions: Expressive negative symptoms have tangible negative interpersonal consequences and directly relate to diminished pro-social behavior and social support, even in non-clinical samples.

1. Introduction

Social impairments in schizophrenia are strongly related to the negative symptoms (Bowie et al., 2008; Couture, Granholm, & Fish, 2011; Ventura et al., 2015) that are comprised of motivational and expressive negative symptoms (Horan, Kring, Gur, Reise, & Blanchard, 2011; Strauss et al., 2012). Motivational negative symptoms are defined as a lack of motivation to engage in pleasant activities along with a diminished recollection and anticipation of receiving pleasure from such activities. Expressive negative symptoms are comprised of reductions in several domains of nonverbal communication, such as facial expressiveness, vocal prosody, gesturing, and quantity of spoken words (Horan et al., 2011). Motivational negative symptoms such as social anhedonia have long been discussed as a risk-factor for the onset of psychosis (Chapman, Chapman, Kwapil, Eckblad, & Zinser, 1994; Gayer-Anderson & Morgan, 2013; Kendler, Thacker, & Walsh, 1996) and have been shown to relate to lower social functioning even in non-clinical samples (Blanchard, Collins, Aghevli, Leung, & Cohen, 2011; Corcoran et al., 2011). Expressive negative symptoms are also discussed to predate the onset of psychosis (Piskulic et al., 2012; Schiffman et al., 2004; Walker, Grimes, Davis, & Smith, 1993). However, little is known about how expressive negative symptoms affect social outcomes, neither in clinical nor in non-clinical samples (Lavelle, Healey, & McCabe, 2014).

Notably, negative symptoms, particularly expressive negative symptoms, appear to be relatively stable phenomena over time (Galderisi et al., 2013; Ventura et al., 2015). One recent study found

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that poor gesture performance was predictive of poor functional outcome over the course of six months which was associated with more severe and more persistent negative symptoms (Walther et al., 2016), thus directly linking expressive negative symptoms to functional outcome and the maintaining of negative symptoms. However, expressive negative symptoms have repeatedly been shown to be less predictive of global social functioning in schizophrenia than motivational negative symptoms (Fervaha, Foussias, Agid, & Remington, 2014; Galderisi et al., 2014; Strassnig et al., 2015).

In order to make these findings comprehensible, it may be important to distinguish long-lasting and global from more immediate and focal social consequences of negative symptoms. Because expressive negative symptoms are inherently reductions in nonverbal communicative behavior, they should interfere with everyday interactions and lead to more rejection by interaction partners, a precursor of diminished social networks (Back, 2015; Hooley, 2010; Thorup et al., 2006). Accordingly, interaction partners of patients with schizophrenia have been shown to respond negatively to reductions in nonverbal behavior (Krause, Steimer-Krause, & Hufnagel, 1992; Lavelle, Dimic, Wildgrube, McCabe, & Priebe, 2015; Lavelle, Healey, & McCabe, 2013; Penn, Kohlmaier, & Corrigan, 2000; Riehle et al., 2015).

Thus, expressive negative symptoms may particularly affect early outcomes of face-to-face interactions, such as being liked by the interaction partner. The formation of mutual liking between interaction partners, in turn, is known to heavily rely on conveying positivity via facial expressions (Tickle-Degnen & Rosenthal, 1990). It might be this conveying of positivity that is impaired in people with expressive negative symptoms: Positive facial expressions rather than negative facial expressions have been found to be affected by the reduced emotional expression both in schizophrenia (Blanchard, Sayers, Collins, & Bellack, 2004; Kring & Moran, 2008; Mattes, Schneider, Heimann, & Birbaumer, 1995) and in non-clinical samples (Leung, Couture, Blanchard, Lin, & Llerena, 2010; Llerena, Park, Couture, & Blanchard, 2012). However, a reduction in positive facial expressions has not yet been investigated as a possible behavioral marker of expressive negative symptoms in relation to the liking that is formed in a face-to-face interaction.

Another important aspect of mutual liking between interaction partners is synchronization of movements (Lakin & Chartrand, 2003; Tickle-Degnen & Rosenthal, 1990) and recent studies have shown that people with schizophrenia exhibit deficits both in the voluntary and spontaneous synchronization of body movements (Kupper, Ramseyer, Hoffmann, & Tschacher, 2015; Lavelle, 2011; Raffard et al., 2015; Varlet et al., 2012). These deficits have been found to be associated with negative symptoms (Kupper et al., 2015), to be associated with more negative social evaluations of patients (Lavelle, 2011),[1] and to be present in un-affected relatives of people with schizophrenia (Del-Monte et al., 2013). Synchronization of expressive facial movements is also known as facial mimicry (Hess & Fischer, 2013). Whether or not synchronization of facial expressions is impaired in schizophrenia is unclear, since the two available studies on facial mimicry produced conflicting results and did not assess facial expressions within social interactions (Kring, Kerr, & Earnst, 1999; Varcin, Bailey, & Henry, 2010).

Taken together, the evidence suggests that expressive negative symptoms could negatively affect face-to-face interactions and their social outcome through a lack of the amount of shown and synchronized positive facial expressions and that this basic mechanism should also be observable in non-clinical samples. For this study, we therefore hypothesized that, in a non-clinical sample, expressive negative symptoms would be reflected in reduced facial expression and facial mimicry within a dyadic face-to-face interaction. We expected expressive negative symptoms to trigger more negative evaluations on sides of the interaction partner and also assumed that reduced smiling behavior (reduced amounts of positive expressions and of smiling mimicry) would be associated with more negative evaluations by the interaction partner. Finally, we assumed that negative symptoms and reduced smiling behavior would be reflective of diminished social support networks.

2. Methods

2.1. Sample

We collected data from 33 same-sex dyadic interactions of mentally healthy subjects ($N = 66$), recruited from the community of the city of Hamburg, Germany. Inclusion criteria included an age of 18–65, a verbal IQ > 80, and no life time diagnosis of any mental disorder. Due to technical recording failures throughout the social interactions, we had to exclude three of the dyads, so that our final sample consisted of 30 dyads ($N = 60$). Mean age of the participants was $M = 35.1$ ($SD = 12.2$) and mean years of education were $M = 16.1$ ($SD = 3.09$). Nineteen of the dyads were female/female, the remaining 11 male/male.

2.2. Materials and instruments

2.2.1. Symptom ratings and diagnostics

Presence of mental disorders was ruled out using the Structured Clinical Interview for DSM-IV Axis I (SCID-I; Wittchen, Fydrich, & Zaudig, 1997) and we assured sufficient verbal IQ with the Multiple Choice Vocabulary Test (MWT-B; Lehrl, 1999). We assessed negative symptoms in all participants with the Clinical Assessment Interview for Negative Symptoms (CAINS; Kring, Gur, Blanchard, Horan, & Reise, 2013), a semi-structured interview that assesses negative symptoms as impairments in “Motivation and Anticipation of Pleasure” (CAINS-MAP) and “Expressiveness” (CAINS-EXP). Based on the information given by participants in the interview, the CAINS-MAP subscale assesses the motivation to engage in social, vocational, and recreational activities, as well as the amount of pleasure people recollect and anticipate to receive from these activities. The observer-rated CAINS-EXP subscale explicitly assesses reductions in the domains of facial expressiveness, vocal prosody, gesturing, and quantity of speech. Three trained raters conducted the CAINS interviews with the participants (inter-rater reliabilities were 0.75 for CAINS-MAP and 0.72 for CAINS-EXP). We assessed social anxiety with the Social Phobia Scale and the Social Interaction Anxiety Scale (SPS/SIAS; Stangier, Heidenreich, Berardi, Golbs, & Hoyer, 1999) and size of and satisfaction with the social support network with the Social Support Questionnaire (SSQ; Leppin, Quast, & Sarason, 1986).

2.2.2. Electromyography measurement of facial expressions

We captured movements of the Zygomaticus major (*‘smiling muscle’*) and the Corrugator supercilii (*‘frowning muscle’*) within a dyadic face-to-face interaction (see procedures) via electromyography (EMG) for both interaction partners simultaneously. For this, we placed Ag/AgCl surface electrodes with a skin-contact area of 5 mm on the participants' cheeks (zygomaticus) and foreheads (corrugator) according to Fridlund and Cacioppo (1986). A reference electrode was placed on one of each participant's earlobes. The EMG-signals were initially sampled at 2048 Hz and continuously measured throughout the interaction.

[1] Negative symptoms were not associated with the synchronization deficit in Lavelle's (Lavelle, 2011) study, but were associated with the social evaluation.