Psicothema

Psicothema 2019, Vol. 31, No. 2, 210-217
doi: 10.7334/psicothema2018.308

ISSN 0214 - 9915 CODEN PSOTEG

www.psicothema.com

Spanish validation of the Aberrant Salience Inventory in a general adolescent population

Sandra Fernández-León[1], Cristina Senín-Calderón[2], María Luisa Gutiérrez-López[3], and Juan F. Rodríguez-Testal[4]
[1] Hospital Juan Ramón Jiménez (Huelva), [2] University of Cádiz, [3] Infanta Elena Hospital, and [4] University of Seville

Abstract

Background: Aberrant salience (AS), related to classical delusional mood and self-disturbances, may be one of the keys to early detection of psychosis, before abnormal assignment of significance. As adolescence is a critical period in development of the self and there are few instruments for evaluating AS, validation of the Aberrant Salient Inventory (ASI) is proposed for use in the general adolescent population. **Methods:** A sample of 4,523 participants, 53.6% women, from 11 to 18 years of age (M = 14.31, SD = 1.66), from 29 schools in Western Andalusia (Spain) were evaluated collectively. **Results:** Good fit was found in the answers, and the original five-factor structure of the inventory was replicated. Reliability (ordinal alpha) was adequate both for the total (.95) and for the factors (.74. to .85). Invariance across sex, adequate indicators of concurrent (ideas of reference) and divergent (negative symptoms) validity, and sensitivity of .88 were found. **Conclusions:** The results suggest the ASI for use in the general adolescent population, and show that 7% of the sample could be at risk of beginning psychosis.

Keywords: Aberrant salience, adolescence, psychosis, risk, general population.

Resumen

Validación española del Inventario de Saliencia Aberrante en población general adolescente. **Antecedentes:** la Saliencia Aberrante (SA), relacionada con el estado de ánimo delirante clásico y las perturbaciones de self, puede ser una de las claves para la detección temprana de la psicosis, antes de la asignación anormal de significados. Como la adolescencia es un período crítico en el desarrollo del yo y los instrumentos para evaluar la SA son pocos, se propone la validación del Inventario de Saliencia Aberrante (ASI) para su uso en población general adolescente. **Método:** participaron 4.523 sujetos, 53,6% mujeres, de 11 a 18 años de edad (M = 14.31, SD = 1.66) de 29 centros escolares de Andalucía Occidental (España). **Resultados:** se encontró un buen ajuste en las respuestas y se replicó la estructura original de cinco factores del inventario. La fiabilidad (alfa ordinal) fue adecuada tanto para el total (.95) como para los factores (de .74. a .85). Se halló invarianza a través del sexo, indicadores adecuados de validez concurrente (ideas de referencia) y divergente (síntomas negativos), y sensibilidad de .88. **Conclusiones:** se sugiere el interés del ASI para su uso en población general adolescente, y se muestra que el 7% de los participantes podrían estar en riesgo de psicosis.

Palabras clave: saliencia aberrante, adolescencia, psicosis, riesgo, población general.

From classical clinical contributions, delusional mood has been described as an abnormal experiential state, of indescribable sensations, of imminent, prior to the onset of delusion (Conrad, 1958/1997). It is observed in different psychoses (not always culminating in delusion), sometimes hard to recognize and communicate (e.g., intense anxiety or depression), but absent in diagnostic classifications (Henriksen & Parnas, 2018).

The concept of aberrant salience (AS) (Kapur, 2003) spread from a physiological perspective. Psychosis would thus be a state of AS mediated by dopaminergic dys(regulation): from normal processing of novel stimulation and acquisition of motivational salience (adaptive salience), to processes by which irrelevant stimuli are considered salient due to genetic and environmental proneness (Kapur, Mizrahi, & Li, 2005).

There has been abundant research attempting to pinpoint this process linked to onset of psychosis and the one final common pathway of presynaptic striatal hyperdopaminergia (Howes & Kapur, 2009). In vulnerable individuals (at-risk mental states, ARMS) descending inputs from the hippocampus to the ventral striatum are related, and from the ventral pallidum pathway, the dopaminergic projection goes to the midbrain (Winton-Brown et al., 2017). After that, the information becomes personally relevant (Henriksen & Parnas, 2018).

It seems that in ARMS, both adaptive and aberrant salience stimuli function normally, although less clearly than in cases identified as psychotic. AS would be an initial state in which some processes precipitate delusion (such as jumping to conclusions), and others maintain the delusional activity (Abboud et al., 2016). It is related to negative symptoms (Roiser et al., 2009) and difficulty focusing and changing attention (Nelson et al., 2009).

From the proneness-persistence-impairment model, the phenotype of psychosis is expressed on, clinically speaking,

Received: November 9, 2018 • Accepted: March 5, 2019
Corresponding author: Cristina Senín-Calderón
Department of Psychology
University of Cadiz (Spain)
11510 Puerto Real (Spain)
e-mail: cristina.senin@uca.es

subthreshold levels, and therefore, AS is phenomenological and temporally close to the concept of psychotic-like experiences (PLE) (Cicero & Cohn, 2018). PLE are relatively frequent in the general population (about 7-8%), and often transitory (80%) (Fonseca-Pedrero & Debbané, 2017). Repeated exposure (stressful factors, substance use, etc.) can lead to persistence of more specific PLEs and later move toward psychosis (Linscott & van Os, 2013).

Some studies have shown that AS was associated with the PLEs to a greater extent in those evaluated with ARMS than among those who presented first episode psychosis or the healthy control group (Reininghaus et al., 2016). The evaluation of AS is, therefore, useful as an indicator (and/or motor) of onset of psychosis, which shows the relationship and persistence of PLEs (Van Os and Linscott, 2012).

Both individuals with PLEs who do not require care and are not affected by them (Peters et al., 2016), and those identified with PLEs but are false positives for psychosis, are considered to be at subclinical risk for various disorders (Van der Steen et al., 2018), and are subtle expressions of AS (Van Os & Linscott, 2012).

In recent years, it has been attempted to reorient the study of schizophrenia spectrum disorders and their previous stages toward a disturbance of the basic sense of self, as suggested by many of the classics (Bleuler, Kraepelin, Blankenburg, etc.). The usefulness of studying the basic or attenuated positive symptoms on which the criteria of clinical risk are based is questioned (Peters et al., 2016) and focus is on the disruption of the sense of ownership of experience and agency of action (Ipseity). AS contributes to this basic self-disturbance, causing hyper-reflexivity (failure to suppress attention to innocuous stimuli or excessive attention to what is familiar; Nelson et al., 2014).

Adolescence is a crucial moment in development of the self. Some studies in the general population have shown the presence of attenuated, intermittent or confirmed psychotic symptoms in adolescents 11 to 13 years of age (Kelleher et al., 2012). PLEs are also related to depression and suicidal ideation at ages 14 to 19 (Jang et al., 2014). Nevertheless, in spite of the associated distress, a percentage of these adolescents are non-help-seeking. It therefore seems relevant to pay attention to the anomalous self-experiences (Koren, Lacoua, Rothschild-Yakar, & Parnas, 2016) and processes, such as AS, linked to proneness to psychosis in a sensitive period of evolutionary development.

For example, AS has been related to constructs concerning the self, such as self-concept clarity (Cicero et al., 2013). Functioning is adequate to the extent that beliefs about the person's attributes are clear and consistent. Confusion about the self (low self-concept clarity) can precipitate search for meaning, which combined with AS, leads to intensification of PLEs (Cicero et al., 2017).

This study concentrates on the *Aberrant Salience Inventory* (ASI; Cicero et al., 2010). There are no other self-reports specific to AS, although there are instruments related to self-disturbance, which includes items alluding to this process (Cicero et al., 2017). The ASI may be relevant for analyzing some particular experiences related to the self, which still have no psychotic significance.

This study is original in that its main objective is validation of the ASI in a general very young adolescent Spanish population. The Italian version, with adequate psychometric properties, includes ages from 19 onward (Raballo et al., 2017). We place the focus of interest on periods of early crucial development of the self which can be useful for precise knowledge of the onset of psychosis and progressing in its prevention, delay, or improvement. The specific objectives were: 1) study the internal structure of the ASI inventory, 2) analyze invariance of measurement of ASI scores across sex, 3) find the internal consistency of the ASI inventory and evidence of concurrent and discriminant validity, 4) find the clinical cutoff point of the ASI.

Method

Participants

The sample was made up of 4,602 participants, although after elimination of 79 subjects because of missing data, 4,523 remained in the final sample, of whom 53.6% were women. Their ages varied from 11 to 18 (M = 14.31, SD =1.66).

Instruments

The Aberrant Salience Inventory (ASI, Cicero et al., 2010). This measure of proneness to psychosis has 29 items with a dichotomous response format (true or false) which evaluate assignment of significance or importance to stimuli which are usually innocuous. In exploratory factor analysis using principal-axis, the authors of the inventory found five first-order factors and one overall second-order factor. The factors are: Increased Significance (IS), Senses Sharpening (SS), Impending Understanding (IU), Heightened Emotionality (HE), and Heightened Cognition (HC). IS refers to attribution of importance to situations or stimuli which are normally innocuous. SS refers to a feeling of greater sensitivity or acuteness of the senses. IU refers to the feeling of facing something important but not knowing exactly what it is. HE is related to emotional and inner experiences which occur while the person is trying to find an explanation for the salient stimuli. The HC factor includes items related to the feeling of discovering that changes are occurring in the world or in the surroundings. The authors designed the inventory for unidimensional use. The complete inventory showed high internal consistency (Cronbach's α = .89) and evidence of concurrent validity with other measures of proneness to psychosis.

The inventory was translated using Back Translation, with two expert translators, one a native speaker of English from the US and the other a native Spanish speaker (Table 1), following the instructions for instrument adaptation (Muñiz, Elosua, & Hambleton, 2013).

Referential Thinking Scale REF (Lenzenweger, Bennett, & Lilenfeld, 1997, Spanish Senín-Calderón et al., 2010). 34 true/false items which evaluate the attribution of casual situations or events (looks, gestures, laughs) to oneself. The authors of the scale found internal consistency of .83 to .85 and high correlations with measures of aberrant perception and magical ideation. The Spanish validation of the scale showed an α = .90 and test-retest reliability of r = .76 (mean interval of 44 days). The Cronbach's α found for the total scale in this study was α = .83.

Self-evaluation of Negative Symptoms. Spanish version Senín-Calderón, Perona-Garcelán, Bellido-Zanin, Medina-Pradas, & Rodríguez-Testal (2017). This scale evaluates negative symptoms in 20 items with three answer choices. It is comprised of five dimensions (avolition, alogia, anhedonia, asociality and diminished emotional range) although a total score can be used. The authors of the scale found a Cronbach's α = .87 for the total scale. The Spanish validation had an ordinal alpha = .92. In this study the Cronbach's α = .82.

Table 1
Aberrant Salience Inventory Spanish version (Cicero et al., 2010)

Instructions: Please read the following questions and answer them true (T) or false (F) as they apply to you in different situations and experiences. There are not right or wrong answers. [*Instrucciones*: por favor, lee las preguntas siguientes y contesta verdadero (V) o falso (F) según se apliquen a ti en diferentes situaciones y experiencias. No hay respuestas correctas ni erróneas.]
1. Do certain trivial things ever suddenly seem especially important or significant to you? [¿Te sucede que algunas cosas habituales o triviales de pronto adquieren una importancia o significado especial para ti?]
2. Do you sometimes feel like you are on the verge of something really big, but you're not sure what it is? [¿Sientes a veces que estás cerca o a punto de algo realmente importante, pero no estás seguro de qué es?]
3. Do your senses sometimes seem sharpened? [¿Sientes algunas veces que tus sentidos (vista, oído, etc.) parecen sensibles o se agudizan?]
4. Do you ever feel like you are rapidly approaching the height of your intellectual powers? [¿Has sentido alguna vez como si te acercaras rápidamente al tope de tu capacidad intelectual?]
5. Do you sometimes notice small details that you have not noticed before that seem important? [¿A veces notas que pequeños detalles a los cuales antes no echabas cuenta parecen importantes?]
6. Do you sometimes feel like it is important for you to figure something out, but you're not sure what it is? [¿A veces sientes que es importante para ti comprender algo, pero no estás seguro de qué es o a qué te refieres?]
7. Do you ever go through periods where you feel especially religious or mystical? [¿Pasas alguna vez por periodos en los que te sientes especialmente religioso o místico?]
8. Do you ever have difficulty telling if you are thrilled, freightened, pained, or anxious? [¿Has tenido alguna vez dificultad en distinguir si has estado emocionado, asustado, apenado, o ansioso?]
9. Do you ever go through periods of heightened awareness? [¿Algunas veces pasas por periodos de mayor sensibilidad (o que te das más cuenta de cualquier cosa)?]
10. Do you ever feel the need to make sense of seemingly random situations or occurrences? [¿Has sentido alguna vez la necesidad de dar sentido a situaciones o sucesos aparentemente azarosos o casuales?]
11. Do you sometimes feel like you are finding the missing piece to a puzzle? [¿Te sientes a veces como si encontrases la pieza perdida de un rompecabezas?]
12. Do you sometimes feel that you can hear with a greater clarity? [¿Algunas veces sientes que puedes oír con mayor claridad?]
13. Do you sometimes feel like you are an especially spiritually evolved person? [¿Sientes a veces que eres una persona con una espiritualidad especialmente desarrollada?]
14. Do normally trivial observations sometimes take on an ominous significance? [¿Las observaciones más habituales o cotidianas tienen a veces un significado negativo o de mal agüero?]
15. Do you go through periods in which songs sometimes seem to have an important meaning for your life? [¿Pasas por periodos en los que las canciones parecen tener un significado importante en tu vida?]
16. Do you sometimes attribute importance to objects which you normally would not? [¿Algunas veces atribuyes importancia a objetos o cosas que normalmente no darías?]
17. Do you sometimes feel like you are on the verge of figuring out something really big or important, but you aren't sure what it is? [¿Sientes algunas veces que estás a punto de averiguar algo realmente grande o importante, pero no estás seguro de qué se trata?]
18. Has your sense of taste ever seemed more acute? [¿Te ha parecido alguna vez que tu sentido del gusto era más agudo o preciso?]
19. Do you ever feel like the mysteries of the universe are revealing themselves to you? [¿Has sentido alguna vez como si los misterios del universo se te estuviesen revelando a ti?]
20. Do you go through periods in which you feel overstimulated by things or experiences that are normally manageable? [¿Pasas por periodos en los que te sientes sobreestimulado o saturado por cosas o experiencias que normalmente son manejables?]
21. Do you often become fascinated by the little things around you? [¿A menudo te sientes fascinado o atraído por las cosas sin importancia que te rodean?]
22. Do your senses ever seem extremely strong or clear? [¿Alguna vez tus sentidos (vista, oído, etc.) llegan a parecer extremadamente fuertes o claros?]
23. Do you ever feel like a whole world is opening up to you? [¿Sientes alguna vez como si el mundo entero se te estuviese abriendo hacia ti?]
24. Do you ever feel that your boundaries between inner and outer sensations have been removed? [¿Has sentido en algún momento que has perdido los límites entre tus sensaciones internas y externas?]
25. Do you sometimes feel like the world is changing and you are searching for an explanation? [¿Sientes a veces que el mundo está cambiando y que tratas de buscar una explicación?]
26. Do you ever have a feeling of inexpressible urgency, and you are not sure what to do? [¿Alguna vez has sentido una urgencia inexpresable, y no estás seguro de qué hacer?]
27. Have you sometimes become interested in people, events, places, or ideas that normally would not make an impression on you? [¿Algunas veces has llegado a interesarte por personas, sucesos, lugares, o ideas que normalmente no te llaman la atención?]
28. Do your thoughts and perceptions ever come faster than can be assimilated? [¿En algún momento tus pensamientos y percepciones van más rápido de lo que pueden asimilarse?]
29. Do you sometimes notice things that you haven't noticed before that take on a special significance? [¿A veces notas que cosas a las cuales antes no prestabas atención tienen un significado especial?]

Procedure

Data were collected at 29 high schools in the provinces of Western Andalusia (Spain). The tests were administered during school hours by expert psychologists. Parents and guardians signed their informed consent authorizing participation of the children in the study. The study was approved by the Bioethical Committee of the Andalusian Government.

Data analysis

Descriptive statistics of the items were calculated. The sample was divided at random into two groups for cross validation. An exploratory factor analysis (EFA) was done to analyze the internal structure of the ASI inventory with Sample 1 and then confirmatory factor analysis (CFA) was done with Sample 2. The goodness-of-fit indicators were evaluated by the Comparative Fit

Index (CFI), Non-Normed Fit Index (NNFI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR). To prove invariance of measurement across sex, we tested model fit separately for men and women, and later performed a multigroup CFA. Model fit was evaluated with the ΔCFI. There is invariance if the Δ in CFI is <.01 (Cheung & Rensvold, 2002). To estimate reliability, the McDonald's Omega was found for the inventory total and the ordinal alpha for each factor and total score. To find evidence of concurrent and discriminant validity, respectively, the Pearson's correlations between the total score on the REF scale and the factors of the ASI, including total the ASI score, and between these and the total score on the negative symptoms scale were found. Finally, the ROC curve was calculated to find out the sensitivity and specificity of the ASI inventory and its cutoff point.

Results

Descriptive statistics

Table 2 shows the descriptive statistics for each of the items on the ASI inventory. Skewness and kurtosis of the items were not especially high, although the Mardia test was statistically significant (6.05, $p < .001$) showing that the assumption of multivariate normality was not met. Statistically significant differences were found between men ($M = 14.26$, $SD = 5.74$) and women ($M = 15.77$, $SD = 5.21$), $t(4521) = -9.25$, $p < .001$, Cohen's $d = .28$ in the ASI inventory total score. 29.8% of the scores were in the 25th percentile (12 points), 48% in P50 (16 points), 21.5% in P75 (19 points), establishing risk at P90 (22 points): 7% of the participants.

Table 2
Descriptive statistics of items on the Aberrant Salience Inventory

Items	Mean	SD	Skewness	Kurtosis
1	.737	.440	-1.079	-.836
2	.619	.485	-.491	-1.759
3	.528	.499	-.114	-1.988
4	.293	.455	.910	-1.172
5	.855	.352	-2.024	2.099
6	.651	.478	-.633	-1.600
7	.299	.458	.880	-1.226
8	.453	.498	.187	-1.966
9	.773	.419	-1.306	-.293
10	.484	.499	.063	-1.997
11	.513	.499	-.054	-1.998
12	.509	.500	-.035	-2.000
13	.305	.460	.848	-1.282
14	.277	.448	.996	-1.009
15	.752	.432	-1.17	-.641
16	.642	.479	-.594	-1.648
17	.486	.500	.054	-1.998
18	.314	.464	.800	-1.361
19	.216	.411	1.38	-.089
20	.590	.492	-.365	-1.868
21	.576	.494	-.310	1.905
22	.365	.481	.561	-1.686
23	.340	.474	.677	-1.543
24	.339	.473	.681	-1.537
25	.569	.496	-.277	-1.924
26	.554	.497	-.218	-1.954
27	.789	.408	-1.42	.019
28	.552	.500	-.089	-1.993
29	.718	.450	-.971	-1.057
Total	15.07	5.51	-.398	-.128

Evidence of ASI internal structure validity

An EFA was done using the Principal Components extraction method with oblimin direct rotation. The matrix of tetrachoric correlations was used. The Kaiser-Meyer-Olkin index was .89, 95% CI [.894, .900] and Bartlett's statistic test $_{(406)}$= 8724.9 ($p < .001$). Parallel Analysis recommended five factors explaining 49% of the variance. The structure found is very similar to what the authors of the inventory found with some variations which are discussed below. The first factor groups the items related to "Increased Significance", where the same factors loaded as in the original inventory (1, 5, 10, 15, 16, 21, 27) although Items 9, 25 and 29 also loaded on it. Items 2, 6, 11 and 17 loaded on the second factor, which the author of the inventory called Impending Understanding. These same factors saturated on the original inventory, but included Item 29. The items related to Heightened Emotionality saturated on the third factor (8, 14, 24, 26, 28, 20, including Item 4). Items 7, 13, 19 and 23 loaded on the fourth factor, related to "Heightened Cognition", the same as on the original inventory factor. Items 4 and 25, which in the original inventory pertained to this factor, saturated with more weight on another factor. Finally, Items 3, 12, 18 and 22 loaded on the fifth factor referring to "Senses Sharpening". In the original inventory, Item 9 was in this factor, but in our analysis, it did not saturate on this factor. Table 3 shows factor loadings and percentage of variance explained by each factor.

A CFA was performed testing three different models. Model 1, taking the EFA structure and a higher-order factor as suggested by the authors of the inventory to interpret the total ASI score. In model 2, the unidimensional structure was analyzed and in Model 3, a two-factor model was performed. Robust Diagonally Weighted Least Squares with Asymptotic Covariance Matrix was used. AS Items 4 and 25 loaded on two factors, which we included in the same factor as the authors of the inventory did in both models 1 and 3 (Heightened Cognition). Goodness-of-fit indicators were acceptable for all three models analyzed. Model 1: Satorra-Bentler Scaled $\chi^2_{(372)} = 1217.48$, $p < .001$, CFI = .984, NNFI = .982, RMSEA = .031, 90% CI [.030, 034], SRMR =.058. Model 2: Satorra-Bentler Scaled $\chi^2_{(377)} = 2682.40$, $p < .001$; CFI = .96, NNFI = .95, RMSEA = .52, 90% CI [.050, .054], SRMR = .049. Model 3: Satorra-Bentler Scaled $\chi^2_{(340)} = 899.57$, $p < .001$, CFI = .989, NNFI = .987, RMSEA = .027, 90% CI [.025, .029], SRMR = .049. Even though the bifactor model had somewhat higher goodness-of-fit indicators, and although very similar to the second-order model, we considered this one more appropriate because it fit the argument by Cicero et al. (2010), and furthermore, the first-order factors were highly correlated to each other (Chen, West, & Sousa, 2006). Figure 1 shows the second order model with standardized factor loadings.

Invariance of measurement across sex

Table 4 shows the results of multiple-group CFA performed to evaluate invariance of measurement across sex. The analyses

Table 3
Exploratory Factor Analysis of ASI

Item	IS	IU	HE	HG	SS[a]
29	**.732**	.129	-.035	.099	-.049
1	**.724**	-.135	.060	.087	.002
5	**.680**	.163	-.071	-.047	-.024
27	**.678**	.024	-.062	-.070	.160
16	**.575**	.019	.029	-.107	.126
9	**.522**	.030	.262	.029	-.018
15	**.500**	.183	.051	.028	-.036
20	**.470**	-.155	.477	.022	.023
10	**.459**	-.155	.305	.118	.004
21	**.444**	.185	.048	.047	.124
25	**.287**	.162	.133	.268	.045
2	.025	**.728**	.191	.007	.030
17	.009	**.727**	-.037	.175	.075
6	.237	**.628**	-.006	-.047	.009
11	.298	**.346**	-.177	.348	.050
14	.060	.140	**.626**	.025	-.005
24	-.020	.336	**.557**	.119	-.005
8	.151	.220	**.498**	-.156	-.011
4	-.142	-.150	**.424**	.379	.117
26	.150	.354	**.342**	-.028	.131
28	.164	.093	**.320**	.197	.268
13	-.079	.107	.024	**.661**	.019
7	.066	-.162	.150	**.633**	-.033
23	.236	.071	-.221	**.628**	.028
19	-.081	.159	.083	**.581**	.137
22	-.090	.090	-.013	.075	**.821**
12	-.022	.024	-.147	.017	**.813**
3	.118	-.141	.154	-.078	**.760**
18	.051	.028	.320	.197	**.664**
Percentage explained variance	26.8%	7.9%	5.3%	4.7%	4.3%

[a]IS: Increased Significance; IU: Impending Understanding; HE: Heightened Emotionality; HG: Heightened Cognition; SS: Senses Sharpening

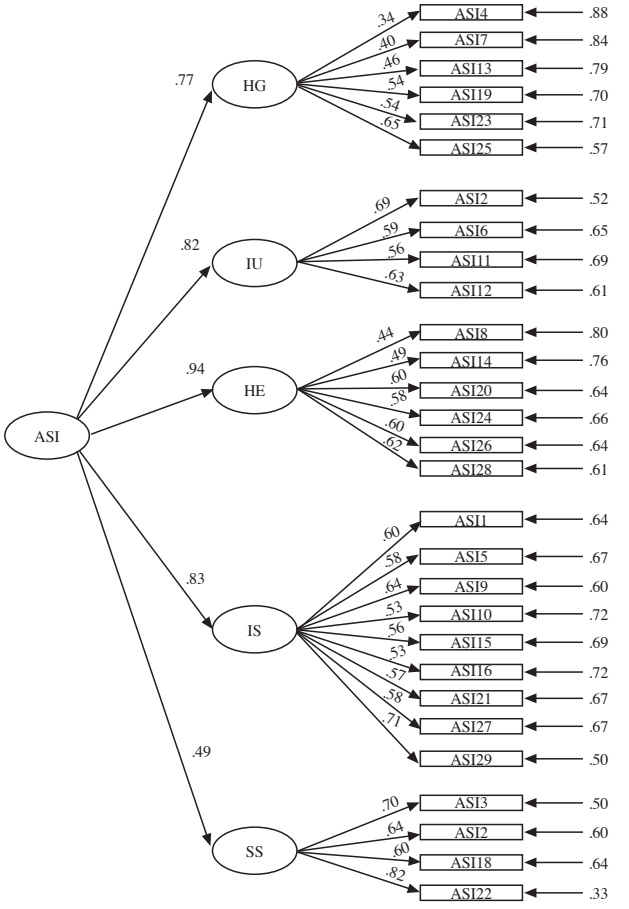

Figure 1. Path diagram and estimates for the five first-order factors related to a second-order of the Aberrant Salience Inventory (ASI)
Note: HG: Heightened Cognition; IU: Impending Understanding; HE: Heightened Emotionality; IS: Increased Significance; SS: Senses Sharpening

of Samples 1 and 2 were performed separately. First a CFA was done for the unconstrained measurement model, where men and women were analyzed separately. Then the baseline model (M0, configural invariance) was estimated with the item loadings on the same factors in both groups and estimating the factor loadings and thresholds freely. As observed in table 4, adequate fit of Model M0 showed evidence of configural invariance. Then the factor loadings and the thresholds were constrained to be equal across sex (M1, scalar invariance). The goodness-of-fit indicators in Model M1 compared to those in M0 increased CFI by less than .01. Therefore, these results show evidence that the ASI inventory is invariant across sex.

ASI reliability

The ordinal alpha of the complete inventory was .95 and McDonald's Omega was .89. The five factors had an acceptable ordinal alpha varying from .74 to .85 (Table 5).

Evidence of validity based on relationships with measures of other variables

High positive correlation was found between the total REF referential thinking scale score and the total ASI score, however, the correlations between the REF and ASI factors were moderate

Table 4
Invariance of measurement of the ASI across sex

Model	Satorra Bentler scaled χ2	df	CFI	RMSEA [90% CI]	ΔCFI
Sample 1					
Men	721.65	372	.989	.030 [.027, .033]	
Women	788.82	372	.984	.030 [.027, .033]	
M0. Configural	1488.45	745	.989	.030 [.028, .032]	
M1. Scalar	1632.58	807	.988	.030 [.028, .032]	-.001
Sample 2					
Men	692.23	372	.986	.029 [.025, .032]	
Women	815.42	372	.985	.032 [.029, .035]	
M0.Configural	1491.31	745	.984	.030 [.028, .032]	
M1. Scalar	1618.30	807	.983	.030 [.028, .032]	-.001

except for the Senses Sharpening factor which was low. The correlations found between the ASI score and factors with the total score on the SNS negative symptoms scale were statistically significant, although very low, except for the Heightened Emotionality factor, which was moderately correlated, showing adequate evidence of divergent validity. The results are shown in table 5.

ROC Curve

The ROC curve was calculated to study the sensitivity and specificity of the ASI inventory. The 90th percentiles on the REF (score ≥ 17) and SNS negative symptoms (score ≥ 19) scales were combined to create a psychometric risk group. As we started out from a general population which had not requested medical or psychological attention, a subgroup of participants was formed with positive and negative indicators at the same time based on a clearly significant percentile of the scores. A total of 152 subjects in the sample (3.36%) showed scores related to the established criterion or psychometric risk group. The ROC curve showed a significant area of .78, 95% CI [.75, .81] with sensitivity of .88 and specificity of .66 for a cutoff point of 17.5 points.

Discussion

Much of current research has focused on the prodromal period, before full development of psychosis. However, some results suggest that attenuated positive symptoms may not be as predictive as the negative and disorganized (Fumero, Marrero, & Fonseca-Pedrero, 2018; Peters et al., 2016). Neither does the study of psychotic experiences (PLEs) in the general population lack drawbacks concerning transition to psychosis (Fusar-Poli et al., 2015).

This study concentrated on validation of the Aberrant Salience Inventory (ASI) in a general adolescent Spanish population. AS, related to classical delusional mood and self-disturbances, may be one of the keys to early detection of psychosis, before processes of abnormal assignment of significance which culminate in delusion (Henriksen & Parnas, 2018).

Table 5
Pearson's correlations between the total ASI and factors, REF and SNS scales

	1	2	3	4	5	6	7	8
1.	.75	.363**	.337**	.334**	.264**	.631**	.343**	.168**
2.		.74	.406**	.414**	.259**	.677**	.415**	.217**
3.			.78	.509**	.278**	.779**	.487**	.337**
4.				.85	.221**	.786**	.406**	.167**
5.					.85	.545**	.280**	.188**
6.						.95	.565**	.313**
7.							.96	.412**
8.								.92

1. Heightened cognition, 2. Impeding Understanding, 3. Heightened Emotionality, 4. Increased Significance, 5. Senses sharpening. 6. Total salience. 7. Total REF. 8. Total SNS. Ordinal alphas for the total ASI and factors, total REF scale and total SNS are shown on the diagonal. **p<.001

The results showed good fit in adolescent responses to the items and the original five-factor inventory of the original structure was replicated: Heightened Cognition, Impending Understanding, Heightened Emotionality, Increased Significance and Senses Sharpening. Reliability was adequate for both overall ASI and its factors.

Responses to the increased significance factor were frequent, which may have to do with the motivational changes and experiences typical of the adolescent stage of life (van Duijvenvoorde, Peters, Braams, & Crone, 2016).

AS was a frequent experience among these youths, with a mean of 15.1 points on the overall ASI (*SD* = 5.5), which is higher than the 13.7 (*SD* = 6.6) found on the original version or the 12.7 (*SD* = 6.7) on the Italian validation of the ASI (Raballo et al., 2017), keeping in mind that in this study the adolescents participating were younger.

Girls scored significantly higher than boys, as was the case with PE (Zammit et al., 2013), but there was invariance across sex, so this variable did not influence how they answered the items.

Concurrent validity was found with the REF scale, mainly with the Heightened Emotionality factor, showing that AS and ideas of reference are processes which are close but not identical, as occurs with others PLEs (Cicero et al., 2013). In the case of divergent validity, negative symptoms were related to significant values due to the sample size. Other contributions have also found a relationship between AS and negative symptoms in patients (Roiser et al., 2009).

However, this study has some limitations which should be considered. Some items on the ASI may be hard for the adolescent population to understand, particularly those having to do with the experiences of demarcation/transitivism (Cicero et al., 2017). The cross-sectional design, selection by accessibility and group application of the tests make the results tentative. Furthermore, reliability retest and clinical interview relating these results to risk of psychosis make it indispensable to avoid its overestimation (Zammit et al., 2013). This study includes clinical follow-up of the participants at psychometric risk, but for reasons of space, it was not discussed in this paper. In view of the above, self-reported information does not lack value, as has been suggested for PLEs (Linscott & Van Os, 2013), as the extent of distress, not only the presence of the criterion measured, should be considered.

Summarizing, availability of an AS inventory such as the ASI would enable its relationship to the appearance of PE, paranoia (So et al., 2018), or positive schizotypy (Raballo et al., 2017), for example, to be studied, due to its reliability, validity and sensitivity for use with a very young community population. 7% of the participants could be at risk of AS, coinciding with the figures for PLEs in the general population (Linscott & van Os, 2013), and therefore follow-up of these scores would be relevant to progress in knowledge of the onset of psychosis.

Acknowledgements

The study was supported by the Ministry of Economy and Competitiveness (Spain) and cofunded with European Regional Development Fund (grant numbers PSI2015-68659-P).

References

Abboud, R., Roiser, J. P., Khalifeh, H., Ali, S., Harrison, I., Killaspy, H. T., & Joyce, E. M. (2016). Are persistent delusions in schizophrenia associated with aberrant salience? *Schizophrenia Research: Cognition*, *4*, 32-38. https://doi.org/10.1016/j.scog.2016.04.002

Chen, F. F., West, S. G., & Sousa, K. H. (2006). A comparison of bifactor and second-order models of quality of life. *Multivariate Behavioral Research*, *41*(2), 189-225. https://doi.org/10.1207/s15327906mbr4102_5

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating Goodness-of- Fit Indexes for Testing Measurement Invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *9*(2), 233-255. https://doi.org/10.1207/S15328007SEM0902

Cicero, D. C., Becker, T. M., Martin, E. A., Docherty, A. R., & Kerns, J. G. (2013). The role of aberrant salience and self-concept clarity in psychotic-like experiences. *Personality Disorders*, *4*(1), 33-42. https://doi.org/10.1037/a0027361

Cicero, D. C., & Cohn, J. R. (2018). The role of ethnic identity, self-concept, and aberrant salience in psychotic-like experiences. *Cultural Diversity and Ethnic Minority Psychology*, *24*(1), 101-111. https://doi.org/10.1037/cdp0000160

Cicero, D. C., Kerns, J. G., & McCarthy, D. M. (2010). The Aberrant Salience Inventory: A New Measure of Psychosis Proneness. *Psychological Assessment*, *22*(3), 688-701. https://doi.org/10.1037/a0019913

Cicero, D. C., Neis, A. M., Klaunig, M. J., & Trask, C. L. (2017). The Inventory of Psychotic-Like Anomalous Self-Experiences (IPASE): Development and validation. *Psychological Assessment*, *29*(1), 13-25. https://doi.org/10.1037/pas0000304

Conrad, K. (1958). *Die beginnende Schizophrenie* [Incipient schizophrenia]. Fundación Archivos Neurobiología. Madrid: Triacastela.

Fonseca-Pedrero, E., & Debbané, M. (2017). Schizotypal traits and psychotic-like experiences during adolescence: An update. *Psicothema, 29*(1), 5-17. https://doi.org/10.7334/psicothema2016.209

Fumero, A., Marrero, R. J., & Fonseca-Pedrero, E. (2018). Well-being in schizotypy: The effect of subclinical psychotic experiences. *Psicothema, 30*(2), 177-182. https://doi.org/10.7334/psicothema2017.100

Fusar-Poli, P., Cappucciati, M., Rutigliano, G., Schultze-Lutter, F., Bonoldi, I., Borgwardt, S., … McGuire, P. (2015). At risk or not at risk? A meta-analysis of the prognostic accuracy of psychometric interviews for psychosis prediction. *World Psychiatry*, *14*(3), 322-332. https://doi.org/10.1002/wps.20250

Henriksen, M. G., & Parnas, J. (2018). Delusional Mood. In G. Stanghellini, A. Raballo, M. Broome, A. Vincent Fernández, S. Fusar-poli & R. Rosfort (Eds.), *The Oxford Handbook of Phenomenological Psychopathology* (Vol. 1, pp. 1-14). Oxford: Oxford Handbooks online.

Howes, O. D., & Kapur, S. (2009). The dopamine hypothesis of schizophrenia: Version III - The final common pathway. *Schizophrenia Bulletin*, *35*(3), 549-562. https://doi.org/10.1093/schbul/sbp006

Jang, J. H., Lee, Y. J., Cho, S. J., Cho, I. H., Shin, N. Y., & Kim, S. J. (2014). Psychotic-like experiences and their relationship to suicidal ideation in adolescents. *Psychiatry Research*, *215*(3), 641-645. https://doi.org/10.1016/j.psychres.2013.12.046

Kapur, S. (2003). Psychosis as a State of Aberrant Salience: A Framework Linking Biology, Phenomenology, and Pharmacology in Schizophrenia. *American Journal of Psychiatry*, *160*(1), 13-23. https://doi.org/10.1176/appi.ajp.160.1.13

Kapur, S., Mizrahi, R., & Li, M. (2005). From dopamine to salience to psychosis-linking biology, pharmacology and phenomenology of psychosis. *Schizophrenia Research*, *79*(1), 59-68. https://doi.org/10.1016/j.schres.2005.01.003

Kelleher, I., Murtagh, A., Molloy, C., Roddy, S., Clarke, M. C., Harley, M., & Cannon, M. (2012). Identification and characterization of prodromal risk syndromes in young adolescents in the community: A population-based clinical interview study. *Schizophrenia Bulletin*, *38*(2), 239-246. https://doi.org/10.1093/schbul/sbr164

Koren, D., Lacoua, L., Rothschild-Yakar, L., & Parnas, J. (2016). Disturbances of the basic self and prodromal symptoms among young adolescents from the community: A pilot population-based study. *Schizophrenia Bulletin*, *42*(5), 1216-1224. https://doi.org/10.1093/schbul/sbw010

Lenzenweger, M. F., Bennett, M. E., & Lilenfeld, L. R. (1997). The referential thinking scale as a measure of schizotypy: Scale development and initial construct validation. *Psychological Assessment*, *9*(4), 452-463.

Linscott, R. J., & van Os, J. (2013). An updated and conservative systematic review and meta-analysis of epidemiological evidence on psychotic experiences in children and adults: on the pathway from proneness to persistence to dimensional expression across mental disorders. *Psychological Medicine*, *43*, 1133-1149. https://doi.org/10.1017/S0033291712001626

Muñiz, J., Elosua, P., & Hambleton, R. K. (2013). Directrices para la traducción y adaptación de los tests: segunda edición. *Psicothema, 25*(2), 151-157. https://doi.org/10.7334/psicothema2013.24

Nelson, B., Fornito, A., Harrison, B. J., Yücel, M., Sass, L. A., Yung, A. R., … McGorry, P. D. (2009). A disturbed sense of self in the psychosis prodrome: Linking phenomenology and neurobiology. *Neuroscience and Biobehavioral Reviews*, *33*(6), 807-817. https://doi.org/10.1016/j.neubiorev.2009.01.002

Nelson, B., Whitford, T. J., Lavoie, S., & Sass, L. A. (2014). What are the neurocognitive correlates of basic self-disturbance in schizophrenia?: Integrating phenomenology and neurocognition. Part 2 (Aberrant salience). *Schizophrenia Research*, *152*(1), 20-27. https://doi.org/10.1016/j.schres.2013.06.033

Peters, E., Ward, T., Jackson, M., Morgan, C., Charalambides, M., McGuire, P., … Garety, P. A. (2016). Clinical, socio-demographic and psychological characteristics in individuals with persistent psychotic experiences with and without a "need for care". *World Psychiatry, 15*(1), 41-52. https://doi.org/10.1002/wps.20301

Raballo, A., Cicero, D. C., Kerns, J. G., Sanna, S., Pintus, M., Agartz, I., … Preti, A. (2017). Tracking salience in young people: A psychometric field test of the Aberrant Salience Inventory (ASI). *Early Intervention in Psychiatry*, (July). https://doi.org/10.1111/eip.12449

Reininghaus, U., Kempton, M. J., Valmaggia, L., Craig, T. K. J., Garety, P., Onyejiaka, A., … Morgan, C. (2016). Stress Sensitivity, Aberrant Salience, and Threat Anticipation in Early Psychosis: An Experience Sampling Study. *Schizophrenia Bulletin*, *42*(3), 712-722. https://doi.org/10.1093/schbul/sbv190

Roiser, J. P., Stephan, K. E., M. den Ouden, H. E., Barnes, T. R. E., Friston, K. J., & Joyce, E. M. (2009). Do patients with schizophrenia exhibit aberrant salience? *Psychological Medicine*, *39*, 199-209.

Senín-Calderón, C., Perona-Garcelán, S., Bellido-Zanín, G., Medina-Pradas, C., Rodríguez-Testal, J.F. (2017). Study of the factorial structure of the Self-evaluation of Negative Symptoms (SNS) scale in young adolescents. In M. T. Ramiro & J. C. Sierra (Eds.), *10th International Congress and 15th National of Clinical Psychology* (p. 522). Granada (Spain): Spanish Association of Behavioral Psychology.

Senín-Calderón, M.C., Rodríguez-Testal, J.F., Fernández-Jiménez, E., Valdés-Díaz, M., Benítez-Hernández, M.M., & Fuentes-Márquez, S. (2010). Reliability and validity of the REF scale for referential thinking. *European Psychiatry, 25*(1), 758. doi: 10.1016/S0924-9338(10)70752-5

So, S. H.-W., Chau, A. K. C., Peters, E. R., Swendsen, J., Garety, P. A., & Kapur, S. (2018). Moment-to-moment associations between negative affect, aberrant salience, and paranoia. *Cognitive Neuropsychiatry*, *23*(5), 299-306. https://doi.org/10.1080/13546805.2018.1503080

van der Steen, Y., Myin-Germeys, I., van Nierop, M., ten Have, M., de Graaf, R., van Dorsselaer, S., … van Winkel, R. (2018). 'False-positive' self-reported psychotic experiences in the general population: An investigation of outcome, predictive factors and clinical relevance. *Epidemiology and Psychiatric Sciences*, 1-12. https://doi.org/10.1017/S2045796018000197

van Duijvenvoorde, A. C. K., Peters, S., Braams, B. R., & Crone, E. A. (2016). What motivates adolescents? Neural responses to rewards and their influence on adolescents' risk taking, learning, and cognitive control. *Neuroscience and Biobehavioral Reviews*, *70*, 135-147. https://doi.org/10.1016/j.neubiorev.2016.06.037

Van Os, J., & Linscott, R. J. (2012). Introduction: The extended psychosis phenotype - Relationship with schizophrenia and with ultrahigh risk

status for psychosis. *Schizophrenia Bulletin*, *38*(2), 227-230. https://doi.org/10.1093/schbul/sbr188

Winton-Brown, T., Schmidt, A., Roiser, J. P., Howes, O. D., Egerton, A., Fusar-Poli, P., … McGuire, P. (2017). Altered activation and connectivity in a hippocampal-basal ganglia-midbrain circuit during salience processing in subjects at ultra high risk for psychosis. *Translational Psychiatry*, *7*(10), 1-8. https://doi.org/10.1038/tp.2017.174

Zammit, S., Kounali, D., Cannon, M., David, A. S., Gunnell, D., Heron, J., … Lewis, G. (2013). Psychotic experiences and psychotic disorders at age 18 in relation to psychotic experiences at age 12 in a longitudinal population-based cohort study. *The American Journal of Psychiatry*, *170*(7), 742-750. https://doi.org/10/vxr