Anomalous echo: Exploring abnormal experience correlates of emotional motor resonance in Schizophrenia Spectrum

Mariateresa Sestito a,b,*, Andrea Raballo c,d, Maria Alessandra Umiltà e, Mario Amore f, Carlo Maggini g, Vittorio Gallese a

a Department of Neuroscience, Unit of Physiology, University of Parma, Parma, Italy
b Department of Neuroscience, Psychiatric Division, University of Genova, Italy
c Department of Pharmacy, University of Parma, Italy
d Department of Mental Health, AUSL of Reggio Emilia, Reggio Emilia, Italy
e Cognitive Neuroscience Center, Unité mixte de recherche 5229, Centre National pour la Recherche Scientifique (CNRS), Bron, France
f Department of Neuroscience, Psychiatric Division, University of Genova, Italy
g Department of Mental Health, AUSL of Reggio Emilia, Reggio Emilia, Italy

Abstract

Anomalous experiences such as Basic Symptoms (BS) are considered the first subjective manifestation of the neurobiological substrate of schizophrenia. The purpose of this study was to explore whether a low or high emotional motor resonance occurring in Schizophrenia Spectrum (SzSp) patients was related to patients' clinical features and to their anomalous subjective experiences as indexed by the Bonn Scale for the Assessment of Basic Symptoms (BSABS). To this aim, we employed a validated paradigm sensitive in evoking a congruent facial mimicry (measured by means of facial electromyographic activity, EMG) through multimodal positive and negative emotional stimuli presentation. Results showed that SzSp patients more resonating with negative emotional stimuli (i.e. Externalizers) had significantly higher scores in BSABS Cluster 3 (Vulnerability) and more psychotic episodes than Internalizers patients. On the other hand, SzSp patients more resonating with positive emotional stimuli (i.e. Externalizers) scored higher in BSABS Cluster 5 (Interpersonal irritation) than Internalizers. Drawing upon a phenomenological-based perspective, we attempted to shed new light on the abnormal experiences characterizing schizophrenia, explaining them in terms of a disruption of the normal self-perception conveyed by the basic, low-level emotional motor mechanisms.

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1. Introduction

Although there is substantial empirical evidence indicating that experiential phenotypes such as anomalous subjective experiences are a core research target to delineate the underlying psychobiological vulnerability to schizophrenia (Parnas and Henriksen, 2014) the relation between phenomenological experiences and neurobiological disorders in schizophrenia is still significantly under-investigated.

Over recent years, indeed, uncharacteristic subjective experiences occurring in schizophrenia have become an important theme in psychopathological research. Among those, Basic Symptoms (BS) were conceptualized as the first subjective echo of the entailed neurobiological underpinnings of schizophrenia. Stemming from the Jasperian phenomenological psychopathology, BS are non-psychotic subtle phenomena privately experienced as unelaborated, yet disconcerting, interferences in daily experience (Gross, 1989). On a clinical level, BS and similar anomalies of subjective experience are detectable in different schizophrenia-related conditions, such as full-blown schizophrenia, prodromal/at risk mental states, schizotypy (Handest and Parnas, 2005; Parnas et al., 2005; Nordgaard and Parnas, 2014) as well as genetically high-risk individuals (Maggini and Raballo, 2004; Raballo and Parnas, 2011; Raballo et al., 2011).

Recent works (Nelson et al., 2014a, 2014b) outlined how various aspects of the phenomenological basic self-disturbances occurring in schizophrenia may correlate with neurocognitive disturbances, suggesting new avenues for empirical investigations into these proposed associations. A wealth of neurophysiological studies considered the involuntary facial mimicry in response to emotional stimuli as an important low-level mechanism that leads
individuals to feel what others feel, hence facilitating a first-person, un-reflective empathic understanding of others’ emotions via their bodily simulation (Preston and De Waal, 2002; Sonnby-Borgström, 2002; Gallese, 2003, 2005; Niedenthal, 2007; Hess and Fischer, 2013; Likowski et al., 2012). A recent study (Sestito et al., 2015) investigated possible connections between phenomenological experience and physiological mechanisms in Schizophrenia Spectrum (SzSp) patients, explored by means of motor facial mimicry in response to emotional stimuli. Interestingly, a correlation between Self-Disorders BSABS-derived subscore (i.e., a pre-EASE-SD-analog scale constructed from the available data obtained from the Bonn Scale for the Assessment of Basic Symptoms (BSABS), see Parnas et al. (2003)) and electromyographic (EMG) facial reactions in response to negative stimuli presented only in the auditory modality was detected. Besides of a polarized sensitivity for negative stimuli, in an earlier study (Sestito et al., 2013) schizophrenia patients exhibited, with respect to healthy controls, a “non-specific” Zygomaticus muscle activation in response to positive as well as to negative emotions, that is, an improper “smile” response occurring both when laugh and cry stimuli were presented. This phenomenon appeared to be similar to what Heiman and Soverri called mimic disintegration (1957)—namely, an indecipherable and bizarre mimic pattern reflecting a disruption of patients’ ability to resonate with others’ emotions through facial mimicry, possibly contributing to the well recognized empathizing deficit present in schizophrenia (Varcin et al., 2010; Derntl et al., 2012). Further studies capitalizing the integration across the phenomenological and neurophysiological levels are hence necessary, in order to provide advances in the understanding of vulnerability markers in schizophrenia and enhance early identification and intervention approaches.

The aim of this study is to explore whether a weak or high emotional motor resonance occurring in SzSp patients—considered a mirror mechanism (Carr et al., 2003; Seitz et al., 2008; Derntl et al., 2012)—is related to patients’ clinical features and to their anomalous subjective experiences as indexed by the Bonn Scale for the Assessment of Basic Symptoms (BSABS). In order to do this, we employed an experimental paradigm able to evoke a congruent facial mimicry (measured by means of facial EMG activity) through multimodal positive and negative emotional stimuli exposure. This paradigm has been previously proven to detect deficits in facial mimicry in schizophrenia patients (Sestito et al., 2013).

2. Methods

In order to explore subjective anomalous experiences characterizing SzSp patients with different degrees of motor resonance to emotional stimuli, participants were divided into two groups—Internalizers and Externalizers—based on their low and high emotional resonance following the same method adopted in previous works (Kring and Gordon, 1998; Sestito et al., 2013). Internalizer and Externalizer classification was used exclusively to characterize individual differences of emotional EMG facial reactivity to specific emotional stimuli as previously reported (Sestito et al., 2013) and did not refer to personality traits and/or coping mechanisms (Asendorpf and Scherer, 1981). Clinical features (positive and negative symptoms, length of illness, age at first recognized psychosis and number of psychotic episodes) and anomalous subjective experiences (BSABS scores) differences between these two subsamples were then explored.

2.1. Sample

The sample included 19 outpatients (14 males; 5 females, mean age 34±11 years S.D.± 6.73) recruited at the Psychiatry Section of Parma University Department of Neuroscience. All participants were diagnosed with a Schizophrenia Spectrum disorder (SzSp) (i.e. schizophrenia or schizotypal personality disorder according to DSM-IV diagnostic criteria [American Psychiatric Association, 1994]) and were clinically stable (i.e., with no current psychotic symptoms) at the time of the assessment. Fifteen participants included in this sample have been considered in the earlier validation study (Sestito et al., 2013).

Before inclusion, all patients were screened for eligibility and those with any history of organic brain disorders, brain injury, alcohol or substance abuse and mental retardation were excluded from the study. Clinical features were documented with the Scales for the Assessment of Positive and Negative Symptoms (SANS, SAPS; Andreasen, 1984a, 1984b), whereas disturbances of subjective experience were explored through the Bonn Scale for the Assessment of Basic Symptoms (BSABS) (Gross et al., 1992). Since all patients were under psychopharmacologic treatment with antipsychotics, the cumulative measure of lifetime drugs exposure was calculated following Andreasen et al. (2010). Demographic and psychopathological features of the sample are provided in Table 1.

Written informed consent was obtained from all participants before entering the study, after the treating clinician gave them an exhaustive explanation about the experimental procedure. The Ethics Committee of the University of Parma approved the study, that was carried out according with the ethical standards of the 2013 Declaration of Helsinki.

2.2. Bonn Scale for the Assessment of Basic Symptoms (BSABS)

Disturbances of subjective experience were investigated through the Bonn Scale for the Assessment of Basic Symptoms (BSABS) (Gross et al., 1992). The BSABS is a semi-structured interview targeting the BS, i.e. self-perceived disturbances in volition, drive, stream of thought, perception, stress tolerance, neurovegetative and connotative experiences (Schultze-Lutter, 2009, 2010).

These subjective symptoms have been empirically clustered into five subsyndromes (Klosterkötter et al., 1996, 1997):

1. Thought, language, perception and motor disturbances (formerly termed “Information processing disturbances”) cluster includes BS involving autopsychic dissonance in cognition, naturalness of agency, perception and linguistic interaction.

2. Impaired bodily sensations (“Coenesthesias”) includes a cluster of cenesthetic BS mainly affecting bodily proprioceptice reflexive and pre-reflexive sensory awareness.

3. Impaired tolerance to normal stress (“Vulnerability”) cluster includes some BS characterized by abnormal intolerance to social, working and attentional demands deriving from the daily environmental engagement.

4. Disorders of emotion and affect (“Adynia”) cluster includes the so-called “adynamic” BS, associated with a lack of dynamic-affective empowerment of emotional and attentional goal directedness.

5. Increased emotional reactivity (“Interpersonal irritation”) cluster is defined by BS expressing hyperreactivity, enhanced impressionability and disturbances in emotional responsiveness.

2.3. Experimental paradigm: stimuli and procedure

The experimental paradigm (Sestito et al., 2013) consists of the following procedure. Participants were presented with 2-s colored video clips portraying expressive (smile), negative (cry) and neutral (control) emotional stimuli in visual (i.e., Video), auditory (i.e., Audio) modalities. Video or Audio modalities were either in isolation (i.e. V or A alone), or combined (i.e. AV). AV combination were either congruent (Audio–Visual Congruent, AVC, i.e. A and V conveying the same emotion (e. g. Laugh) or incongruent (Audio–Visual Incongruent, AVI), i.e. A and V conveying contradictory information (for example, in AV Cry participants saw an actor laughing but heard crying whereas in AVL Laugh participants saw an actor crying but heard laughing). Participants were requested to recognize and quantitatively rate the emotional value of the perceived stimuli (see Fig. 1), while EMG activity of Corrugator

* Drugs are expressed as the cumulative value measured in dose-years in the form of (chlorpromazine equivalent in mg) × (time on dose measured in years) (Andreasen et al., 2010).
of SzSp and Internalizers with respect to clinical features and abnormal subjective experiences (i.e., Externalizers for negative stimuli) also had increased levels of anomalous subjective experiences indicative of overall impaired vulnerability, (see Appendix C for details) as well as more psychotic episodes (n = 17; t = 2.48, p < 0.03) than Internalizers.

For all the other clinical features, we found no significant differences (all p > 0.05).

4. Discussion

This study adopted a multimodal paradigm to evoke congruent electromyographic facial reactions in SzSp participants. The latter were then dichotomized into Externalizers vs. Internalizers, according to the intensity of their emotional motor resonance to positive and negative stimuli. SzSp participants with high (i.e., Externalizers) or low (i.e., Internalizers) EMG congruent responses revealed a different pattern of specific anomalous subjective experiences as well as different clinical features.

Those SzSp patients who were more resonating with negative emotional stimuli (i.e., Externalizers for negative emotions) presented higher scores in BSABS Cluster 3 (Vulnerability, for item composition see Appendix C) (n = 18; t = 2.47, p < 0.03) (Fig. 2, upper panel).

Whereas, with respect to negative emotions, Externalizers presented higher scores in BSABS Cluster 3 (Vulnerability, for item composition see Appendix C) (Fig. 2, lower panel) (n = 18; t = 2.73, p < 0.02) as well as more psychotic episodes (n = 17; t = 2.48, p < 0.03) (Fig. 3) than Internalizers.

With respect to positive emotions, Externalizers participants scored higher than Internalizers in BSABS Cluster 5 (Interpersonal irritation, for item composition see Appendix C) (n = 18; t = 2.47, p < 0.03) (Fig. 2, upper panel).

After item analyses, all BSABS clusters reached a satisfactory alpha coefficient (> 0.50; for item composition and alpha coefficients for each cluster, see Appendix B) and were retained for the subsequent analyses.

3.2. Internalizer vs. Externalizer group: experiential and clinical differences

3.1. BSABS subscales item analyses

3. Results

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Overall the results indicate that the electrophysiological endophenotypes (i.e., Internalizers vs. Externalizer for positive vs. negative emotional stimuli) actually capture relevant endophenotypic features at a clinical level.

SzSp subjects that reacted more to negative emotional stimuli (i.e., Externalizers for negative stimuli) had also increased levels of anomalous subjective experiences indicative of overall impaired tolerance to any daily solicitations in the socio-functional sphere (i.e. BSABS Cluster 3 “vulnerability”, see Appendix C for details) as well as more recurrent psychotic episodes. This coheres with the evidence indicating the relevance of mechanisms such as aberrant

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assignment of salience, selective bias toward negative stimuli, and tendency to ascribe meaning where none is present (Kapur, 2003; Hoffman et al., 2007; Sestito et al., 2013; Nelson et al., 2014b) for the development of positive symptoms (see Klosterkötter (1992)).

On the contrary, SzSp participants that were Externalizers for positive emotions scored higher in Interpersonal irritation BSABS Cluster 5 (“Interpersonal irritation”) than Internalizers. This cluster of anomalous subjective experiences indicates an overall hyper-reactivity with enhanced impressionability and disturbances in emotional responsiveness (e.g. decrease in facial expression, intonation and communication gestures).

Thus, on a clinical-experiential level, those who are Externalizers for positive emotions (i.e. patients more resonating with positive stimuli) tend to contextually experience a disorder in the immediate, phenomnic relation to others, particularly with respect to the impression of an inadequate emotional responsiveness at a mimic-expressive level (as indicated by the BSABS Cluster “Interpersonal irritation”), as if the smile reaction exhibited—although congruent with the emotion perceived—is something completely extraneous from what is actually felt.

For indicative purposes, we reported some BSABS Cluster 5 related descriptions:

“During social interactions (…), I feel a tense expression on my face as I ought to laugh or make a face, stupid.”

“I laugh in such a beastly and ridiculous way, and I feel I am disfigured. My face lineaments are completely altered. I have a different appearance now, my smile, my eyes, all is changed” (Gross et al., 1992; our translation).

Overall these results, together with other studies that investigated the facial reactivity to emotional stimuli of SzSp (Sestito et al., 2013, 2015), seem to revitalize the notion of mimic disintegration (Heimann and Spoerri, 1957; Juckel and Polzer, 1998), as a graded phenomenon (ranging from altered, uncoordinated muscular reactions and reaching more radical expressive manifestations such as manneristic and parathymic facial expressions) that plausibly goes along with a multisensory integration impairment and disturbances of emotional responsiveness in schizophrenia (Sestito et al., 2015).

Indeed, these descriptions are consistent with what we found in an earlier study (Sestito et al., 2013) in which the “smile” EMG reaction occurred not only when patients perceived laughter, but also—oddly—when cry stimuli were presented. In this context we are inclined to consider that the disruption of the automatic, low-level processes related to facial mimicry probably fosters patients’ sense of detachment, thereby increasing disconnection between the “expressed” and the “felt” l. This growing disconnection crucially creates a sense of distance—and even alienation—from patient’s own experience, ending up in a scission of the Self.

A disjunction between one’s subjectivity and bodily experience is frequently observed in SzSp conditions, particularly during the preonset or prodromal phase (Klosterkötter et al., 2001; Maggini and Raballo, 2004). Specifically in our study, a tendency to resonate and experientially go along with negative stimuli is nonetheless accompanied by an apparent experiential disconnection between the self and the bodily resonance for positive emotions. Under these circumstances, the body would end up to be experienced as an object, rather than an emotion-fulfilled aspect of selfhood (Nelson and Sass, 2009). Hence, as Stanghellini and Fusar-Poli (2012) argued: “Schizophrenic persons undergo a special kind of depersonalization: the living body becomes a functioning body, a thing-like mechanism in which feelings, perceptions, and actions take place as if they happened in an outer space.” (p. 338). Embodiment is a fundamental condition of selfhood (Gallese and Sinigaglia, 2010, 2011; Stanghellini et al., 2012; Gallese and Ferri, 2013), and such disembodiment of emotion (Fuchs, 2005; Vodůšek et al., 2013) we found in our study—actualized through a bodily, anomalous echo—further remarks the need to conceptualize schizophrenia as a disorder of the Self and of the Intersubjective attunement (Stanghellini and Fusar-Poli, 2012).

Considerations about limitations concerning the described results include the modest samples size finally obtained by

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dividing the whole sample in subgroups, resulting in a possible reduced statistical power. However, despite these intrinsic limitations, the current study adopts a novel trans-domain approach to track the phenomic, experiential correlates of the underlying physiological, motor facial mimicry mechanisms occurring in Schizophrenia Spectrum disorders. Such approach allows a closer integration of findings belonging to the phenomenological and physiological levels of analysis. In this respect, our results indicate that certain candidate neurobiological underpinnings (e.g. electro-mygographic facial reactions) of Schizophrenia Spectrum vulnerability are non-randomly associated to clinical-phenomenological endophenotypes (BSABS clusters and psychotic episodes) that index patients’ subjective experiences and symptomatic manifestations. Therefore, our results might represent an inspiring advance in research investigating the relation between (neuro) physiological and phenomenological trait markers of susceptibility to schizophrenia.

Contributors

Conceived and designed the experiment: MS, MAU, VG. Performed the experiment: MS. Analyzed the data: MS and AR. Wrote the paper: MS, supervised by AR. All the authors contributed to the final revision of the manuscript.

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The authors have declared that there are no conflicts of interests in relation to the subject of this study.

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Appendix A. Supplementary Information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.psychres.2015.05.038.

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