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Reporting Meaningful Chinese Words While Listening to the Deutsch Word Illusions in Chinese Patients with Cluster A Personality Disorders

You Xu[1], Hongying Fan[1], Qianqian Gao[1], Hongjing Mao[2], Yonghua Zhang[2], Wanzhen Chen[1] and Wei Wang[1,2*]

[1]*Department of Clinical Psychology and Psychiatry/ School of Public Health, Zhejiang University College of Medicine, Hangzhou, China*

[2]*Department of Clinical Psychology, Affiliated Psychiatric Hospital, Zhejiang University College of Medicine, Hangzhou, China*

***Corresponding author:** Wei Wang, Department of Clinical Psychology and Psychiatry/ School of Public Health, Zhejiang University College of Medicine, Yuhangtang Road 866, Hangzhou, Zhejiang 310058, China, Tel: 86-571-88208188; E-mail: wangmufan@msn.com, DrWang@Doctor.com

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Abstract

The meaningful words reported by the healthy people when listening to the Deutsch word illusion were correlated with the normal personality traits. Whether the phenomenon would be more pronounced in patients with personality disorders, especially the cluster A types remains unknown. We therefore invited 11 patients with paranoid, 34 schizoid, and 13 schizotypal personality disorders, and 116 healthy volunteers, to report the Chinese words when they were listening to the Deutsch "High-Low" and "Harvey" word illusions. The paranoid and schizoid personality disorder patients reported more meaningful Chinese words than the healthy volunteers did when they were listening to the "Harvey" word illusion, and more meaningful Chinese words which were corresponding to the DSM-5 pathological personality traits than the healthy volunteers did. The study had demonstrated that when interpreting the illusion stimuli, patients with cluster A personality disorders would mobilize more cognitive processes relating to their personality-specific traits.

Keywords: Meaningful Chinese words; Cluster A personality disorder; Deutsch word illusions

Introduction

Patients with schizophrenia often display hallucination and semantic deficits, and their positive symptoms of delusion and speech disorganization often reveal the activation of inappropriate semantic representations [1]. The verbal content of hallucination and the delusion in schizophrenia generally produce social or express personal or emotionally charged meanings [2]. Therefore one might speculate that, when these patients listen to the ambiguous sounds such as the auditory illusion, they might report hearing words which reflect their inappropriate semantic representation.

The auditory illusion occurs in both the healthy people and the psychiatric patients [3,4]. The auditory system does not faithfully transmit the sound information as it arrives at our ears, but alters and reorganizes this information in various ways, so we sometimes experience an auditory illusion when the sounds we perceive do not correspond to those that were actually presented [5]. The subjective experience is sometimes dissociated from a physical input, such as in verbal transformations where the subjective changes of percepts are continually caused by listening to a repeating word without pause. Therefore, the auditory illusions provide us with clues to examine how auditory percepts are formed in the brain [6]. For example, when the Japanese people listened to a 90-sec session of 265 repetition of the word "banana" spoken by a female native Japanese speaker, they reported words they heard as "nan-pa", "nan-do", "nappa" and some other nonsense words [6].

Another illusion reported by Deutsch [7] is the auditory octave illusion. Through earphones, people hear two tones spaced an octave apart that are repeatedly presented to both ears in alternation without pause. When the right ear receives the high tone, the left ear receives the low tone, and vice versa. However, most people experience exactly the same phenomenon - the tone that had appeared in the right ear still appears in the right ear, and the tone that had appeared in the left ear still appears in the left ear, regardless of earphone reverses or total duration of time. Later, Deutsch improved this pattern into a "High-Low" word illusion [8] and a phantom word presentation – the "Harvey" word illusion [9]. The "High-Low" word illusion adopts natural sounds of the word "high" and "low" pronounced by a woman instead of the high and low tones respectively; and for phantom words, either two words or a single word composed of two syllables are repeated over and over again, while these two words or syllables substituted two tones in octave illusion. Interestingly, when listening to the "High-Low" word illusion through the stereo loudspeakers, the English-speaking people have reported hearing English words such as the "buy loan", "long time", "no, no" and "boatman" [8], the Chinese-speaking people on the other hand, have reported hearing Chinese words such as "开端 (beginning)", "看一看 (have a look)", "买 (buy)", and "快点 (hurry up, at once)", and some words correspond to the personality traits of the individual under test [10]. When listening to one of the phantom word "Harvey", the English-speaking people have reported hearing the word and phrases such as "coffee", "popcorn", "think big", "honeycomb" and "convict" [9]. It is unclear what would the Chinese people report when hearing from the phantom word "Harvey", or whether the reported word will be related to the normal or pathological personality traits of the individual.

There are some trials of the auditory illusion tests in the psychiatric patients. For example, the dichotic listening test has shown that the reduced language lateralization is a strong trait marker for the experience of auditory hallucinations in schizophrenia [11,12]. In addition, in schizophrenia, there is a pervasive impairment in the binaural temporal processes extending to the creation of auditory objects which has functional consequences in terms of the use of these

cues to extract information in the complex auditory environments [13]. Moreover, extracting spurious message from meaningless input by the schizophrenic patients at risk has extended beyond the speech processing *per se* [14]. Hoffman et al. [14] also applied a multi-speaker babble task in people with prodromal symptoms of schizophrenia-spectrum disorders, where the stimulus derived from the overlapping recordings of six speakers (three women, three men) reading neutral texts, and participants were instructed to repeat any words or phrases that they "heard" while listening to the babble. They found that the elevated length of speech illusion scores was constituted by the longest phrase generated (counted as the number of words), which might have been caused by excessive top-down processing of phonetic inputs, distorted perceptual processing or misinterpretation of percepts. Some other studies have found that auditory verbal hallucinations are linked with the functional abnormalities of the auditory- or language-related areas [15], and the auditory spatial perception impairment is consistent with the difficulty in utilizing binaural cues during auditory spatial perception in schizophrenia [16].

On the other hand, the paranoid, schizoid and schizotypal personality disorders, classified together as the cluster A personality disorders, are within a continuum of schizotypy, which is ranging from the relative psychological health to the full-blown schizophrenia: the schizoid symptoms are associated with the negative schizotypy [17-19], whereas the paranoid and schizotypal symptoms are associated with positive schizotypy [18] or with both positive and negative schizotypies [17,19]. Furthermore, the event-related potential results suggested that individuals with schizotypy were associated with the decreased use of context to activate related items and inhibit unrelated items in a semantic processing task [20,21]. This semantic processing deficit in individuals with schizotypy has seemingly resulted from the enhanced automatic processing which might be due to both increased spreading activation within the semantic network and the illogical storage of semantic information [22].

Thus, a question arises whether patients with cluster A personality disorders would report some meaningful words which are related to their disordered (or pathological) personality traits when listening to an auditory illusion. Considering that the healthy people often report hearing words, in their own native language, which are related to what is in their minds, rather than real ones when listening to the Deutsch phantom words [9], and that the healthy people often report hearing words which correspond to their normal personality traits when listening to the Deutsch "High-Low" word illusion [10], we could speculate that the patients with Cluster A personality disorders would report hearing words that corresponded to their disordered personality traits when listening to the "High-Low" or the "Harvey" word illusion. On the other aspect, a schizophrenia patient might construct meaningless words (neologisms) if he is unable to delimit conceptual boundaries among words with different meanings [23], and this phenomenon might contribute to patients with Cluster A personality disorders. Therefore, we would only focus on the meaningful words reported by these patients as well as by the healthy volunteers.

Methods

Participants

In the current study, we have recruited 116 healthy volunteers (52 women, aged from 18-49 years, mean age 22.91 years with 5.46 S.D.), 11 patients with paranoid personality disorder (6 women, aged from 18-32, mean 23.45 ± 5.65), 34 schizoid personality disorder (15 women, aged from 18-45, mean 24.09 ± 5.93) and 13 schizotypal personality disorder (5 women, aged from 18-44, mean 26.15 ± 8.35). The educational levels of the participants were noted as 1 - 7, indicating the primary school, junior middle school, secondary middle school, junior college, bachelor, master, and doctoral degrees respectively. Their hunger levels at test time were also noted using a visual analogue scale with no hunger coded as 0 and the maximal hunger as 10. None of these participants had an experience of the professional musical-training. All participants have been born and grown up in China, and speak Chinese as their mother language. The study design was approved by a local Ethics Committee, and all participants had given their written informed consents to be included in the current study.

The Deutsch word illusions

The Deutsch "High-Low" illusion was taken from the Compact Disc of Musical Illusions and Paradoxes [8], and the Deutsch phantom word "Harvey" from the Compact Disc of Phantom Words, and Other Curiosities [9]. The former was consisted of repeated alternated two words, "high" and "low", while the later was repeated a disyllabic word "Harvey", pronounced by a woman, in the same way as the high and low tones of octave illusion [7]. The presentation of "High-Low" illusion lasted 1 minutes and 59 seconds, while the phantom word lasted 2 minutes and 2 seconds, with 1 sec interval between the two illusion presentations. After participants sat with a relaxed posture in a sound-proof room for 20 min, they listened to the "High-Low" or the phantom word "Harvey" illusions through two stereo loudspeakers (MUVGD and CR6504, Shenzhen MUVGD Electronics Co. Ltd, China) 1.5 m apart in front of the participant's chair. The two loudspeakers and the participant formed a right triangle 1.5 m on a side. The participant sat comfortably on the chair and the sound level was adjusted to a comfortable level according to the participant's feed-back.

Participants noted down all Chinese words they heard, and later these words were scrutinized by six judges (1 PhD holder, 3 PhD and 2 Master's degree candidates) to be labeled as meaningful or not. Each word was voted on by five judges independently and labeled as meaningful if it received more than three "yes" votes. If a word received three "yes" and two "no" votes, the sixth judge (the PhD holder) made the final decision. The reference tools were The Contemporary Chinese Dictionary - Extended Edition (Beijing, The Commercial Press, 2002) and A Chinese-English Dictionary, Revised Edition (Beijing, Foreign Language Teaching and Research Press, 1995).

Then another ten judges (nine majored in Medicine and one majored in Chinese Language and Literature) decided whether the meaningful words selected by the former six judges could represent the disordered (or pathological) personality traits according to the criteria in the Section III of the Diagnostic and Statistical Manual of Mental Disorders, version 5 (DSM-5) [24]. Five pathological personality traits, i.e. Negative affectivity, Detachment, Antagonism, Disinhibition and Psychoticism, and 25 pathological personality trait facets were used. A word which received five "yes" votes on a pathological personality trait domain/facet was designated as the representative of the corresponding trait.

Data analyses and statistics

Only meaningful Chinese words that participants reported when listening to the Deutsch "High-Low" or "Harvey" word illusion were counted. A Kruskal-Wallis test was applied to compare the numbers of reported meaningful Chinese words and the numbers of personality trait-related words in four groups (the healthy controls, and paranoid, schizoid and schizotypal personality disorders). The scorer-reliabilities among the ten judges were calculated using the Cochran chi-square test. Once a significantly difference was found, a Mann-Whitney test was applied to compare the further difference between each personality disorder group and the control group. The statistic power of the present study was 88.39% based on the mean sample size of patient groups at an alpha level of 0.05.

Results

There were no age, gender, education or hunger level differences among the four groups. For the "High-Low" word illusion, the nonparametric test detected no differences on the numbers of words reported in the four groups. By contrast, for the phantom word-the "Harvey" word illusion, the nonparametric test detected that the numbers of words reported were higher in the schizoid (p=0.012) and paranoid (p=0.000) groups than that in the controls. The number of words reported in the schizoid group was similar to that in the controls (Table 1).

Illusion	Group	Min	Lower quartile	Median	Upper quartile	Max	Mean (S.E.M)
Numbers of total meaningful Chinese words							
High-Low	Controls	0	0	1	2	6	1.37 (0.13)
	Paranoid	0	1	1	2	5	1.64 (0.43)
	Schizoid	0	1	2	3	5	1.82 (0.24)
	Schizotypal	0	0	1	2	4	1.31 (0.35)
Harvey	Controls	0	0	0	0	4	0.39 (0.08)
	Paranoid	0	0	1	1	3	0.82 (0.26)*
	Schizoid	0	0	1	1	5	0.97 (0.21)*
	Schizotypal	0	0	0	1	2	0.54 (0.18)
Pathological personality trait-related words							
High-Low	Control	0	0	0	1	2	0.39 (0.06)
	Paranoid	0	0	0	1	2	0.36 (0.20)
	Schizoid	0	0	0	1	3	0.32 (0.11)
	Schizotypal	0	0	0	0.5	1	0.23 (0.12)
Harvey	Controls	0	0	0	0	1	0.02 (0.01)
	Paranoid	0	0	0	0	1	0.18 (0.12)*
	Schizoid	0	0	0	0	1	0.12 (0.06)*
	Schizotypal	0	0	0	0	0	0.00 (0.00)

Table 1: Medians, quartiles and mean (S.E.M) of the numbers of meaningful Chinese words and the pathological personality trait-related words reported when listening to the word illusions ("High-Low" and "Harvey") in the four groups of participant. Note: *p<0.05 vs. Control.

Among the 203 meaningful Chinese words noted down, 38 were considered to represent the pathological personality traits. There were high consensuses among the ten judges when labeling the 38 words regarding their personality correlates (the Cochran Qs were 0.22 to 13.13, all ps>0.05). For the "High-Low" word illusion, the four groups reported similar numbers of personality-related words. For the "Harvey" illusion, the paranoid (p=0.003) and schizoid (p=0.009) groups reported higher numbers of personality-related words than the controls did, while the schizotypal group and the controls reported similarly.

When scrutinizing the individual data, the meaningful Chinese words reported were also different referring to the personality trait-related domain or facet among the four groups (Tables 2 and 3). For example, a patient with paranoid personality disorder had reported hearing a word "变态 (psychologically perverted)" which was related to the DSM-5 the pathological trait Psychoticism (domain) and Eccentricity (facet), and a word "棺材 (coffin)" which was related to the Negative Affectivity (domain) when one was listening to "High-Low" illusion; the patient had reported hearing a word "诽 (slander)", which represented the Antagonism (domain), Hostility (facet) and Suspiciousness (facet) when one was listening to the "Harvey" illusion. One patient with schizoid personality disorder had reported hearing a word "叫你碰 (How dare you to touch)" which was related to the

Antagonism and Hostility when one was listening to "High-Low" illusion; while one had reported hearing a word "赔钞 (lose money)" which related to the Negative Affectivity when one was listening to "Harvey" illusion. Another patient with schizoid personality disorder had reported a word "笨蛋 (idiot)" which represented the Negative Affectivity and Antagonism, a word "我该 (I should do)" and a word "我改 (I should change)" which represented the Negative Affectivity when he was listening to the "High-Low" illusion.

Chinese word	English translation	Personality trait-specific (DSM-5)	Group	Frequency
笨蛋, n.	Idiot	Negative Affectivity, Antagonism; Hostility	Schizoid	1
变态, adj.	Psychologically perverted	Psychoticism; Eccentricity	Paranoid	1
断, v.	Break	Negative Affectivity	Controls	1
赶快, adv.	Hurry up	Anxiousness	Controls	1
棺材, n.	Coffin	Negative Affectivity	Paranoid	1
滚开, v.	Get out	Hostility	Controls	3
叫你碰, interj.	How dare you to touch	Antagonism; Hostility	Schizoid	1
快点过来, v..	Come on quickly	Negative Affectivity, Antagonism; Anxiousness, Manipulativeness	Controls	1
快一点, adv.	Hurry up	Negative Affectivity; Anxiousness	Schizoid	1
累赘, n.	Burdensome	Depressivity	Controls	1
冷淡, adj.	Affectively cold	Negative Affectivity; Intimacy avoidance	Controls	2
			Schizoid	1
冷饭, n.	Cold meal	Negative Affectivity; Depressivity	Controls	2
			Schizotypal	2
冷汗, n.	Cold sweat	Negative Affectivity; Anxiousness	Controls	4
			Schizoid	2
冷战, n.	Cold war	Negative Affectivity, Antagonism; Hostility	Controls	11
垄断, n.	Monopoly	Antagonism; Manipulativeness	Controls	4
			Paranoid	1
			Schizoid	3
乱猜, v.	Random guess	Suspiciousness	Controls	1
乱动, v.	Fiddle with	Disinhibition	Controls	1
乱了, n.	Mess	Negative Affectivity; Anxiousness	Controls	1
扰乱, v.	Disturb	Negative Affectivity; Hostility	Controls	1
忍, v.	Tolerate	Negative Affectivity; Depressivity	Controls	1
太渴, adv.	Very thirsty	Negative Affectivity; Anxiousness	Controls	1
太累, adv.	Overtired	Negative Affectivity; Depressivity	Controls	2
太乱, adv.	Too messy	Anxiousness	Controls	2
太热, adv.	Too hot	Negative Affectivity; Anxiousness	Controls	1
我该, v.	I should do	Negative Affectivity	Schizoid	1
我改, v.	I should change	Negative Affectivity	Schizoid	1
战, v.	Fight	Hostility	Controls	1

战争, n.	War	Negative Affectivity; Hostility	Controls	1
站一边, v.	Stand aside	Hostility, Withdrawal, Manipulativeness	Controls	1
罪过, n.	Sin	Negative Affectivity; Depressivity	Paranoid	1
			Schizotypal	1

Table 2: The pathological personality trait-specific Chinese words and their English translations reported by the four groups of participants when listening to the Deutsch "High-Low" word illusion.

Chinese word	English translation	Personality trait-specific (DSM-5)	Group	Frequency
备考, v.	Prepare for exams	Negative Affectivity; Anxiousness	Controls	1
变胖, v.	Getting fat	Negative Affectivity	Schizoid	1
抄袭, v.	Plagiarize	Antagonism; Deceitfulness	Schizoid	1
肥, adj.	Fat	Negative Affectivity	Schizoid	1
诽, v.	Slander	Antagonism; Hostility, Suspiciousness	Paranoid	1
亢奋, adj.	Excited	Disinhibition; Impulsivity, Risk taking	Controls	1
赔钞, v.	Lose money	Negative Affectivity	Schizoid	1
伪钞, n.	Counterfeit bank note	Deceitfulness	Paranoid	1

Table 3: The pathological personality trait-specific Chinese words and their English translations reported by the four groups of participants when listening to the Deutsch "Harvey" word illusion.

One patient with paranoid and another patient with schizoid personality disorder had reported hearing both words "抄袭 (plagiarize)" and "伪钞 (counterfeit bank note)" which represented the Deceitfulness (facet) when they were listening to the "Harvey" illusion.

Discussion

When listening to the Deutsch word illusions, the paranoid and schizoid patients reported more meaningful Chinese words and more pathological personality traits-related words, which confirmed one of our hypotheses. The patients with paranoid personality disorder often show the abnormal perception of stimuli [25], and this predisposition for hallucinatory experiences increases the probability of possessing the paranoid ideation [26]. An event-related cerebral potential study also showed that paranoid patients had a faster automatic detection of the tones and their change [27]. Our results were also consistent with the clinical description that patients with paranoid personality disorder might read the hidden demeaning or threatening "significance" from the benign remarks or events [24].

As we have hypothesized, the schizoid personality disorder patients had reported more meaningful Chinese words when they were listening to the illusions. In clinics, these patients often show the emotional coldness, detachment, or flattened affect, and hold a restricted range of expression of emotions in different interpersonal settings [24]. Their social isolation is associated with the hypervigilance for social threats which produces the attentional, confirmatory and memorial biases [28]. Another event-related potential study also provided an evidence of a higher vigilance or cortical arousal level in the schizoid patients, which led them to over-interpret the external (social) stimuli [29].

There were some words such as the "冷战 (cold war)" and "垄断 (monopoly)" reported by both the healthy volunteers and the personality disorder patients when they were listening to the "High-Low" word illusion. There were however, some patients, especially the paranoid and schizoid individuals, that had reported more words which were related to the personality trait-specific, the Antagonism/Hostility domain. In clinics, the paranoia as one of the key features of the paranoid personality disorder, was associated with perception of hostility for the ambiguous situation [30]. It is understandable that our patients with paranoid personality disorder had reported the Antagonism-related words such as the "诽 (slander)" or "伪钞 (counterfeit bank note)" when they were listening to the phantom word "Harvey". The former word is highly correlated to the suspiciousness and the later one deceitfulness. Interestingly, our results in paranoid patients were consistent with the relationship between Aggression-Hostility trait and the paranoid personality disorder functional style reported previously [31]. Take another example, patients with schizoid personality disorder had reported words such as the "笨蛋 (idiot)" and the "叫你碰 (How dare you to touch)" when they were listening to the "Harvey" and "High-Low" illusions respectively. These results again were in line with the clinical description of the emotional coldness, detachment, or the difficult interpersonal relationships of the schizoid personality disorder [24].

Limitations of the Study

One should also notice that there were some limitations in the current study design. Firstly, the sample sizes of the paranoid and schizotypal personality disorder groups were small, whether the mean numbers of the meaningful words reported would increase with the sample size remains unknown. Secondly, we did not count the

meaningless words reported, especially those reported by patients, which might also be related to the schizophrenia-like features. Thirdly, we only enrolled patients with cluster A personality disorders, including other groups of personality disorder or schizophrenia would be nice controls.

Conclusion

Nevertheless, we have found that patients with cluster A personality disorders reported more meaningful Chinese words when they were listening to the Deutsch word illusions, and some words were personality trait-specific. Our finding therefore might help to understand the personality-related cognitions in these patients, and provide more supports for the cognitive therapy applied in these disorders. Clinicians or researchers might also trial these Deutsch word illusions in the neuropsychiatric patients with auditory illusions or hallucinations, for a clearer picture of the clinical manifestation or pathophysiology of these disorders.

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Authors' Declarations

Regarding research work described in the paper, each one of our co-authors, You Xu, Hongying Fan, Qianqian Gao, Hongjing Mao, Yonghua Zhang, Wanzhen Chen, and Wei Wang, declares that there is no conflict of interest, and have conformed to the Helsinki Declaration concerning human rights and informed consent, and have followed correct procedures concerning treatment of humans in research.

References

1. Debruille JB, Rodier M, Prévost M, Lionnet C, Molavi S (2013) Effects of a small dose of olanzapine on healthy subjects according to their schizotypy: An ERP study using a semantic categorization and an oddball task. European Neuropsychopharmacology 23: 339-350.
2. Hoffman RE (2007) A social deafferentation hypothesis for induction of active schizophrenia. Schizophrenia Bulletin 33: 1066-1070.
3. Bentall RP (1990) The illusion of reality: a review and integration of psychological research on hallucinations. Psychological Bulletin 107: 82-95.
4. Schacter DL (1996) Illusory memories: a cognitive neuroscience analysis. Proceedings of the National Academy of Sciences USA 93: 13527-13533.
5. Deutsch D (2009) Auditory Illusion. In: E. Bruce Goldstein (Ed) Encyclopedia of Perception, Volume 1:160-164.
6. Kondo H, Kashino M (2007) Neural mechanisms of auditory awareness underlying verbal transformations. NeuroImage 36: 123-130.
7. Deutsch D (1974) An auditory illusion. Nature 251: 307-309.
8. Deutsch D (1995) Musical illusion and paradoxes (Compact Disc). La Jolla: Philomel Records.
9. Deutsch D (2003) Phantom words and other curiosities."(Compact Disc). La Jolla: Philomel Records.
10. Xu Y, Zhu J, Chen W, Chai H, He W, et al. (2012) Personality correlates of reporting Chinese words from the Deutsch "high-low" word illusion by Chinese-speaking people. Neuroscience Bulletin 28: 240-246.
11. Hugdahl K, Løberg EM, Falkenberg LE, Johnsen E, Kompus K, et al. (2012)Auditory verbal hallucination in schizophrenia as aberrant lateralized speech perception: evidence from dichotic listening. Schizophrenia Research 140: 59-64.
12. Ocklenburg S, Westerhausen R, Hirnstein M, Hugdahl K (2013) Auditory hallucinations and reduced language lateralization in schizophrenia: a meta-analysis of dichotic listening studies. Journal of the International Neuropsychological Society 19: 410-418.
13. Matthews N, Todd J, Mannion DJ, Finniqan S, Catts S, et al. (2013) Impaired processing of binaural temporal cues to auditory scene analysis in schizophrenia. Schizophrenia Research 146: 344-348.
14. Hoffman RE, Woods SW, Hawkins KA, Pittman B, Tohen M, et al. (2007) Extracting spurious messages from noise and risk of schizophrenia-spectrum disorders in a prodromal population. British Journal of Psychiatry 191: 355-356.
15. Zhang Z, Shi J, Yuan Y, Hao G, Yao Z, et al. (2008) Relationship of auditory verbal hallucinations with cerebral asymmetry in patients with schizophrenia: An event-related fMRI study. Journal of Psychiatric Research 42: 477-486.
16. Hunter M, Linington H, Mitchell J, Thakur Y, Mir N, et al. (2008) Evidence for impaired auditory spatial perception in people with schizophrenia and auditory hallucinations. Schizophrenia Research 98(suppl): 178.
17. Kwapil TR, Barrantes-Vidal N, Silvia PJ (2008) The dimensional structure of the Wisconsin Schizotypy Scales: Factor identification and construct validity. Schizophrenia Bulletin 34: 444-457.
18. Barrantes-Vidal N, Gross GM, Sheinbaum T, Mitjavila M, Ballespí S, et al. (2013) Positive and negative schizotypy are associated with prodromal and schizophrenia-spectrum symptoms. Schizophrenia Research 145: 50-55.
19. Kwapil TR, Gross GM, Silvia PJ, Barrantes-Vidal N (2013) Prediction of psychopathology and functional impairment by positive and negative schizotypy in the Chapman's ten-year longitudinal study. Journal of Abnormal Psychology 122: 807-815.
20. Kiang M, Kutas M (2005) Association of schizotypy with semantic processing differences: An event-related brain potential study. Schizophrenia Research 77: 329-342.
21. Wang K, Wang Y, Yan C, Wang YN, Cheung EF, et al. (2013) Sematic processing impairment in individuals with schizotypal personality disorder features: A preliminary event-related potential study. Progress in Neuro-Psychopharmacology & Biological Psychiatry 40: 93-102.
22. Johnston AE, Rossell SL, Gleeson JF (2008) Evidence of semantic processing abnormalities in schizotypy using an indirect semantic priming task. The Journal of Nervous and Mental Disease 196: 694-701.
23. Mitterauer BJ (2011) Possible role of glia in cognitive impairment in schizophrenia. CNS Neuroscience & Therapeutics 17: 333-344.
24. American Psychiatric Association. Diagnostic and statistical manual of mental disorder (5th edition) (DSM-5). American Psychiatric Association, Washington DC, 2013.
25. Freeman D, Gittins M, Pugh K, Antley A, Slater M, et al. (2008) What makes one person paranoid and another person anxious? The differential prediction of social anxiety and persecutory ideation in an experimental situation. Psychological Medicine 38: 1121-1132.
26. Lopes B, Pinto-Gouveia J (2013) The Role of Predisposition to Hallucinations on Non-Clinical Paranoid vs. Socially Anxious Individuals after Hearing Negative Affective-Laden Sounds: An Experimental Investigation. Behavioural and Cognitive Psychotherapy 41: 221-237.
27. Liu Y, Shen X, Zhu Y, Xu Y, Cai W, et al. (2007) Mismatch negativity in paranoid, schizotypal, and antisocial personality disorders. Neurophysiologie Clinique 37: 89-96.
28. Cacioppo JT, Hawkley LC (2009) Perceived social isolation and cognition. Trends in Cognitive Sciences 13: 447-454.
29. Shen Y, Zhu M, Wang D, Hao C, Ma J, et al. (2008) Passive event-related potentials by a single tone in personality disorders. Social Behavior and Personality 36: 985-998.
30. Combs DR, Penn DL, Michael CO, Basso MR, Wiedeman R, et al. (2009) Perceptions of hostility by persons with and without persecutory delusions. Cognitive Neuropsychiatry 14: 30-52.

31. Huang J, He W, Chen W, Yu W, Chen W, et al. (2011) The Zuckerman-Kuhlman Personality Questionnaire predicts functioning styles of personality disorder: A trial in health subjects and personality-disorder patients. Psychiatry Research 186: 320-325.