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Meaning in meaninglessness: The propensity to perceive meaningful patterns in coincident events and randomly arranged stimuli is linked to enhanced attention in early sensory processing

Christian Rominger^{*}, Günter Schuler, Andreas Fink, Elisabeth M. Weiss, Ilona Papousek

Department of Psychology, Biological Psychology Unit, University of Graz, Austria

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ABSTRACT

Perception of objectively independent events or stimuli as being significantly connected and the associated proneness to perceive meaningful patterns constitute part of the positive symptoms of schizophrenia, which are associated with altered attentional processes in lateralized speech perception. Since perceiving meaningful patterns is to some extent already prevalent in the general population, the aim of the study was to investigate whether the propensity to experience meaningful patterns in co-occurring events and random stimuli may be associated with similar altered attentional processes in lateralized speech perception. Self-reported and behavioral indicators of the perception of meaningful patterns were assessed in non-clinical individuals, along with EEG auditory evoked potentials during the performance of an attention related lateralized speech perception task (Dichotic Listening Test). A greater propensity to perceive meaningful patterns was associated with higher N1 amplitudes of the evoked potentials to the onset of the dichotically presented consonant-vowel syllables, indicating enhanced automatic attention in early sensory processing. The study suggests that more basic mechanisms in how people associate events may play a greater role in the cognitive biases that are manifest in personality expressions such as positive schizotypy, rather than that positive schizotypy moderates these cognitive biases directly.

1. Introduction

Overreached experiences of meaningful patterns arising from purely coincident events and random stimuli have been reported in both prodromal and early stages of schizophrenia (Chadwick, 2007; Conrad, 1958; Hemsley, 1993, 2005; Kapur, 2003; Morrison and Murray, 2009). The experience of “meaningful” coincidences is defined as “surprising concurrence of events, perceived as meaningfully related, with no apparent causal connection” (Diaconis and Mosteller, 1989, p. 853; e.g., thinking about a missed friend and running into him subsequently). If two co-occurring events, a thought and an external event, are perceived as contingent in time, space, or sense, they are experienced as being significantly connected. This characteristic of “meaningful coincidences” underlines its close link with the perception of causality and apophenia, the tendency to suddenly perceive “meaningful” patterns in randomness (cf. Brugger et al., 1993a; Conrad, 1958; DeYoung et al., 2012; Fyfe et al., 2008).

Experiencing “meaningful” coincidences is also common in non-clinical populations, though its frequency greatly varies between individuals (Bressan, 2002; Rattet and Bursik, 2001; Rominger et al.,

2011). In accordance with the dimensional approach of Claridge (1997), some features of schizophrenia are (in a milder form) also present in schizotypy (Calkins et al., 2004; Chapman et al., 1994; Ettinger et al., 2015; Grant, 2015; Johns and van Os, 2001; Lenzenweger, 2015; Meehl, 1962). Accordingly, the perception of meaningful patterns in coincident events and random stimuli was also found to be associated with delusion-like facets of positive schizotypy (Brugger et al., 1993b) such as the belief in paranormal, magical ideation, and unusual experiences (Blackmore, 1994; Bressan, 2002; Brugger et al., 1990, 1993a; Farias et al., 2005; Krummenacher et al., 2010; Rominger et al., 2011; Sannwald, 1962), as well as with the disposition toward hallucinations (Jakes and Hemsley, 1986; Merckelbach and van de Ven, 2001).

However, while the propensity of unusual experiences of meaningful patterns in coincident events and random stimuli and positive facets of schizotypy such as the belief in paranormal phenomena and delusion-like beliefs seem to be associated, they might still have different cognitive and neurophysiological correlates (e.g., Bressan, 2002; Rominger et al., 2011). The propensity to perceive meaningful patterns might be more directly linked with *perceptual processes* whereas other

^{*} Correspondence to: University of Graz, Department of Psychology, Biological Psychology Unit, Univ.-Platz 2, A-8010 Graz, Austria.
 E-mail address: christian.rominger@uni-graz.at (C. Rominger).

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positive schizophrenia/schizotypy features might involve additional components (e.g., higher order cognitive functions, belief in paranormal phenomena). This assumption nicely fits previous findings showing independent correlations of paranormal experience versus paranormal belief with various cognitive and neurophysiological features (e.g., reasoning bias, critical thinking, perception of randomness, neurophysiological activation; Dagnall et al., 2016; Hergovich and Arendasy, 2005; Lawrence et al., 1995; Lawrence and Peters, 2004; Rattet and Bursik, 2001; Sumich et al., 2008).

While the perception of meaningful patterns has a strong impact on daily life as well as on the formation of psychosis (Chadwick, 2007; Kammerer, 1919), its correlates have been underinvestigated so far. Some authors hypothesized that the experience of meaningful patterns in coincident events might be linked to automatic, early attention-related perceptual processes (Bressan et al., 2008; Diaconis and Mosteller, 1989). However, in a reaction time experiment, Bressan et al. (2008) only found an association between automatic attentional processes and the belief in the meaningfulness of coincidences (e.g., “Premonitory dreams exist and are not simple coincidences”, cf. Bressan et al., 2008, p. 1302).

Nevertheless, deviations in attentional processes are well known in patients with schizophrenia (see e.g., Hugdahl, 2015; Krishnan et al., 2011). For instance, attention related perceptual deviations such as reduced monitoring and basic auditory dysfunctions in schizophrenia were reported in studies using speech stimuli (Dale et al., 2016; Ford et al., 2012; Frith, 1992; Hugdahl, 2009). Many studies in this context used consonant-vowel syllables to investigate these associations (Bruder, 1983; Dale et al., 2016; Ocklenburg et al., 2013). The verbal Dichotic Listening Test, a well-established measure of lateralized speech perception (Hugdahl and Andersson, 1986; Kimura, 1967) implicates attentional processes. Attention modulates the well-known right-ear-advantage for dichotic speech sounds (Bryden, 1982; Collinson et al., 2009; Hiscock and Kinsbourne, 2011; Kinsbourne, 1970). In a similar vein, numerous studies found a reduction of the typically reported right-ear-advantage in patients with schizophrenia, which is assumed to indicate deviations in attentional processes (for a meta-analysis see Ocklenburg et al., 2013). Aberrations of the right-ear-advantage are also well in line with Hugdahl's (2009) perceptual theory, which proposes associations between left hemispheric deficits, lateralized speech perception, and auditory verbal hallucinations (Hugdahl, 2009, 2015; Hugdahl et al., 2012, 2013).

The N1 component of the auditory evoked potential represents early attention-related perceptual processes, which are largely automatic (not intentional) in nature (occurring at about 50–150 ms post-stimulus; Näätänen and Picton, 1987). Bruder et al. (1999) reported a reduced N1 component of the auditory evoked potential during the verbal Dichotic Listening Test in patients with schizophrenia (see also Dale et al., 2016). A reduction of the auditory evoked N1 component has even been proposed as a potential biomarker of schizophrenia (Force et al., 2008; Ford et al., 2001; Gallinat et al., 2002; Salisbury et al., 2010; for review see Rosburg et al., 2008), and was even found in relatives of schizophrenia patients (Ethridge et al., 2015; Foxe et al., 2011). However, some authors reported also an increased auditory evoked N1 component in patients with schizophrenia (Adler et al., 1990) and with acute psychosis (Valkonen-Korhonen et al., 2002).

Similarly, deviations in attentional processes during lateralized speech perception indicated by smaller or greater right-ear-advantages or reduced accuracy in the Dichotic Listening Test were shown in non-clinical individuals with high levels of positive schizotypy (Overby, 1992; Poreh et al., 1993; Weinstein and Graves, 2002; for summary see Grimshaw and Kranz, 2015). Sumich and colleagues reported an association between decreased N1 amplitudes and positive schizotypal symptoms in an auditory oddball paradigm by means of non-speech tones (Sumich et al., 2008, 2014; but see Klein et al., 1999).

On the basis of this evidence we expected that a high propensity to experience meaningful patterns in coincident events and random

stimuli would be associated with a reduced right-ear-advantage (Hiscock and Kinsbourne, 2011; Ocklenburg et al., 2013) and a decreased N1 amplitude of the EEG auditory evoked potential during the verbal Dichotic Listening Test (Rosburg et al., 2008; Sumich et al., 2008). We further hypothesized that the propensity to experience meaningful patterns might be more directly linked with early attention-related sensory processes during lateralized speech perception (i.e., right-ear-advantage and N1; see e.g., Bressan et al., 2008; Diaconis and Mosteller, 1989) compared to positive facets of schizotypy (comprising the belief in paranormal phenomena; Dagnall et al., 2016).

2. Methods

2.1. Participants

From a pool of 560 university students screened with the Schizotypal Personality Questionnaire (SPQ; Raine, 1991), 52 were selected based on their positive schizotypy scores, in order to cover a broad range of positive schizotypy. All participants were right-handed (as assessed by the hand dominance test, HDT; Steingrüber and Lienert, 1971; Papousek and Schuller, 1999) and reported no hearing deficit. Participants did not take psychoactive medication. Due to technical problems during EEG recording, three participants were excluded (final sample: $n = 49$; 25 women; age range 18–35, $M = 24.27$, $SD = 3.59$). The study was performed in accordance with the American Psychological Association's Ethics Code and the 1964 Declaration of Helsinki and was approved by the local ethics committee. Informed consent was obtained from all participants.

2.2. Experience of meaningful patterns

2.2.1. Propensity to experience meaningful patterns in coincident events

A German translation (Rominger et al., 2011) of the Coincidence Questionnaire (Bressan, 2002) was used, which assesses the frequency with which several categories of “meaningful” coincidences have been experienced (e.g., “Spontaneous associations” like thinking of someone and running unexpectedly into that person soon afterwards; “Perception of something distant in time” like having a dream that then comes true; 7 items, 5-point Likert scale, from “never” to “very often”). The score is constituted by the sum of all items ($M = 18.88$, $SD = 4.65$, $min = 8$, $max = 27$).

2.2.2. Propensity to experience meaningful patterns in randomly arranged stimuli

The behavioral indicator of apophenia (see Brugger and Regard, 1995 for a similar approach) was assessed by means of 33 random inkblots (Drey Fuchs, 1958; Rorschach, 1949; Zulliger, 1946, 1951). Participants were instructed to name the object they saw (if any, within 10 s) when looking at the inkblot using one noun. Following previous studies, experience of meaningful patterns was calculated as the number of non-unique perceptions.¹ Consequently, the score is constituted by the total sum of responses minus the number of unique responses ($M = 13.53$, $SD = 3.84$, $min = 5$, $max = 22$).

2.3. Positive schizotypy

The Schizotypal Personality Questionnaire (SPQ) is a 74-item questionnaire modelled on DSM criteria for schizotypal personality disorder (Raine, 1991; German version by Klein et al., 1997). According to the validated factor structure of the German adaptation of the SPQ

¹ Uniquely perceived patterns (i.e., responses generated by only one person in an extended data set, $n = 127$) were considered to indicate spurious and oblique answers, which are “completely idiosyncratic” (Gianotti et al., 2001, p. 599; thereby carrying error variance but no variance that is relevant to the present research).

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