VALIDATION OF THE GEOPTE SCALE OF SOCIAL COGNITION FOR PSYCHOSIS IN PATIENTS DIAGNOSED WITH SCHIZOPHRENIA IN LATIN AMERICA

Alejandra Caqueo-Urízar[1], Patricio Mena-Chamorro[1], Alfonso Urzúa[2], Guillaume Fond[3] and Laurent Boyer[3]
*[1]University of Tarapaca; [2]Catholic University of the North (Chile);
[3]Aix-Marseille University (France)*

Abstract

The purpose of this study was to validate the GEOPTE scale of social cognition for its use in patients diagnosed with schizophrenia in Latin American countries. The participants were 253 patients with a diagnosis of Schizophrenia and 253 main caregivers from mental health services in Bolivia, Chile and Peru. The psychometric properties of the GEOPTE scale were obtained through confirmatory factor analysis (CFA), CFA-multigroup, reliability coefficients and Pearson's correlation. The CFA showed the adequacy between the original theoretical factor structure and the one established in this validation study. The scale showed satisfactory reliability indicators, presented significant associations with the Positive and Negative Syndrome Scale (PANSS) and showed only weak invariance according to gender. The GEOPTE scale has sufficient evidence of validity and reliability for its use in patients diagnosed with Schizophrenia in Latin American countries.
KEY WORDS: *validation, GEOPTE Scale, social cognition, Latin America*.

Resumen

El propósito de este estudio fue validar la escala GEOPTE de cognición social para su uso en pacientes con diagnóstico de esquizofrenia en países Latinoamericanos. Participaron 253 pacientes con un diagnóstico de esquizofrenia y 253 cuidadores principales provenientes de los servicios públicos de salud mental de Bolivia, Chile y Perú. Las propiedades psicométricas de la escala GEOPTE fueron obtenidas mediante análisis factoriales confirmatorios (CFA), CFA-multigrupo, coeficientes de fiabilidad y correlación de Pearson. El CFA mostró la adecuación entre la estructura factorial teórica original con la establecida en este estudio de validación. La escala evidenció satisfactorios indicadores de fiabilidad, presentó asociaciones significativas con la "Escala de los síndromes positivo y negativo" (PANSS) y sólo mostró invarianza débil según el sexo. La escala GEOPTE posee pruebas de validez y fiabilidad suficiente para su uso en pacientes con diagnóstico de esquizofrenia en países Latinoamericanos.
PALABRAS CLAVES: *validación, escala GEOPTE, cognición social, Latinoamérica*.

Introduction

Schizophrenia is a severe mental disorder that affects about 21 million people, which is equivalent to 1% of the world's population (World Organization Health [WHO], 2019). Resulting from the manifestation of positive and negative symptoms, as well as cognitive impairment, patients with a diagnosis of schizophrenia, suffer from physical, psychological and social limitations that, in most cases, disable their daily and independent functioning, which manifest through reduced quality of life, social connections and employability (Calafell et al., 2014; Rabinowitz et al., 2012; Rocca et al., 2014; Strassnig et al., 2018).

Although the impairment of basic cognitive functions and social cognition are not considered symptoms within the diagnosis of schizophrenia, several studies have shown that these are very typical aspects in its development (Green & Harvey, 2014; Green et al., 2019; Hofer et al., 2011; Valaparla et al., 2017), as well as being associated with patients' daily functioning (Barrios et al., 2018; Lindenmayer et al., 2017). Most studies on cognition in schizophrenia, have focused on the assessment of basic functions, such as attention, working memory, learning, processing speed and problem solving (Nuechterlein et al., 2004), however, during the last few years, studies that include social cognition have significantly increased. This is probably because research has shown that social cognition, in comparison to basic cognitions, exerts a greater influence on the daily functioning of patients with a diagnosis of schizophrenia, basically in terms of their family and social integration observing an impairment in the identification of the inappropriateness of one's actions in a specific social context whether this is known or unknown to the patient or a failure in the ability to adequately attribute intentionality to others with whom he/she interrelates (Atenas et al., 2019; Green et al., 2012; Fett et al., 2011; Mora-Castañeda et al., 2020). Social cognition has an influence on the severity of the disorder, relapse rates, social competence, functioning in the community, and patients' quality of life (Brown et al., 2012; Brown et al., 2014; Caqueo-Urízar et al., 2015; Pinkham et al., 2003; Couture et al., 2006; Shean & Meyer, 2009).

Social cognition is characterized by a set of psychological processes that are a function of social interactions, that is, they are involved in the perception, storage, and retrieval of information about other people's emotions and thoughts, as well as one's own reaction, noting four critical domains that make up social cognition, namely (1) Emotional processing; (2) Social perception; (3) Theory of mind; and (4) Attribution styles. (Green et al., 2019; Green et al., 2005; Raballo, 2018).

The study of social cognition in schizophrenia has presented difficulties in the assessment and measurement of this construct, which is mostly characterized by the use of instruments that assess specific sections of social cognition, such as perception and discrimination of facial expressions, intentions, false beliefs, social situations and internal or external attributions, instead of being evaluated as a general construct (Savla et al., 2013). Assessments that, in addition, are mostly performed through experimental tasks such as the assessment of abstract thinking, working memory and online monitoring (Gil-Sanz et al., 2019; Palha, 2008), such as: Facial Emotion Identification Task (Kerr & Neale, 1993), Graphic Sequence Task (Langdon & Coltheart, 1999) or Situational Feature Recognition Test-2 (Corrigan et

al., 1996), among others. This entails a high economic and time cost, which adds to the already existing distance between research and clinical practice, reducing access and use by mental health officials (Gilbody et al., 2002; Jensen-Doss & Hawley, 2011). In response to this limitation, the Spanish group for the optimization and treatment of schizophrenia (Grupo Español para la optimización y el tratamiento de la esquizofrenia, GEOPTE), developed the GEOPTE scale of social cognition for psychosis (Sanjuán et al., 2003), which stands out for being self-report, of brief application (15 items), which also defines social cognition in a general way and considers the perspective of both the patient and the main caregiver. This scale is also characterized by being two-dimensional and composed of the dimensions of basic cognitive functions and social cognition. The first dimension refers to impairments and/or deficits in learning, attention/surveillance, working memory and problem solving, while the second dimension refers to the ability to respond appropriately to social cues by perceiving, interpreting and processing these cues. The GEOPTE scale reported adequate evidence of validity, with the ability to explain 39% of the total variance and satisfactory levels of reliability (Cronbach's $\alpha= .86$) (Sanjuán et al., 2003). Since its publication, this scale has been used in different samples of patients with a diagnosis of schizophrenia, who have associated social cognition with other constructs such as empathy, quality of life, positive and negative psychotic symptoms, depressive symptomatology, adherence to treatment, among others (Bobes et al., 2009; Ciudad et al., 2009; Martín et al., 2017; Sánchez-Gutiérrez et al., 2018). Along these lines, the GEOPTE scale has been adapted and validated for use in Italian (Pelizza et al., 2019) and Portuguese (Filipa, 2011) clinical populations. Both studies presented adequate evidence of validity (Italian sample, CFI= 0.957, TLI= 0.950, RMSEA= 0.079; Portuguese sample, able to explain 37.4% of the total variance) and satisfactory levels of reliability (Italian sample, Cronbach's $\alpha= 0.90$; Portuguese sample, Cronbach's $\alpha= 0.88$).

Currently, there is no research that reports psychometric properties in clinical samples from Latin American countries, evidencing the need for measuring instruments of rapid application and with adequate psychometric properties, to provide information for the design of interventions in contexts where access to mental health care is limited.

The aim of this study is to validate the GEOPTE scale (Sanjuán et al., 2003) for use in patients with schizophrenia in Bolivia, Chile and Peru. Also, it is proposed as a hypothesis of this study, to find a factorial structure similar to that proposed by Sanjuán et al. (2003), with adequate levels of reliability.

Method

Participants

The sample was non-probabilistic and integrated by 506 participants, where 253 correspond to patients with a diagnosis of schizophrenia and the other 253 to their respective primary caregivers (persons - almost always family members - who provide attention, informal care and assistance to the patient without professional training). The patients attended public mental health services in three Latin American countries, specifically in the cities of Arica (Chile) (*N*= 170), La Paz (Bolivia) (*N*= 166) and Tacna (Peru) (*N*= 170).

Details of the sociodemographic characteristics are presented in Table 1.

Table 1

Sociodemographic characteristics of patients with a diagnosis of Schizophrenia and primary caregivers

Variables	Bolivia (*N*= 83)	Chile (*N*= 85)	Peru (*N*= 85)
Pacient	*n* (%)	*n* (%)	*n* (%)
Gender			
Female	18 (22.2%)	25 (30.1%)	40 (48.2%)
Male	65 (77.8%)	60 (69.9%)	45 (51.8%)
Age (years) *M* (*SD*)	33.7 (11.3)	37.9 (15.3)	35.2 (10.3)
Ethnics			
Aymara	48 (57.8%)	31 (36.5%)	38 (44.7%)
Non-Aymara	35 (42.1%)	54 (63.5%)	47 (55.3%)
Marital Status			
Single	76 (91.6%)	70 (82.4%)	72 (85.7%)
Married	7 (8.4%)	15 (17.6%)	13 (14.3%)
Education level			
≥ 12 years	10 (12.0%)	6 (7.1%)	24 (28.2%)
≤ 12 years	73 (88.0%)	79 (92.9%)	61 (71.8%)
Type of disease			
Paranoid schizophrenia	48 (57.8%)	65 (76.4%)	71 (83.5%)
Disorganized schizophrenia	0 (0.0%)	0 (0.0%)	1 (1.1%)
Undifferentiated schizophrenia	14 (16.8%)	0 (0.0%)	0 (0.0%)
Residual schizophrenia	12 (14.4%)	11 (12.9%)	5 (5.8)
Schizoaffective	2 (2.4%)	1 (1.1%)	0 (0.0%)
Schizophreniform	0 (0.0%)	0 (0.0%)	2 (2.3%)
Other	7 (8.6%)	8 (9.6%)	6 (7.3%)
Duration of disorder (years) *M* (*SD*)	13.3 (11.1)	17.0 (13.6)	13.4 (10.0)
Primary caregiver			
Gender			
Female	59 (71.1%)	57 (67.1%)	54 (63.5%)
Male	24 (28.9%)	28 (32.9%)	31 (36.5%)
Age (years) *M* (*SD*)	54.2 (13.5)	56.1 (14.8)	53.7 (14.8)

Variables	Bolivia (*N*= 83)	Chile (*N*= 85)	Peru (*N*= 85)
Ethnics			
Aymara	52 (40.0%)	30 (23.1%)	48 (36.9%)
Non-Aymara	31 (25.2%)	55 (44.7%)	37 (30.1%)
Marital Status			
Married	47 (56.6%)	35 (41.2%)	39 (45.9%)
Single	18 (21.7%)	21 (24.7%)	23 (27.1%)
Other	18 (21.7%)	29 (34.1%)	23 (27.1%)
Education level			
≥ 12 years	31 (37.5%)	71 (83.4%)	21 (24.9%)
≤ 12 years	52 (62.5%)	14 (16.6%)	64 (75.1%)
Occupation			
Employed	45 (54.2%)	39 (45.9%)	24 (28.2%)
Homeowner	24 (28.9%)	28 (32.9%)	12 (14.5%)
Unemployed	4 (4.8%)	1 (1.1%)	10 (11.7%)
Other	10 (12.1%)	17 (20.1%)	37 (45.6%)
Type of relationship			
Mother	35 (42.2%)	44 (51.8%)	36 (42.4%)
Father	20 (24.0%)	15 (17.6%)	22 (25.8%)
Sibling	16 (19.2%)	12 (14.1%)	12 (14.1%)
Spouse/Partner	1 (1.1%)	6 (7.0%)	6 (7.0%)
Other	11 (13.5%)	8 (9.5%)	9 (10.7%)
Time spent with patient			
≥ 10 hours	21 (25.3%)	33 (38.8%)	28 (32.9%)
≤ 10 hours	62 (74.7%)	52 (61.2%)	57 (67.1%)
Participation in psychoeducational workshops			
No	58 (69.9%)	39 (45.9%)	80 (94.1%)
Yes	25 (30.1%)	46 (54.1%)	5 (5.9%)

Instruments

a) *Ad hoc sociodemographic and clinical data questionnaire.* This questionnaire was designed to obtain information about on sex (male, female), age, educational level (over 12 years, under 12 years), marital status (married, single, widowed, divorced, other), ethnicity (Aymara, non-Aymara), occupation of caregiver (unemployed, employed, retired, homeowner, student, other) and type of relationship (mother, father, sibling, spouse/partner, child, other), as well as type of diagnosis of schizophrenia (paranoid, disorganized, undifferentiated, residual, schizoaffective, schizophreniform, other), duration of the disorder (in years), time spent with the patient and participation in workshops such as psychoeducation (yes, no).

b) *GEOPTE scale of social cognition for psychosis* (Sanjuán et al., 2003). A brief 15-item scale designed to measure social cognition in psychosis in patients diagnosed with schizophrenia, using two dimensions: basic cognitive functions (9 items) and social cognition (6 items). It should be answered by self-administration by the patient and his or her primary caregiver, independently

and using the same items. This instrument contains questions such as "Do you forget errands, tasks or chores?" or "When you are in a group, are you often told that you misinterpret the attitudes, looks or gestures of others?". Response options correspond to behavioral statements in a 5-point Likert format (1= "no" to 5= "very much"). Scores are obtained through the sum of the numerical values associated with each response option for both the patient and the primary caregiver, whereby the minimum score will be 15 and the maximum score will be 75, where low scores will represent the best possible state of social cognition and high scores the worst possible. The scale reported adequate evidence of construct validity and satisfactory internal consistency (Sanjuán et al., 2003).

c) *Positive And Negative Syndrome Scale* (PANSS; Kay et al., 1987). A 30-item scale designed to specifically assess psychotic symptoms in individuals diagnosed with schizophrenia through five dimensions: positive, negative, cognitive, depressive and arousal psychopathology. The PANSS was translated, adapted and validated in Spanish by Peralta and Cuesta (1994). Response options correspond to behavioral statements in a 7-point Likert format (1= "absent" to 7= "extreme"). Dimensional scores are calculated from the mean of each set of items, where high scores suggest greater positive and/or negative symptomatology, while low scores suggest the opposite. The scale evidences adequate construct validity and modest levels of internal consistency (Cronbach's α> .60) for both the original and adapted versions (Peralta & Cuesta, 1994).

Procedure

Non-experimental, cross-sectional instrumental study (Ato et al., 2013). The study was approved by the Ethics Committee of the University of Tarapacá (Chile), by the National Health Service of Chile and was authorized by the Directors of the Public Mental Health Services of Bolivia and Peru.

Initially, the lead author (AC-U.) trained two clinical psychologists to conduct interviews over a three-month period in each country. During monthly follow-up visits, patients with diagnoses of schizophrenia along with their respective primary caregivers were invited to participate. Prior to the start of the assessment, written informed consent was requested from those patients and caregivers who agreed to participate. The consent stated the objectives of the study, confidentiality, anonymity, the rights of the participants and the voluntary nature of the interview. The assessment lasted 20-30 minutes, was conducted in pencil and paper format, and no gratuity and/or compensation was offered for participation in the study.

The following inclusion criteria were applied for the selection of patients: being older than eighteen; speaking Spanish; having a diagnosis of schizophrenia granted by a psychiatrist according to the criteria of the International Classification of Diseases, 10th version (ICD-10) (WHO, 1992); being stabilized, i.e., not having experienced a psychotic episode in the last 6 months; and having a primary caregiver (family member and/or person close to the patient), while presenting ongoing acute psychotic episodes or the presence of sensory and/or cognitive impairment that prevented their evaluation were considered exclusion criteria.

For caregivers, the inclusion criteria were being older than eighteen, speaking Spanish and being the primary caregiver of a patient with a diagnosis of schizophrenia, while presenting organic symptomatology; substance abuse or sensory and/or cognitive disorder that prevented their evaluation were considered as exclusion criteria.

Analysis of data

Initially, in order to control for the effects of a possible distortion of the patient, associated with the degree of insight about his schizophrenia diagnosis in obtaining his GEOPTE scale score and following the recommendations of Sanjuán et al. (2003), a single index of central tendency was estimated, through the calculation of the geometric mean (GM) with the summary scores of the patient (p) and his main caregiver (c). The geometric mean index (GMI) of a group of n values is the n-th root of the product of group values. The GMI is used instead of the arithmetic mean because there is a probability that the scores of the patient and the primary caregiver are very different from each other, with significant deviations. Therefore, in the face of a large difference between scores the GM will provide a central mean closer to the best of the two cognitive states, that is, GMI is able to control the effect of extreme values, the opposite would be the case if the arithmetic mean were used (Pardo et al., 2014).

The formula described below was used to calculate the GMI, in which p= is the total scores of the patients and c= is the total scores of the caregivers:

$$GMI = \sqrt{p \; x \; c}$$

To characterize the sample, the proportions of each sociodemographic and clinical variable in each country (Bolivia, Chile and Peru) were obtained. Then, descriptive analyses of central tendency (mean), dispersion (standard deviation, minimum and maximum), distribution (skewness and kurtosis) and normality (Shapiro-Wilk test) were performed on the continuous variables of social cognition and psychotic symptomatology in the whole sample. Also, comparisons were made based on the means of the GEOPTE scale scores by gender, through Student's t-test for independent samples, and by country of residence, using a one-factor ANOVA. For the post-hoc tests, Tukey's correction was used, because the data presented homoscedasticity (Levene's test, $F= 0.327$; $p= 0.721$). Although the variables in this sample are not normally distributed (Table 2), parametric comparative analyses were used because the *t* and *F* statistics are sufficiently robust under conditions of skewness and with large sample sizes ($n> 50$) (Pardo et al., 2014).

To establish validity evidence based on the internal structure of the GEOPTE scale test (Sanjuán et al., 2003), a confirmatory factor analysis (CFA) was performed from polychoric correlation matrices (Barendse et al., 2015) and with the robust weighted least squares (WLSMV) estimation method, which is robust with non-normal discrete variables (Asparouhouv & Muthén, 2007; Li, 2016). As a precaution and in order to report evidence of validity for use between the two sources of information independently and jointly, the CFA models were made from the items resulting from the combination of the GMI, patient, and caregiver. Two models were estimated, one with the original factor structure of two covariate dimensions (M1)

and one with a single dimension (M2). The overall fit of the models was estimated according to the cut-point recommendations proposed by Schreiber (2017) for the following indicators: comparative fit index (CFI; > 0.90 acceptable, > 0.95 excellent), Tucker-Lewis index (TLI; > 0.90 acceptable, > 0.95 excellent) and root mean square error of approximation (RMSEA; < 0.08 acceptable, < 0.06 excellent).

Reliability was estimated for each dimension and between the different sources of information (GMI, patient and caregiver), using Cronbach's alpha and McDonald's omega coefficients. Values above 0.70 are considered acceptable and above 0.80 adequate (Cho & Kim, 2015). To evaluate the stability of the GEOPTE scale (Sanjuán et al., 2003) between people of different sexes (men and women) and by country (Bolivia, Chile and Peru), metric invariance analysis (same factor loadings in all groups) and scalar invariance analysis (same intercepts in all groups) were performed by means of a multigroup confirmatory factor analysis (MGCFA), using the items corresponding to patients and caregivers. The invariance of the scale was interpreted according to the recommendations of Chen (2007) and Dimitrov (2010), who suggest invariance when the CFI and RMSEA differentials are less than 0.010. Finally, evidence based on the relationship with other variables was established, through Spearman correlations between the dimensions of the GEOPTE scale and the dimensions of the Positive and Negative Syndrome Scale (PANSS), as well as their total versions. It should be noted that the scale was not adapted linguistically, since the items were written and published in Spanish and English by Sanjuán and collaborators (2003).

All analyses were performed through the statistical software JASP, v.0.14.1(JASP Team, 2020) and Mplus, version 8.2 (Muthén & Muthén, 1998-2017).

Results

Descriptive characteristics of social cognition

Overall, patients presented a moderate state of social cognition on the GEOPTE scale, with a total score of 36.3 (*SD*= 10.7) around the middle of the range (15.4-64.4) and manifested moderately severe symptoms on the PANSS scale, with a total score of 71.3 (*SD*= 28.2) close to the middle of the range (30.0-191.0). It should be noted that none of the variables included in this study were normally distributed, as indicated by the outlying values in skewness and kurtosis (-2 - 2), as well as the Shapiro-Wilk normality test (W= 0.761 - 0.979; *p*< .001).

Student's *t*-test showed that there were no statistically significant differences according to the sex of the patients (men= 36.4 [*SD*= 10.3]; women= 35.2 [*SD*= 10.8]; *t*= 0.798; *p*= .425). One-factor ANOVA showed statistically significant differences between patients according to country of residence and explained 6% of the total variance in social cognition (*F*= 8.603; *p*< .001; η^2= 0.06). *Post hoc* analyses showed that Bolivia had significant moderate differences with Chile (Bolivia= 40.1 [*SD*= 10.7]; Chile= 35.3 [*SD*= 9.8]; *t*= 2.967; *p*= .009; *d*= 0.463) and Peru (Bolivia= 40.1 [*SD*= 10.7]; Peru= 33.6 [*SD*= 10.6]; *t*= 4.000; *p*< .001; *d*= 0.603), with Bolivian patients perceiving a worse state of social cognition. There were no

statistically significant differences between Chilean and Peruvian patients. Details of the descriptive statistics are presented in Table 2.

Table 2
Descriptive statistics of the study variables

Variables	*M*	*DT*	Min.-Max.	Skewness	Kurtosis	Shapiro-Wilk	*p*
GEOPTE total[a]	36.3	10.7	15.4-64.4	3.5	0.6	0.969	< .001
Basic cognition	19.0	6.7	9.0-41.0	5.3	2.4	0.947	< .001
Social cognition	14.1	5.0	6.0-27.0	2.1	1.1	0.979	< .001
PANSS total	71.3	28.2	30.0-191.0	4.9	1.9	0.944	< .001
Positive	8.3	4.6	3.0-21.0	3.9	2.0	0.914	< .001
Negative	18.6	8.3	6.0-37.0	2.3	3.0	0.951	< .001
Depressive	6.4	3.6	3.0-20.0	7.5	2.7	0.852	< .001
Cognitive	7.2	3.9	3.0-20.0	5.4	0.1	0.899	< .001
Excitatory	11.5	5.9	7.0-44.0	13.4	19.8	0.761	< .001

Note: [a] GEOPTE score with Geometric mean index.

Construct validity and reliability

Based on the original proposal of the GEOPTE scale for social cognition by Sanjuán et al. (2003), two models were contrasted, one with a factorial structure of two covariate dimensions (M1) and the other unidimensional (M2), through the sources of information of the geometric mean indicator (GMI), patient and caregiver.

According to the most commonly used fit criteria in the literature (CFI> 0.90; TLI> 0.90; RMSEA < 0.08) the two-dimensional covariate (M1) and one-dimensional (M2) model, both in the GMI, patient and caregiver information sources, evidenced to be partially sufficient and even insufficient explanations of the observed covariation matrix, as CFI and TLI were below 0.90 or RMSEA exceeded the 0.08 criterion (Schreiber, 2017). To decide whether the models needed re-specifying, the modification indexes were reviewed, which suggested correlating items 9 and 10 ("*When you are in a group, are you often told that you misinterpret others' attitudes, looks, or gestures?*" and "*Do you feel very sensitive to others' looks, words, or gestures?*") of the social cognition dimension in both models, as they could allow increasing the models' fit. The revised models (M1-R and M2-R) for the GMI, patient and caregiver, evidenced a significant improvement in the comparative and absolute fit indicators, being a sufficient explanation of the observed covariation matrix. Likewise, the comparison between the re-specified models showed that the

covariate model (M1-R) fits substantially better than the unidimensional model (M2-R). Therefore, the re-specified covariate model (M1-R) was used as a reference for the CFA-multigroups. Details of the fit of the measurement models are presented in Table 3.

Table 3
Indicators of overall fit of measurement

Models	Par.	χ^2	df	CFI	TLI	RMSEA	90% IC RMSEA	
							Min.	Max.
GMI								
M1	75	338.65	89	0.924	0.911	0.107	0.095	0.119
M1-R	76	219.51	88	0.960	0.952	0.078	0.065	0.091
M2	74	528.29	90	0.867	0.845	0.141	0.129	0.152
M2-R	75	248.22	89	0.952	0.943	0.085	0.073	0.098
Patient								
M1	76	320.38	89	0.916	0.901	0.103	0.091	0.115
M1-R	77	226.33	88	0.950	0.940	0.080	0.067	0.093
M2	75	439.92	90	0.874	0.852	0.126	0.114	0.138
M2-R	76	232.72	89	0.948	0.939	0.081	0.068	0.094
Caregiver								
M1	76	339.59	89	0.939	0.928	0.107	0.095	0.119
M1-R	77	246.44	88	0.961	0.954	0.086	0.073	0.098
M2	75	541.87	90	0.890	0.872	0.143	0.131	0.155
M2-R	76	286.90	89	0.952	0.943	0.095	0.083	0.107

Notes: Par.= Number of parameters; CFI= comparative fit index; TLI= Tucker-Lewis index; RMSEA= root mean square error of approximation; M1= CFA with two covariate dimensions, 15 items; M1-R= CFA with two covariate dimensions revised; M2= unidimensional CFA, 15 items; M2-R= unidimensional CFA revised, 15 items.

Invariance

For the GMI and caregivers, only metric invariance was evidenced according to the sex variable, since the metric model (restricted) compared to the configural model (unrestricted) did not show changes greater than 0.010 in the deltas CFI and RMSEA (GMI: ΔCFI= -0.001, ΔRMSEA= -0.004; Caregivers: ΔCFI= -0.001, ΔRMSEA= -0.003) and when comparing the scalar model (restricted) with the configural model (unrestricted) the delta RMSEA showed considerable fit changes, suggesting, as in patients, equivalence between factor loadings, but not equivalence between intercepts, indicating that items possess the same meaning between men and women. Likewise, neither metric nor scalar invariance was observed among caregivers, suggesting that the interpretation of the items could be different depending on the country of residence (Bolivia, Chile or Peru).

Both in the model for GMI, patients and caregivers, factor loadings evidenced moderate ($\lambda > 0.30$) and strong ($\lambda > 0.50$) (Cohen, 1988) representations on each factor and were statistically different from 0 in the population, in addition to presenting large ($r > 0.5$) and significant (Cohen, 1988) factorial covariations between the dimensions of basic cognitive functions and social cognition. Finally,

for the IMG model, patients and caregivers, reliability estimates for each dimension were satisfactory (> 0.80) or at least sufficient (> 0.70), depending on whether Cronbach's alpha or McDonald's hierarchical omega is used. Details of factor loadings, covariations between factors, and reliability estimates for each dimension are presented in Table 4.

For patients, both factorial invariance according to sex and by country evidenced only the presence of metric invariance, since the metric model (restricted) compared to the configural model (unrestricted) did not present modifications greater than 0.010 in the deltas CFI and RMSEA (ΔCFI= 0.002, ΔRMSEA= -0.005), while, when comparing the scalar (constrained) model with the configural (unconstrained) model the delta RMSEA showed considerable fit changes, which highlights equivalence between factor loadings, but not equivalence between intercepts, suggesting that the items possess the same meaning between the two groups. The details of factorial invariance are presented in Table 5.

Discriminant validity

The GEOPTE scale of social cognition in its total version, together with its dimensions of basic cognitions and social cognition showed slight (*r* > 0.1), moderate (*r* > 0.3) and large (*r* > 0.5) direct associations (Cohen, 1988) different from zero in the population in all the dimensions of the PANSS and its total version, except for the depression factor that did not show statistically significant associations with the dimensions of the GEOPTE scale and its total version. This suggests that, as patients manifest a worse state in social cognition, they will also tend to present a greater degree of severity in their psychotic symptomatology and vice versa. The details of the validity results based on the relationship with other variables are presented in Table 6.

Table 4

Standardized factor loadings, factorial covariates and reliability coefficients (alpha and McDonald's) for each dimension

Items	GMI			Patient			Caregiver		
	M (SD)	Factor loadings BC	SC	M (SD)	Factor loadings BC	SC	M (SD)	Factor loadings BC	SC
Do you have difficulty paying attention?	2.24 (1.03)	.639**		2.35 (1.33)	.611**		2.60 (1.24)	.666**	
Do you have difficulty following a conversation involving several people?	2.40 (1.11)	.728**		2.48 (1.39)	.744**		2.79 (1.35)	.728**	
Do you have difficulty learning new things?	2.24 (1.06)	.657**		2.39 (1.36)	.626**		2.64 (1.41)	.660**	
Do you forget errands, tasks or errands?	2.08 (0.99)	.490**		2.15 (1.28)	.546**		2.46 (1.27)	.608**	
When you have to talk to someone, are you at a loss for words?	2.47 (1.18)	.736**		2.65 (1.43)	.703**		2.80 (1.41)	.786**	
Do you have trouble understanding what a movie is about?	1.82 (1.03)	.771**		2.04 (1.31)	.715**		1.90 (1.22)	.699**	
Do you have trouble making sense of a conversation?	1.67 (0.89)	.706**		1.79 (1.11)	.730**		1.90 (1.15)	.667**	
If you are alone at home and a problem arises (e.g., an appliance breaks down): Do you find it difficult to find a solution?	2.20 (1.30)	.573**		2.25 (1.55)	.553**		2.60 (1.56)	.611**	
Do you find it difficult to maintain personal hygiene (being clean and neat)?	2.14 (1.20)	.695**		2.14 (1.39)	.704**		2.56 (1.48)	.592**	
Do you have difficulty recognizing the emotions of others?	1.54 (0.83)		.615**	1.65 (1.16)		.548**	1.74 (1.16)		.569**
When you are in a group, are you often told that you misinterpret the attitudes, looks or gestures of others?	2.17 (1.14)		.613**	2.22 (1.39)		.604**	2.52 (1.36)		.661**
Do you feel very sensitive to the looks, words or gestures of others?	2.31 (1.14)		.603**	2.40 (1.41)		.648**	2.63 (1.41)		.650**
Do you find it difficult to make plans for the weekend?	2.92 (1.43)		.618**	3.03 (1.61)		.597**	3.29 (1.60)		.679**
Do you have difficulty making friends?	2.69 (1.38)		.593**	2.85 (1.69)		.482**	3.11 (1.61)		.674**
Are you dissatisfied with your sex life?	2.85 (1.48)		.361**	3.02 (1.75)		.468**	3.07 (1.66)		.373**
Factorial covariations									
Basic cognitions	---	---	.819**	---	---	.906**	---	---	.787**
Reliability estimators									
Alfa (α)	---	.851	.715	---	.833	.689	---	.844	.732
Omega (ω)	---	.856	.741	---	.837	.710	---	.848	.754

Notes: GMI= Geometric mean index; BC= Basic cognitive functions; CS= Social cognition. **p< .01; *p< .05.

Table 5
Measurement invariance test

	χ^2	df	CFI	RMSEA	$\Delta\chi^2$	Δ_{gl}	$P_{\Delta\chi^2}$	Δ_{CFI}	Δ_{RMSEA}
GMI									
Gender									
Configural	485.9	178	.920	.119	---	---	---	---	---
Metrical	503.7	191	.919	.115	26.9	13	.012	-.001	-.004
Scalar	509.2	233	.928	.098	70.5	55	.077	.008	-.021
Country									
Configural	596.1	267	.912	.121	---	---	---	---	---
Metrical	677.1	293	.898	.125	98.6	26	.000	-.014	-.004
Scalar	750.7	377	.900	.109	226.9	110	.000	-.012	-.012
Patient									
Gender									
Configural	427.3	178	.932	.107	---	---	---	---	---
Metrical	434.6	191	.934	.102	10.4	13	.654	.002	-.005
Scalar	463.7	234	.937	.089	71.6	56	.078	.005	-.018
Country									
Configural	602.1	267	.941	.122	---	---	---	---	---
Metrical	646.1	293	.937	.120	58.6	26	.000	-.004	-.002
Scalar	751.2	379	.934	.108	216.8	112	.000	-.007	-.014
Caregiver									
Gender									
Configural	455.6	178	.958	.112	---	---	---	---	---
Metrical	473.0	191	.957	.109	25.7	13	.018	-.001	-.003
Scalar	501.5	234	.960	.096	84.8	56	.007	.002	-.016
Country									
Configural	414.6	228	.923	.099	---	---	---	---	---
Metrical	472.4	252	.909	.102	66.8	24	.000	-.014	.003
Scalar	676.3	332	.858	.111	295.5	104	.000	-.065	.012

Note: GMI= Geometric mean index; CFI= comparative fit index; RMSEA= root mean square error of approximation.

Table 6
Evidence of validity based on the relationship with other variables using a Spearman correlation matrix

PANSS	GEOPTE Scale		
	GEOPTE Total	Basic cognitions	Social cognitions
PANSS Total	0.589**	0.486**	0.532**
Positive	0.399**	0.309**	0.425**
Negative	0.632**	0.544**	0.560**
Cognitive	0.547**	0.473**	0.445**
Depressive	0.094	0.077	0.053
Excitative	0.294**	0.277**	0.232**

Notes: PANSS= Positive and Negative Syndrome Scale; GEOPTE Scale= GEOPTE Scale of Social Cognition for Psychosis; **$p< .01$; *$p< .05$.

Discussion

The purpose of this study was to validate the GEOPTE scale in three Latin American countries, due to the need for short and low-cost measurements for the Mental Health Services of these Regions.

The results show that the fit indicators of the revised covariate two-dimensional model (M1-R), together with the effect size of the factor loadings, support the adequacy between the original theoretical factor structure of the GEOPTE scale (Sanjuán et al., 2003) and the one coming from this validation, that is, that the dimensions of basic cognitive functions and social cognition are satisfactorily explained by a solution of two covariate dimensions, providing at the same time evidence of validity based on the internal structure, which allows an adequate interpretation of the scores of the dimensions of social cognition in patients with a diagnosis of schizophrenia. Furthermore, adequate indicators of fit in the revised covariate model (M1-R) as well as in the revised unidimensional model (M2-R) also allow the scale to be used two-dimensionally as well as unidimensionally, suggesting that the substantive content of the GEOPTE scale generally assesses social cognition. Reliability estimation based on Cronbach's alpha and McDonald's omega coefficients suggest satisfactory levels of internal consistency, which minimizes measurement errors. Regarding validity based on association with other variables, it is observed that the associations of the dimensions of the GEOPTE scale (basic cognitions and social cognition), as well as of its total version and the dimensions of the PANSS together with its total version are in the expected direction and in accordance with what has been pointed out in previous research (Caqueo-Urízar et al., 2015; Caqueo-Urízar et al., 2016; Fretland et al., 2015; Vaskinn et al., 2018), except for the associations between the PANSS depression factor. These findings are consistent with adaptation and validation studies conducted in Italian and Portuguese clinical samples (Pelizza et al., 2019; Filipa, 2011), in addition to suggesting that the GEOPTE scale has satisfactory psychometric properties for measuring social cognition in patients with a diagnosis of schizophrenia in Latin American countries.

While it is only possible to support metric invariance according to sex on the GEOPTE scale, the interpretation of the comparison between the levels of social cognition of male and female patients with diagnosis of schizophrenia is recommended. However, when comparing social cognition levels by country, caution is necessary when interpreting differences. This finding of weak invariance for the sex of the participants could be due to the existing differences in prevalence, symptomatology and responses to treatment that clinical observations manifest (Li et al., 2016; Riecher-Rössler et al., 2018), where the majority of patients diagnosed with schizophrenia tend to be men, who also present more negative symptoms compared to women (Caqueo-Urízar et al., 2018). The non-presence of invariance according to the country of residence, could probably respond to the fact that patients from Bolivia, Chile and Peru, despite being bordering countries, which share various cultural aspects, such as language, beliefs and customs, conceive schizophrenia differently, which could be affected by the patient's own perception of their diagnosis, as well as in the familiarization with the symptomatology and/or

treatment, which are subject to the different public health policies used between countries, namely, in Chile, the presence of the program called "Garantías Explícitas en Salud (Explicit Guarantees in Health; GES)" guarantees benefits by law for people with a diagnosis of schizophrenia or other mental disorder, ensuring care and antipsychotic drugs unlike Peru and Bolivia, where access to medicines is not universal for the population of patients diagnosed with schizophrenia (Ministerio de Salud [MINSAL], 2016).

This study has at least two limitations. First, this study used the modification indexes to allow for the association between item 9 and 10 errors ("When you are in a group, are you often told that you misinterpret the attitudes, looks, or gestures of others?" and "Do you feel very sensitive to the looks, words, or gestures of others?"), which consequently improved the fit. This strategy is justified by the similarity of the content presented by both items (MacCallum et al., 1992). Secondly, this study also used a non-probabilistic sampling strategy, by convenience, which does not fully represent all patients with diagnoses of schizophrenia in Bolivia, Chile and Peru, therefore, it is necessary to conduct new studies with samples that present a greater representativeness.

Despite the limitations and in order to obtain new evidence of validity and reliability, it is recommended to apply the GEOPTE scale of social cognition for psychosis in mental health centers in the rest of the countries that share the region, such as Colombia, Argentina, among others. The incorporation of the GEOPTE scale in assessment protocols in mental health services will provide relevant information to promote the inclusion of interventions to address and improve, as far as possible, social cognition and thus increase the daily functioning of patients with schizophrenia.

The findings of this study provide sufficient evidence for the use of the GEOPTE cognition scale for psychosis in patients with schizophrenia in Latin American countries. The results suggest that this scale can be used by mental health professionals in Bolivia, Chile and Peru, as well as to develop research in the clinical area in these Latin American regions.

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