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## Experiential pleasure deficits in different stages of schizophrenia



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### ABSTRACT

Prior research has found dampened anticipatory pleasure but relatively intact consummatory pleasure in people with first-episode and more chronic schizophrenia, but no study has examined anticipatory and consummatory pleasure across the schizophrenia spectrum. To confirm the factor structure of the Chinese version of the Temporal Experience Pleasure Scale (TEPS), which measures four components of anhedonia, we recruited 364 people with schizophrenia for confirmatory factor analysis. To examine anhedonia in people across the schizophrenia spectrum, we recruited people with first-episode ( $n = 76$ ) and chronic schizophrenia ( $n = 45$ ), people with schizotypal traits ( $n = 210$ ), first-degree relatives ( $n = 45$ ) of people with schizophrenia and healthy controls. Deficit in abstract anticipatory pleasure appeared to be most severe in people with chronic schizophrenia, while dampened abstract consummatory pleasure was observed in people with schizotypal personality features and in people with chronic schizophrenia. In addition, both abstract anticipatory and abstract consummatory pleasure were negatively correlated with negative schizotypal personality features and schizophrenia symptoms. Our results suggest that deficits in anticipatory pleasure are present across the schizophrenia spectrum, particularly in the abstract domain.

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### 1. Introduction

Anhedonia refers to the diminished capacity to experience pleasure and it is a feature of schizophrenia that is associated with poor prognosis. Empirical findings suggest that anhedonia can be divided into anticipatory pleasure and consummatory pleasure underpinned by two distinct neural mechanisms (Berridge, 2003, 2007; Kring and Barch, 2014). To capture these components of anhedonia, Gard and colleagues developed the Temporal Experience Pleasure Scale (TEPS), which has been used to investigate anhedonia in people with schizophrenia and schizophrenia spectrum disorders (Gard et al., 2006). People with schizophrenia have been found to have impaired anticipatory, but relatively intact consummatory pleasure experience. As listed in Table 1, six studies have reported impaired anticipatory but intact consummatory pleasure experience in people with recent onset and chronic schizophrenia (but see Strauss et al., 2011), while in high risk groups, four

studies have reported both dampened anticipatory and consummatory pleasure experience (Gooding and Pflum, 2012; Martin et al., 2011; Schlosser et al., 2014; Shi et al., 2012).

Chan et al. (2012) reported a more culturally appropriate four-factor structure of the TEPS among people without schizophrenia in China. Although the comparable affective representation system across diverse populations is essential (Kring et al., 2003), no study to date has examined the four-factor structure of the TEPS in people with schizophrenia. To the best of our knowledge, no study has examined anhedonia across the spectrum of schizophrenia, i.e., people with schizotypal personality features, people with first-episode and chronic schizophrenia as well as their non-psychotic first-degree relatives. The recent proposal of the Research Domain Criteria (RDoC) suggests that core features such as anhedonia might be more appropriate domains for research than schizophrenia symptomatology (Cuthbert, 2014; Cuthbert and Insel, 2010). According to the neurodevelopmental hypothesis, subgroups in the schizophrenia spectrum are conceptualized as progressive stages in which some traits like anhedonia may deteriorate with time (Insel, 2010; Wood et al., 2011). Paralleled with cardiovascular disease or diabetes, which can be conceptualized into different stages, the staging

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**Table 1**  
TEPS studies in schizophrenia-spectrum since 2006.

Authors	Year	Participants	Anticipatory pleasure	Consummatory pleasure	Age match
Gard et al.	2007	SZ(51) vs. HC(50)	SZ < HC	n.s.	Yes
Favrod et al.	2009	SZ(21) vs. HC(82)	SZ < HC	n.s.	Yes
Wynn et al.	2010	SZ(34) vs. HC(36)	SZ < HC	n.s.	No
Chan et al.	2010	NSPZ(34) vs. NNSZ(21)	NSZ < NNSZ	n.s.	Yes
Mote et al.	2014	RO(88) vs. HC(66)	RO < HC	n.s.	No
Lui et al.	2014	RO(27) vs. HC(26)	RO < HC	n.s.	Yes
Martin et al.	2011	SocAhn(54) vs. PerMag(27) vs. HC(304)	SocAhn < HC	SocAhn < HC	Yes
Gooding et al.	2012	SocAhn(68) vs. PerMag(88) vs. HC(79)	SocAhn < HC	SocAhn < HC	Yes
Shi et al.	2012	NSPD(55) vs. PSPD(62) vs. HC(116)	NSPD < HC; PSPD > HC	PSPD > HC	Yes
Schlosser et al.	2014	HR(60) vs. RO(60) vs. CSP(78) vs. HC(29)	CHR < RO&CSP&HC	CHR < RO&CSP&HC	No
Strauss et al.	2011	SZ(86) vs. HC(59)	n.s.	SP < HC	Yes
Cassidy et al.	2012	PP(91) vs. HC(91)	n.s.	n.s.	Yes
Chan et al.	2012	SPD(92) vs. NSPD(85)	n.s.	n.s.	Yes

Note: SZ = Schizophrenia, HC = Healthy controls, NSZ = Schizophrenia with negative symptoms, NNSP = Schizophrenia with no negative symptoms, RO = Recent-onset schizophrenia, NSPD = People with negative schizotypal personality features, SocAhn = People with social anhedonia, PerMag = People with perceptual aberration/magical ideation, PSPD = People with positive schizotypal personality features, CHR = Clinic high risk group for schizophrenia, PP = Psychosis patient.

viewpoint strengthens the temporal association between “stages” of the schizophrenia spectrum, from high-risk to prodromal, to first-episode and chronic schizophrenia.

Investigating features of anhedonia in each stage of the schizophrenia spectrum may illuminate where in the course of the illness different hedonic deficits emerge and thus suggest points of intervention. [Bedwell et al. \(2014\)](#) argued that anhedonia is a dimensional transdiagnostic symptom. Their findings showed that anhedonia was present across different diagnoses and did not differ depending on a history of psychosis, which is consistent with the growing number of reports of increased levels of subjective experiential anhedonia such as the TEPS in individuals with schizophrenia and other related disorders with anhedonia.

We had two aims in the present study. First, we sought to confirm the four-factor structure of the TEPS in a large sample of people with schizophrenia in China. Second, we examined anticipatory and consummatory pleasure deficits across the schizophrenia spectrum. We hypothesized that the four-factor structure of the TEPS would characterize the phenomenon of anhedonia in people with schizophrenia in China as it did in healthy Chinese people ([Chan et al., 2012](#)). Moreover, we hypothesized that deficit in anticipatory pleasure would be robust across the different stages of schizophrenia. Finally, we hypothesized that both anticipatory and consummatory pleasure would be related to negative symptoms in people with schizophrenia and negative symptoms-like behavior in people with schizotypal traits.

## 2. Method

### 2.1. Participants

Four samples were recruited in the present study. Sample A consisted of 364 people with chronic schizophrenia in which 196 were registered in a local community hospital in the Haidian District in Beijing, and 168 were inpatients recruited from Beijing Anding Hospital and Huilongguang Hospital. Sample A was used for confirmatory factor analysis. In addition, 114 healthy volunteers matched in age and gender with the inpatients were also recruited from the Haidian District of Beijing as a healthy comparison group for Sample A. Sample B comprised 75 people with first-episode schizophrenia recruited from Castle Peak Hospital in Hong Kong. The duration of illness of the people in Sample B was less than six months to minimize the possible confounding effects of chronicity and medication exposure. An additional 78 healthy volunteers were recruited from the local community and were matched with the people with first-episode schizophrenia in Sample B.

Sample C consisted of 103 healthy volunteers and 210 people with schizotypal traits recruited from a large undergraduate sample ( $n = 1979$ ) in Beijing. Participants who scored greater than 38 on the Schizotypal Personality Questionnaire (SPQ) ([Raine, 1991](#)) were classified

as having schizotypal personality disorders (SPD) traits while those who scored lower than 10 were classified as healthy controls. Furthermore, the SPD group were subdivided into a positive-SPD group ( $n = 105$ ) and a negative-SPD group ( $n = 105$ ), based on cluster analysis of the cognitive-perceptual, interpersonal, and disorganized subscales of the SPQ.

Finally, 45 first-degree relatives of people with schizophrenia, 45 people with chronic schizophrenia from Beijing Anding Hospital and Huilongguang Hospital and 45 healthy volunteers from the Haidian District of Beijing were recruited for Sample D. The demographics of the three groups in Sample D were matched.

People with a history of head injury, coma, and drug or alcohol abuse, were not recruited for the study. The undergraduates in Sample C and healthy volunteers in all samples had no family history of mental disorder. Written informed consent was obtained from each participant before the administration of the battery of questionnaires. The study was approved by the ethics committees of the Institute of Psychology, the Chinese Academy of Science, Beijing Anding Hospital, Huilongguang Hospital and Castle Peak Hospital.

### 2.2. Measures

#### 2.2.1. The Temporal Experience of Pleasure Scale (TEPS)

This self-report scale consists of 18 items on a six-point Likert scale ranging from (1) ‘very false for me’ to (6) ‘very true for me’. Ten items measure anticipatory pleasure while eight items measure consummatory pleasure ([Gard et al., 2006](#)). The Chinese version of the TEPS used in this study was modified with the deletion of two items and the addition of four items, resulting in a total of 20 items ([Chan et al., 2012](#)). In a large undergraduate sample from China ([Chan et al., 2012](#)), the 20-item TEPS yielded a four-factor framework: “abstract anticipatory pleasure”, “concrete anticipatory pleasure”, “abstract consummatory pleasure” and “concrete consummatory pleasure”. The abstract items refer to stating something abstract or conceptual such like “Looking forward to a pleasurable experience is in itself pleasurable”, while the concrete items refer to concrete events such like “I get so excited the night before a major holiday I can hardly sleep”. The Chinese version of the TEPS has been shown to have good reliability and validity ([Chan et al., 2012](#)). All participants completed the TEPS.

#### 2.2.2. The Schizotypal Personality Questionnaire (SPQ)

This widely used self-report questionnaire contains 74 true-false items which capture nine schizotypal personality features in the DSM-III-R ([Raine, 1991](#)). The nine traits were further clustered into the cognitive-perceptual, the interpersonal and the disorganized subscales which measure positive, negative and disorganized features respectively. The Chinese version of the SPQ has been shown to have good

reliability and validity (Chen et al., 1997). Participants in Sample C completed the SPQ.

2.2.3. The Positive and Negative Syndrome Scale (PANSS)

This standardized clinical scale with 30 items captures positive and negative symptoms, as well as general psychopathology of schizophrenia (Kay et al., 1987). Trained psychiatrists administered the PANSS to people with chronic schizophrenia in Sample A.

2.3. Statistical analysis

Confirmatory factor analysis (CFA) was conducted using LISREL 8.7 to identify the fit of the four-factor frameworks of the TEPS in Sample A. Mean scores of each the four-factor structure subscales (abstract anticipatory, concrete anticipatory, abstract consummatory, concrete consummatory) were analyzed. We computed four mixed effect ANOVAs with group as a between-subject factor and the four subscales of the TEPS as within-subject factors for each sample.

We computed correlations between the PANSS and four TEPS subscales for the 168 inpatients from Sample A. We also computed correlations between medication dosage, illness duration and scores on the TEPS in people with first-episode and chronic schizophrenia. Due to missing data in medication prescription and duration of illness in Sample A, only 292 people with chronic schizophrenia were included in the correlational analyses.

3. Results

3.1. Demographics

The demographics of each group in each sample are shown in Table 2. There were no demographic differences between samples with one exception: the ratio of men in the healthy control group was significantly higher than people with negative-SPD and positive-SPD.

3.2. Confirmatory factor analysis

Consistent with findings from healthy people in China (Chan et al., 2012), the four-factor model ( $\chi^2(d.f.) = 527.03(146)$ ,  $p < 0.001$ , GFI/CFI = 0.87/0.94, RMSER = 0.083,  $P < 0.001$ ) provided a good fit for the data.

3.3. Comparison between people with chronic schizophrenia and healthy controls

The  $2 \times 4$  mixed effect ANOVA yielded significant main effects for group ( $F(1,280) = 6.43$ ,  $p = 0.012$ ,  $\eta^2 = 0.02$ ) and subscale ( $F(3,840) = 227.03$ ,  $p < 0.001$ ,  $\eta^2 = 0.448$ ), and their interaction ( $F(3,840) = 4.06$ ,  $p = 0.007$ ,  $\eta^2 = 0.014$ ). People with chronic schizophrenia reported lower abstract anticipatory pleasure ( $p = 0.001$ , Cohen's  $d = 0.42$ ) and lower abstract consummatory pleasure ( $p = 0.005$ , Cohen's  $d = 0.35$ ) than healthy controls (Table 3). However, group differences in the concrete subscales (anticipatory or consummatory) were not detected.

3.4. Comparison between people with first-episode schizophrenia and healthy controls

The  $2 \times 4$  mixed effect ANOVA yielded significant main effects for group ( $F(1,151) = 7.02$ ,  $p = 0.009$ ,  $\eta^2 = 0.04$ ), subscale ( $F(3,453) = 91.19$ ,  $p < 0.001$ ,  $\eta^2 = 0.377$ ) and their interaction ( $F(3,453) = 3.04$ ,  $p = 0.029$ ,  $\eta^2 = 0.02$ ). Follow-up tests indicated that the groups differed only in the abstract anticipatory pleasure scale ( $p < 0.001$ , Cohen's  $d = 0.67$ ) (see Table 3), with people with first episode schizophrenia reporting less abstract anticipatory pleasure.

Table 2  
Demographics of participants in all samples.

	HC	CSZ (inpatient)	CSZ (community)	HC	FES <sup>a</sup>	HC	P-SPD	N-SPD	HC	REL	CSZ
N (men/women)	114(62/52)	168(90/78)	196(95/101)	78(42/36)	75(37/38)	102(63/40)	105(52/53)	105(45/60)	45(30/15)	45(20/25)	45(25/20)
Age (years)	29.28(8.75)	27.4(9.42)	52.54(16.25)	24.63(6.45)	24.35(5.55)	19.48(1.56)	19.4(1.36)	19.36(1.31)	36.02(7.34)	38.89(13.2)	34.84(11.19)
Education (years)	13.01(3.01)	12.34(2.87)	11.19(3.19)	12.47(2.37)	11.9(2.16)	13.01(1.25)	13.13(1.12)	12.99(1.27)	12.27(3.27)	12.16(3.32)	12.62(3.26)
SPQ_Total						4.69(2.11)	42.54(4.16)	43.43(4.88)			
Cognitive-Perceptual (Pos)						2.74(1.57)	21.67(3.11)	17.93(3.86)			
Interpersonal (Neg)						1.11(1.43)	13.9(3.07)	20.14(3.01)			
Disorganized						1.02(0.9)	11.06(2.51)	10.05(2.6)			
Medication <sup>b</sup>		268.33 (175.69)	304.57(269.68)		36.35(35.02)						210(123.86)
Duration of illness (months)		68.44(83.36)	18.5(10.07)		2.03(1.34)						113.56(126.85)
PANSS_Total		53.13(16.47)			12.25(4.8)						55.71(17.96)
Positive symptoms		11.96(4.68)			13.68(6.19)						12.38(4.95)
Negative symptoms		15.08(6.79)			24.43(7.37)						16(7.18)
General psychopathology		26.1(7.8)			50.36(15.14)						27.33(8.64)

HC = Healthy controls, P-SPD = People with positive schizotypal personality features, N-SPD = People with negative schizotypal personality features, SPQ = Schizotypal Personality Questionnaire, Pos = Positive schizotypy, Neg = Negative schizotypy; FES<sup>a</sup> = First episode schizophrenia, REL = First-degree relatives of people with schizophrenia, CSZ = Chronic Schizophrenia, PANSS = Positive and Negative Syndrome Scale.  
<sup>a</sup> The medication was the percentage of maximum British National Formulary (BNF)-recommended dose, rather than the chlorpromazine equivalence.  
<sup>b</sup> Chlorpromazine equivalence, mg/day.

**Table 3**  
TEPS in schizophrenia, schizotypal personality disorder, and first-degree relatives.

	HC	P-SPD	N-SPD	REL	FESZ	CSZ
Sample A	n = 114					n = 168
TEPS_ANT_ABSTRACT <sup>a</sup>	4.67(0.84)					4.31(0.91)
TEPS_ANT_CONCRETE	3.17(0.76)					3.18(0.86)
TEPS_CON_ABSTRACT <sup>a</sup>	4.17(0.58)					3.96(0.63)
TEPS_CON_CONCRETE	3.72(0.89)					3.54(0.91)
Sample B	n = 78				n = 75	
TEPS_ANT_ABSTRACT <sup>a</sup>	4.74(0.65)				4.30(0.65)	
TEPS_ANT_CONCRETE	3.46(0.69)				3.45(0.76)	
TEPS_CON_ABSTRACT	4.28(0.67)				4.10(0.58)	
TEPS_CON_CONCRETE	3.83(0.74)				3.59(0.87)	
Sample C	n = 103	n = 105	n = 105			
TEPS_ANT_ABSTRACT <sup>a</sup>	4.97(0.70)	5.17(0.69)	4.44(0.92)			
TEPS_ANT_CONCRETE <sup>a</sup>	3.28(0.91)	3.70(0.80)	3.07(0.69)			
TEPS_CON_ABSTRACT <sup>a</sup>	4.72(0.73)	4.82(0.72)	4.23(0.84)			
TEPS_CON_CONCRETE <sup>a</sup>	3.98(0.92)	4.40(0.89)	3.77(0.93)			
Sample D	n = 45			n = 45		n = 45
TEPS_ANT_ABSTRACT <sup>a</sup>	4.83(0.64)			4.07(0.88)		3.76(0.72)
TEPS_ANT_CONCRETE <sup>a</sup>	3.22(0.68)			3.04(0.91)		2.88(0.70)
TEPS_CON_ABSTRACT	4.32(0.47)			4.24(0.99)		3.75(0.60)
TEPS_CON_CONCRETE <sup>a</sup>	3.87(0.76)			3.46(0.98)		3.17(0.75)

HC = Healthy controls, P-SPD = People with positive schizotypal personality features, N-SPD = People with negative schizotypal personality features, FESZ = First episode schizophrenia, REL = First-degree relatives of people with schizophrenia, CSZ = Chronic Schizophrenia, TEPS = Temporal Experience Pleasure Scale, ANT = Anticipatory pleasure, CON = Consummatory pleasure.

<sup>a</sup> Significant group difference,  $p < 0.01$ .

### 3.5. Comparison between negative-SPD, positive-SPD and healthy controls

In the  $3 \times 4$  mixed effect ANOVA, the main effects of group ( $F(2,310) = 34.36, p < 0.001, \eta^2 = 0.18$ ), subscale ( $F(3,930) = 295.60, p < 0.001, \eta^2 = 0.49$ ), and their interaction ( $F(6,930) = 2.27, p = 0.035, \eta^2 = 0.01$ ) were significant. People with negative-SPD reported lower abstract anticipatory pleasure ( $p < 0.001$ , Cohen's  $d = 0.65$ ) and lower abstract consummatory pleasure ( $p < 0.001$ , Cohen's  $d = 0.63$ ) than healthy controls. In contrast, people with positive-SPD reported significantly higher concrete anticipatory pleasure ( $p = 0.001$ , Cohen's  $d = 0.50$ ) and higher concrete consummatory pleasure ( $p = 0.002$ , Cohen's  $d = 0.47$ ) than healthy controls (Table 3). The healthy controls reported similar concrete anticipatory and consummatory pleasure compared with people with negative SPD, and similar abstract anticipatory and consummatory pleasure compared with people with positive SPD.

### 3.6. Comparison between first-degree relatives, people with chronic schizophrenia and healthy controls

In the  $3 \times 4$  mixed ANOVA, we found a significant main effect for group ( $F(2,132) = 13.97, p < 0.001, \eta^2 = 0.18$ ) and subscale ( $F(3,396) = 115.18, p < 0.001, \eta^2 = 0.466$ ), and their interaction was also significant ( $F(6,396) = 4.32, p < 0.001, \eta^2 = 0.061$ ). First-degree relatives reported lower abstract anticipatory pleasure than healthy controls ( $p < 0.001$ , Cohen's  $d = 0.98$ ), but higher abstract anticipatory pleasure than people with chronic schizophrenia ( $p < 0.001$ , Cohen's  $d = 1.57$ ). People with chronic schizophrenia reported lower abstract consummatory pleasure than first-degree relatives ( $p < 0.001$ , Cohen's  $d = 0.60$ ) and healthy controls ( $p < 0.001$ , Cohen's  $d = 1.06$ ), while the latter two groups were similar to each other (see Table 3).

### 3.7. Correlations between TEPS, symptoms and symptom-like behavior in people with schizophrenia and people with SPD

As shown in Table 4, positive schizotypy (i.e., cognitive-perceptual features of the SPQ) was positively correlated with all the four subscales of the TEPS ( $p < 0.001$ ). In contrast, negative schizotypy (i.e., interpersonal features of the SPQ) was negatively correlated with all four subscales of the TEPS (all  $p < 0.001$ ). Thus, cognitive-perceptual features were

associated with more reported pleasure while interpersonal features were associated with less reported pleasure.

For people with chronic schizophrenia, negative symptoms were negatively correlated with abstract anticipatory and abstract consummatory pleasure. Duration of illness was also negatively correlated with both anticipatory pleasure subscales (abstract, concrete) and concrete consummatory pleasure. Medication, positive symptoms and general psychopathology symptoms were not correlated with reported pleasure (Table 4).

## 4. Discussion

Consistent with our hypothesis, the four-factor model of the TEPS fit the data in Chinese people with chronic schizophrenia. Furthermore, we observed deficits in abstract anticipatory pleasure across stages of the

**Table 4**  
Correlates of anticipatory and consummatory pleasure.

	TEPS component			
	ANT_ABST	ANT_CONT	CON_ABST	CON_CONT
<i>SPD (n = 210)</i>				
SPQ_Total	0	-0.06	-0.13	-0.04
Cognitive-Perceptual (Pos)	0.27**	0.25**	0.18*	0.19**
Interpersonal (Neg)	-0.31**	-0.32**	-0.35**	-0.26**
Disorganized	0.08	-0.01	0	0.02
<i>CSZ (n = 168)(Sample C)</i>				
PANSS_Total	-0.08	0.02	-0.14	-0.04
Positive symptoms	-0.04	0.09	-0.09	-0.07
Negative symptoms	-0.17*	-0.06	-0.19*	-0.1
General psychopathology	0	0.05	-0.08	0.04
<i>CSZ (n = 294)(Sample C &amp; Sample D)</i>				
Duration of illness (months)	-0.22**	-0.15*	0	-0.12*
Medication <sup>a</sup>	0.02	0.03	-0.02	0

HC = Healthy controls, SPD = People with positive schizotypal personality features, SPQ = Schizotypal Personality Questionnaire, Pos = Positive Schizotypy; Neg = Negative Schizotypy; REL = First-degree relatives of people with schizophrenia, CSZ = Chronic Schizophrenia, TEPS = Temporal Experience Pleasure Scale, ANT = Anticipatory pleasure, CON = Consummatory pleasure, ABST = Abstract, CONT = Concrete, PANSS = Positive and Negative Syndrome Scale.

<sup>a</sup> Chlorpromazine equivalence, mg/day.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

schizophrenic illness: among people with first episode and chronic schizophrenia, people with schizotypal features, and first-degree relatives. Interestingly, we found that people with chronic schizophrenia and SPD features also reported less abstract consummatory pleasure compared with their healthy counterparts, a finding consistent with Strauss et al. (2011). Our results further demonstrate that schizotypal personality features, negative symptoms and duration of illness are related to reported pleasure experience.

#### 4.1. The four-factor model of the TEPS in China

The four-factor structure of the TEPS had good fit indices in a large sample of people with chronic schizophrenia. This finding corroborates the four-factor framework in Chinese undergraduates and people without schizophrenia (Chan et al., 2012; Chan et al., 2010; Shi et al., 2012). Cultural factors appear to have an important effect on the factor structure of the TEPS (Prado et al., 2014; Su et al., 2014). The abstract component is associated with concepts and beliefs about pleasurable events, whereas the concrete component is associated with specific, tangible rewards and pleasurable events. Concrete items likely represent activities and events that are more frequently pursued, and hence could be more readily encoded into memory and then readily retrieved when answering a TEPS question. By contrast, abstract items likely require people to activate a representation of a pleasure concept that may or may not have been previously experienced.

#### 4.2. Deficits in anticipatory pleasure

People with first-episode and chronic schizophrenia reported deficits in abstract anticipatory pleasure, extending the literature to a Chinese context (Favrod et al., 2009; Gold et al., 2008; Mote et al., 2014; Wynn et al., 2010). Moreover, impaired abstract anticipatory pleasure was also demonstrated in first-degree relatives of schizophrenia patients and people with schizotypal personality features, suggesting that the deficits may be present along the schizophrenia spectrum.

The distribution of this deficit in anticipatory pleasure along the schizophrenia spectrum lends further support to the trait- rather than state-like characteristic of anticipatory pleasure (Kring and Barch, 2014; Kring and Caponigro, 2010). Several theories have been suggested to explain the neural and behavioral mechanisms of deficit in anticipatory pleasure in schizophrenia-spectrum disorders (Cohen et al., 2011). Midbrain dopamine is linked to the “wanting” system which has been associated with anticipatory pleasure (Berridge, 2007; Schultz et al., 1997). Furthermore, deficits in dopamine function have been well documented in schizophrenia and have been detected in people with schizotypal personality features (Davis et al., 1991; Howes and Kapur, 2009; Siever and Davis, 2004). Inappropriate value representation in people with schizophrenia may also compromise their motivation to approach or avoid leading to suboptimal decision-making (Germans and Kring, 2000; Gold et al., 2012; Gold et al., 2008). Finally, the maintenance and recall of emotional experience which are impaired in people with schizophrenia are essential for anticipatory pleasure encoding (Kring et al., 2011; Strauss and Gold, 2012). However, to establish a causal relationship between the dampened anticipatory pleasure and the abovementioned factors in schizophrenia-spectrum disorders requires further research.

Healthy controls reported higher abstract anticipatory pleasure than first-degree relatives of people with schizophrenia, who in turn reported higher abstract anticipatory pleasure than people with schizophrenia. However, first-degree relatives reported similar abstract consummatory pleasure as healthy controls, but higher than people with schizophrenia. This is partly consistent with a previous study in which first-degree relatives showed intermediate anhedonia between healthy controls and people with schizophrenia (Katsanis et al., 1990). However, our results provide further evidence that the anhedonia deficits may be specific to abstract anticipatory pleasure, at least in China, and suggest that this

deficit is present along the schizophrenia spectrum and may be independent from the effects of antipsychotics.

Indeed, what comes out clearly from these findings is that deficits in abstract anticipatory pleasure were central to the impaired anticipatory pleasure. We found deficits in abstract anticipatory pleasure across all stages of the schizophrenia spectrum. This finding lends support to Strauss and Gold's postulation that the anticipatory pleasure may reflect difficulties in accessing beliefs about positive events and pleasure (Strauss and Gold, 2012). In our study, answering abstract anticipatory pleasure items may draw more from beliefs about pleasure, and this may be associated with this particular deficit. This will be important to systematically test in future research. Interestingly, concrete anticipatory pleasure appears to be relatively intact, and this finding has not been reported in previous studies. Continued research on the distinctions between abstract and concrete items outside of the Chinese context may help uncover areas of anticipatory pleasure that are more and less deficient in people with schizophrenia. This may in turn guide future treatment development. More broadly, the distribution of anticipatory pleasure deficits, at least abstract anticipatory pleasure, along the schizophrenia spectrum is consistent with the ‘expectancy’ component in the ‘Approach motivation’ construct of the RDoC (NIMH, 2008).

#### 4.3. Deficits in consummatory pleasure

People with chronic schizophrenia in this study also exhibited dampened consummatory pleasure, but this was specific to abstract consummatory pleasure. This finding differs from some previous studies (Favrod et al., 2009; Gard et al., 2007; Wynn et al., 2010), but not all (Strauss et al., 2011). However, the relatively preserved consummatory pleasure (abstract and concrete) in people with first-episode schizophrenia and their first-degree relatives suggests that deficits in consummatory pleasure may not be evident across the schizophrenia spectrum. However, in contrast to concrete consummatory pleasure, abstract consummatory pleasure may be more sensitive in discriminating between schizophrenia-spectrum disorders.

#### 4.4. Anhedonia and symptomatology of schizophrenia

Consistent with previous research (Gard et al., 2007; Wynn et al., 2010), we found that anticipatory and consummatory pleasure was negatively correlated with negative symptoms in people with chronic schizophrenia, but this was true only for the abstract subscales. The correlations further highlight the importance of abstract anticipatory pleasure in people with schizophrenia in China. Furthermore, medication, duration of illness and schizophrenia symptoms of people with first-episode schizophrenia were not correlated with TEPS scores, which is different from one prior study (Mote et al., 2014). It is worth noting that the criterion for the first-episode group in this study was below 6 months which is shorter than that in study of Mote et al. Moreover, Mote et al. presented results using the original 2 scales which are different with the 4 factor solution applied in the present study.

Although we did not find significant correlations between TEPS scores and medication in people with chronic schizophrenia, duration of illness was negatively correlated with anticipatory pleasure (abstract and concrete) and concrete consummatory pleasure.

### 5. Limitations

The primary limitation of the present study was sampling. Due to the heterogeneity of the demographics of the SPD group and people with first-episode and chronic schizophrenia, we did not compare the TEPS scores of each sample directly. Second, only self-report scales were used to investigate anhedonia in this study. To investigate the neural and genetic mechanisms of anticipatory and consummatory pleasure across the schizophrenia-spectrum, the use of imaging and molecular techniques would be needed (Cuthbert, 2014; Cuthbert and Insel, 2010).

## 6. Conclusions

The present findings support a four-factor structure of the TEPS in Chinese people with schizophrenia. The findings from people along the schizophrenia spectrum also suggest that abstract anticipatory pleasure deficits are present early in the course of the illness and may persist. Our findings highlight the importance of cultural considerations in studying anticipatory and consummatory pleasure, and that abstract anticipatory pleasure is particularly salient among people in China.

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The funding agents had no further role in the study design; in the collection, analysis and interpretation of the data; in the writing of the manuscript; and in the decision to submit the paper for publication.

### Contributors

Zhi Li designed the study, collected and analyzed the data, and wrote up the first draft. Fl. Geng collected and analyzed the data. Simon Lui, Ying Li, WX Li, CY Wang, and SP Tan performed clinical interview and administered clinical ratings to the participants. Eric FC Cheung and Ann Kring made significant comments to the all drafts of the paper. All authors contributed to and have approved the final text. Raymond Chan generated the idea, designed the study, interpreted the findings and wrote up the first draft.

### Conflict of interest

The authors declare they have no conflict of interest.

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