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Psychological Assessment

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Psychometric Properties and Adaptation of the ASRS in a Spanish Sample of Patients With Substance Use Disorders: Application of Two IRT Rasch Models

AQ: au

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The Adult ADHD Self-Report Scale (ASRS; Kessler et al., 2005) is one of the most extensively used scales to detect attention-deficit hyperactivity disorder (ADHD) in adults. The aim of this work is to analyze the psychometric properties of the 18 ASRS items in people with substance use disorders (SUDs). Furthermore, we aimed to (a) confirm or, if necessary, modify the dichotomization criteria of the items proposed by the authors, and (b) identify the most informative items for a screening version or, when applicable, confirm the use of the 6 items that comprise the initially proposed short version. The ASRS was completed for 170 patients with SUD at the Provincial Unit for Drug Dependence of Huelva, Spain, aged 16 to 78 years. Two Rasch models—the dichotomous Rasch model and the Rating Scale Model (RSM) for polytomous items—were used in the psychometric analysis. The ASRS items fitted the RSM adequately, but the locations of the items along the underlying construct led us to propose new criteria of dichotomization. After analyzing the information function of dichotomized items, we identified 6 items that should integrate a new screening scale. Our dichotomization proposal is different from the original one and takes into account the different weights of the items. The selected screening version showed better metric properties than the other analyzed versions. Future research should test our proposal by using external criteria and to obtain evidences for other populations, cultures, or patient profiles.

AQ: 1

Keywords: ADHD, ASRS, Rasch model, rating scale model, item response theory

AQ: 2

Attention-deficit hyperactivity disorder (ADHD) is a disorder starting in childhood, the symptoms of which persist ~~into in adulthood in a large percentage~~ (Barkley, Fischer, Smallish, & Fletcher, 2002; Biederman et al., 1995). The estimation of its prevalence in adult population is still controversial; some works find rates of 2.9% (Faraone & Biederman, 2005) or 2.5% (Simon, Czobor, Bálint, Mészáros, & Bitter, 2009), whereas others report 4.4% (Kessler et al., 2006) or 4.5% (Polanczyk & Rohde, 2007).

The higher prevalence of ADHD in people with substance use disorders (SUDs) has been well documented (i.e., Daigre, Terán, García-Vicent, & Roncero, 2013; Kalbag & Levin, 2005; Vergara-Moragues et al., 2011; Wilens, 2004), and is associated with a worse course and prognosis of SUD (Arias et al., 2008; Eyup, Coskunol, Varan, & Toksoz, 2003; Levin et al., 2004; Vergara-Moragues, González-Saiz, Lozano, & Verdejo-García, 2013). In a meta-analytical review, van Emmerik-van Oortmerssen et al. (2012) detected prevalences ranging from 0.8% to 54%, with mean values of 25% and 21% among adolescents and adults, respectively. This disparate estimation of ADHD prevalence is attributed to the great difficulty to diagnose it in adults, which is even more complicated among patients with SUD (Faraone et al., 2007). Various authors (e.g., Chiasson et al., 2012; Wilens & Biederman, 2006) agree that ADHD is overrepresented in the population of patients with SUD to a great extent because of the lack of specificity of the measuring instruments. It is therefore necessary to use instruments that yield reliable scores with strong evidence of validity to diagnose ADHD in SUD patients.

Among the measurement instruments for ADHD, the Adult ADHD Self-Report Scale (ASRS; Kessler et al., 2005) is one of the most broadly used scales (Fuller-Killgore, Burlison, & Dwyer, 2013). Since its initial publication, it has been extensively applied in people with SUD (Crunelle, van den Brink, et al., 2013; Crunelle, Veltman, van Emmerik-van Oortmerssen, Booij, & van den Brink, 2013; Hesse, 2010) and in other populations (i.e., El-Hay & El Sawy, 2011; Garnier-Dykstra, Pinchevsky, Caldeira, Vincent, & Arria, 2010; Hanson et al., 2012; Usher, Stewart, & Wilton, 2013). The ASRS is a self-applied test of 18 items, on an ordinal 5-point scale, ranging from 0 (*never*) to 4 (*very often*), which provides a measure of ADHD symptoms according to the criteria of the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev; *DSM–IV–TR*; American Psychiatric Association, 2000). The authors established a cutoff or criterial point at which to dichotomize the responses to each item as presence–absence. The screening version is made up of six items, which,

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according to the authors, are those that better predict the presence or absence of the disorder.

Numerous psychometric studies have been conducted to study the validity of interpretations and uses of ASRS scores, both in patients with SUD (i.e., Daigre Blanco et al., 2009; Dakwar et al., 2012; van de Glind et al., 2013) and in other populations (i.e., Adler et al., 2012; Fuller-Killgore et al., 2013; Kessler et al., 2005; Zohar & Konfortes, 2010). However, the psychometric analyses and the scores generated in these studies were developed within the framework of the classical test theory (CTT). CTT is a psychometric theory that enables the psychometric characteristics of tests and items to be found and a person's test score to be estimated (Hambleton & Jones, 1993). CTT has been one of the most widely used measurement models in the analysis of metric properties of items and tests in the 20th century and continues to be so to date. This is because of its simplicity, its applicability to a multitude of psychological variables and measurement contexts, its easy calculation of patients' scores, and because the basic statistics used in the analysis of items (means, variances, and corrected item-test correlations) and tests (reliability coefficients) are implemented in most data analysis computer programs. However, this model has certain shortcomings. One of the most important, from the viewpoint of psychometric analysis, is that estimation of the properties of items and tests depends on the sample analyzed.

Item response theory (IRT) includes a set of estimation models for a person's scores and items that offer important advantages over the CTT (Embretson & Reise, 2000; Lord & Novick, 1968), such as the invariance of measures: The estimates of person and item parameters are independent of the samples (of the items and persons) from which they are obtained. Other advantages include the possibility of determining the degree to which items and persons fit to the model, and measurement of the interval level.

AQ: 3

In addition to these, two more differences between the CTT and the IRT should be emphasized: scaling of items and local accuracy. The first refers to the weighting or ranking of items with respect to the trait measured. In the CTT, the items are considered replicates of each other, and it therefore assigns the same score to all of the items. On the contrary, IRT models allow identification of items with higher or lower level on the construct measured (e.g., with greater or lesser severity), which, in turn, permits locating people on the continuum of the variable as a function of their agreement with some items (they present some symptoms), but not with others. In other words, in items with a high value, low response options, such as "1 (*rarely*)," could indicate ADHD, whereas for items with a low level on the construct, it would be necessary to choose "4 (*very often*)" to establish the presence of the disorder. This would involve different cutoff points in the dichotomization process. As argued by various authors (Kessler et al., 2002; Purpura, Wilson, & Lonigan, 2010), it is more appropriate to allow the cutoff point to vary among items as a function of the degree of severity involved.

Apart from this, with regard to local accuracy, in the CTT, the measurement error of scores is constant on all levels of the variable measured, whereas in the IRT models, reliability of a person's test scores and their items change with the amount of the variable the person has. This implies that different test scores correspond to different levels of accuracy for each item evaluated. This property is very important for analyzing an instrument such as the ASRS, in which a certain score is used as the cutoff or criterion, after which patients are classified as ADHD, because the measurement error can be found for each item at this level of the trait measured and those with the most information or reliability (or the lowest standard error of measurement) selected. These items make it possible to discriminate with greater accuracy among patients who are above and below this cutoff point. All of this is very useful for selecting a small group of items that can be used for screening.

The goal of this study was the psychometric analysis of the 18 ASRS items in SUD patients, using two Rasch IRT models that are especially useful for empirically finding the quality of items that use a graduated response format (rating scale model [RSM], for the original items; Wright & Masters, 1982) or a dichotomous response format (Rasch model, for dichotomous items; Rasch, 1960).

In addition to this general goal, we intended to

1. Confirm or, if necessary, correct item dichotomization criteria. In clinical practice, items originally in a Likert-type format are usually recoded into presence (1) or absence (0) of the symptom measured. This makes it possible to diagnose ADHD (or not) based on the number of symptoms present. Kessler et al. (2005) dichotomized the scores of the 18 ASRS items by comparing different dichotomizations of the items with the clinical classification of subjects made by experts. Each item was dichotomized in such a way that the difference between the number of false positives and of false negatives for that external criterion was as small as possible. The result was two dichotomization criteria: ADHD was defined for seven items as answers of "2 (*sometimes*)," "3 (*often*)," and "4 (*very often*)." For all the remaining 11 items, "3 (*often*)" and "4 (*very often*)" were the clinically significant symptom levels. This proposal would be appropriate if all the symptoms ~~in the~~ items were centered on the construct measured. However, as shown in other studies on scales based on the same 18 diagnostic criteria (see, e.g., Gomez, 2011; Purpura et al., 2010), the symptoms might be associated with different levels of ADHD, which would imply changes in the choices of answers associated with the presence or absence of each symptom. Thus, in this study, we tried to reanalyze the dichotomization criteria using the information about degree of severity provided by the RSM.

2. Identify the most informative items around the cutoff point to generate a screening version or, if applicable, confirm the use of the six items that make up the original short version. As explained by Kessler et al. (2005), of the 18 items ~~with the~~ *DSM–IV–TR* Criterion A ~~diagnostic criteria~~ (American Psychiatric Association, 2000), they selected six items considered the most predictive and useful for a short, or "screening," version of the ASRS. Our goal was to use the information functions of the dichotomized items in the Rasch model to identify those that are the most useful, discriminating precisely at the cutoff point set for diagnosis of ADHD. As mentioned ~~above~~, one of the advantages of this model is that it enables to select the items that differentiate with more

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accurately between the subjects who are above this cutoff point and those who are below it.

Method

Participants and Procedure

The sample was made up of 170 patients with SUDs recruited at the Servicio Provincial de Drogodependencias [Provincial Unit for Drug Dependence] in Huelva, Spain. This is a public center that provides treatment for substance-related disorders in an outpatient setting. All patients met criteria for alcohol, heroin, cocaine, or cannabis abuse or dependence. Patient interventions are part of the same program also followed by other public treatment centers in Andalusia, Spain. This program was developed by a committee of clinicians from drug treatment centers in Andalusia (Consejería de Igualdad, Salud y Políticas Sociales [Regional Ministry for Equality, Health & Social Policies], 2005) and is periodically updated.

Men comprised 79.3% of the sample. The mean age was 38.9 (*SD* = 10.8) and the nationality of 96.4% was Spanish. The main source of income of 20.9% came from their employment, 24.7% received aid from family members, and 49.3% received some type of social benefits (unemployment, pension, etc.). The remaining percentage (5.1%) obtained funds from illegal activities (selling drugs, etc.). The mean numbers of years of education was 7.1 (*SD* = 1). Almost one quarter of the sample (23.5%) had some higher education and 4.3% had completed at least three years. The percentage of patients employed at the time of interview was 39.7%, and 43.9% were unemployed. Just over 6% (6.1%) were studying and the rest (9.9%) were in other situations (receiving benefits, etc.). AQ: 5

As shown in the Table 1, 23.5% of patients were admitted to treatment for an alcohol-related disorder, 22.8% for cocaine, 21.5% for heroin, and 13.4% for cannabis. Criteria for more than one SUD (Multiple SUD [MSUD]) were met by 18.8%. Most of the patients (67.7%) had used more than one substance in the month before the interview. More than half (51.5%) used cannabis, 44.8% used alcohol, and 27% used heroin. T1

Table 1
Descriptive Data of the Sample

	Mean (*SD*)	Range of values	Percentage
Main drug for treatment admission			
Alcohol			23.5
Cocaine			22.8
Heroine			21.5
Cannabis			13.4
MSUD			18.8
Drugs used last 30 days			
Cannabis			51.5
Alcohol			44.8
Cocaine			27
Heroine			8.6
Sedatives			4.9
Hallucinogenics			2.5
2 or more			67.7
ADHD scores (18 items)	27.12 (13.60)	1–72	
INA scores (9 items)	12.54 (7.91)	0–36	
H/I scores (9 items)	14.58 (7.81)	0–36	
Prevalence (ADHD ≥37)			24.1
Prevalence (INA ≥21)			16.5
Prevalence (H/I ≥21)			22.4

Note. The scale and subscale scores and prevalence were calculated from the scores on the original items (0–4). MSUD = ~~***~~; ADHD = attention-deficit hyperactivity disorder; INA = inattention; H/I = hyperactivity/impulsivity.

Measures

The ADHD was assessed with the ASRS (Kessler et al., 2005). The ASRS has been translated into many languages, including Spanish, using the standard World Health Organization translation and back-translation protocol (National Comorbidity Survey, 2005). ~~The Spanish version used in this study can be retrieved online from http://www.hcp.med.harvard.edu/ncs/ftpdir/adhd/18Q_Spanish (US and Mexico)_final.pdf.~~ AQ: 6

The ASRS is made up of two parts—the first one (Part A, screening) includes six items that, according to the authors, best predict the presence or absence of ADHD; Part B is made up of the remaining 12 items. The response options of the 18 items are arranged on a 5-point Likert scale: 0 (*never*), 1 (*rarely*), 2 (*sometimes*), 3 (*often*), and 4 (*very often*). To transform the 5-point scale into a dichotomous scale of 0 (absence) or 1 (presence) for each item, the authors determined a cutoff or critical point: a response option higher than or equal to that cutoff point indicates the presence (1) of the disorder. Response options lower than the cutoff point indicate the absence (0) of the disorder. As shown in ~~Table 2,~~ for Items 1, 2, 3, 9, 12, 16, and 18, a score of 1 (*presence*) is assigned to the scores equal to or higher than Response Option 2 (*sometimes*). For the remaining items, a score of 1 (*presence*) is assigned to scores equal to or higher than 3 (*often*). Dichotomized scores (0 to 1 for each item, 0 to 18 for the full scale) are mainly used in clinical practice, and the cutoff point to classify a person as having ADHD is ≥9. In the research setting, the original scores, based on the scores of 0 to 4 for each item (0 to 72 for the full scale; cutoff point at 37), are habitually used. AQ: 7 T2 AQ: 8

The 18 items of the ASRS are grouped into two subtypes (according to the *DSM–IV–TR*; American Psychiatric Association, 2000) or presentations (*DSM–5*; American Psychiatric Association, 2013): Inattentive (INA) and Hyperactive/Impulsive (H/I), each one comprised of nine items. Thus, the scale permits a global ADHD diagnosis, while identifying adults who present predominant INA or H/I symptomatology, as diagnosed by the presence of six of the nine diagnostic criteria.

Analyses

The Winstep (v. 3.61; Linacre, 2006) program was used. In a first phase, the RSM (Wright & Masters, 1982) was used to analyze the polytomous items. Usually, RSM assumes the same response structure (number of response options and subjective distance between them) for all items analyzed. However, Kessler

Footnote: 1. The Spanish version used can be retrieved online from http://www.hcp.med.harvard.edu/ncs/ftpdir/adhd/18Q_Spanish_(US and Mexico)_final.pdf.

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Table 2 Insert here Figure 1. Dichotomization Proposal, in a word file email to APAProduction@cadmus.com
Dichotomization Proposal

Item	Never	Rarely	Sometimes	Often	Very often	Kessler et al. (2005)	Our proposal
I. Inattention							
INA_1. How often do you make careless mistakes when you have to work on a boring or difficult project?						012 vs. 34	**01 vs. 234**
INA_2. How often do you have difficulty keeping your attention when you are doing boring or repetitive work?						012 vs. 34	012 vs. 34
INA_3. How often do you have difficulty concentrating on what people say to you, even when they are speaking to you directly?						01 vs. 234	01 vs. 234
INA_4. How often do you have trouble wrapping up the fine details of a project, once the challenging parts have been done?						01 vs. 234	01 vs. 234
INA_5. How often do you have difficulty getting things in order when you have to do a task that requires organization?						01 vs. 234	01 vs. 234
INA_6. When you have a task that requires a lot of thought, how often do you avoid or delay getting started?						012 vs. 34	**01 vs. 234**
INA_7. How often do you misplace or have difficulty finding things at home or at work?						012 vs. 34	012 vs. 34
INA_8. How often are you distracted by activity or noise around you?						012 vs. 34	012 vs. 34
INA_9. How often do you have problems remembering appointments or obligations?						01 vs. 234	**012 vs. 34**
II. Hyperactivity–Impulsivity							
H/I_1. How often do you fidget or squirm with your hands or your feet when you have to sit down for a long time?						012 vs. 34	**0123 vs. 4**
H/I_2. How often do you leave your seat in meetings or other situations in which you are expected to remain seated?						01 vs. 234	**0 vs. 1234**
H/I_3. How often do you feel restless or fidgety?						012 vs. 34	**0123 vs. 4**
H/I_4. How often do you have difficulty unwinding and relaxing when you have time to yourself?						012 vs. 34	**01 vs. 234**
H/I_5. How often do you feel overly active and compelled to do things, like you were driven by a motor?						012 vs. 34	**0123 vs. 4**
H/I_6. How often do you find yourself talking too much when you are in a social situation?						012 vs. 34	012 vs. 34
H/I_7. When you're in a conversation, how often do you find yourself finishing the sentences of the people that you are talking to, before they can finish them themselves?						01 vs. 234	01 vs. 234
H/I_8. How often do you have difficulty waiting your turn in situations when turn-taking is required?						012 vs. 34	**0123 vs. 4**
H/I_9. How often do you interrupt others when they are busy?						01 vs. 234	**0 vs. 1234**

et al. (2005) established two groups of items according to their severity and the cutoff point (01 vs. 234 for a group of seven items, and 012 vs. 34 for the remaining 11 items). Therefore, based on this differentiation, we identified two groups of items in the RSM.

The many advantages and possibilities of analysis provided by RSM and other IRT models are achieved when the items and persons analyzed fit the model employed. The Winstep program provides two fit indexes: INFIT and OUTFIT (Linacre, 2002), which reflect the difference between the observed responses and those predicted by the model. Values between 0.5 and 1.5 indicate an acceptable fit, and values between 1.5 and 2 indicate moderate misfit.

Regarding the dichotomization criterion, Winstep provides diverse threshold values or transition points between response categories. These values indicate the relation between the person's level in the variable measured and the selected response option. As a cutoff point defined by the authors in the original scale can be identified, the best option is to use the information provided by the Rasch-Thurstone or cumulative probability thresholds (Linacre, 2009). These thresholds represent points on the ability continuum at which the probability of choosing a certain response option or a higher option is equal to 50%. In practice, dichotomizing each item at the response option that is closest to the cutoff point generates items whose maximum information—maximum precision—is achieved at scores near the cutoff point. In this way, maximum discrimination around the cutoff point is achieved and subjects are thereby correctly classified.

After dichotomization, in a second phase, the most informative items for the screening version were selected. This selection was done taking into account the accuracy of the items at the established cutoff point, calculated from a dichotomous Rasch model (Rasch, 1960).

Results

Fit and Metric Properties of the Scale According to RSM

The INFIT and OUTFIT values revealed an adequate fit of our data. For the items (INFIT $M = 1.00$, OUTFIT $M = 1.00$), the highest misfit value corresponded to Item 5 of H/I (H/I_5: *Like you*

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AQ: 9 *were driven by a motor*). With regard to persons, only 11% presented fit values ~~(Infit or Outfit)~~ higher than 1.5 and no one exceeded the value of 2 (persons INFIT $M = 1.00$, OUTFIT $M = 1.00$). The item-test correlations ranged from .33 to .56, with the lowest one corresponding to item H/I _5.

F1 The difficulty parameter of each item (see ~~Figure 1~~) reflects its severity level on ADHD: The most extreme positions corresponded to H/I items. Some items, such as H/I_1 (*You fidget or squirm with your hands or your feet*), are associated with low levels of ADHD. For this item, only the Response Option 4 (*very often*) reveals the disorder. At the opposite end, item H/I _9 (*You interrupt others when they are busy*) reflects a high degree of the disorder: In this case, Option 1 (*Rarely*) or higher options indicate the disorder. At the central positions of the scale are Items 1 (*You make careless mistakes*), 7 (*You misplace or have difficulty finding things*) and 9 (*You have problems remembering appointments or obligations*) of INA, and Item 6 of H/I (*You talk too much when you are in a social situation*).

Dichotomization

The position of each item on the continuum, as a reflection of the degree of disorder implied, determines the cutoff point for its dichotomization.

The dichotomization criterion is generated from the Rasch-Thurstone thresholds, selecting the response option that is closest to the cutoff point. Thus, for example, Items 1, 3, 5, and 8 from H/I will be dichotomized according to the criterion: *0123* versus *4*, and Items 2 and 9 from H/I will be dichotomized as *0* versus *1234*. ~~Table 2~~ shows the dichotomization proposal of Kessler et al. (2005) and our proposal. The dichotomization proposals that are different from the original proposal are in boldface. In the shaded cells, the darker pattern corresponds to our proposal.

The main difference in these proposals is in the H/I items, which are generally at the extremes of the ADHD dimension, leading to extreme dichotomizations: *0* versus *1234* for items reflecting greater severity, and *0123* versus *4* for items associated with milder symptoms.

To verify the adequacy of our dichotomization, it was compared with the original proposal using various indexes provided by the Winstep Program as well as other CTT indexes. For the latter, we generated a classification criterion for the subjects based on the polytomous scores and the two dichotomization proposals analyzed. To classify a person as having ADHD, three conditions had to be met: (a) a score of 37 or more on the polytomous scale, (b) a score of 9 or more on the dichotomized scale following the Kessler et al. (2005)criterion, and (c) a score of 9 or more on the dichotomized scale following our own criterion. Therefore, for this final phase of analysis, we only selected patients classified the same way on the basis of all three scores: 147 patients, of whom 41 were classified as having ADHD by all three criteria and 106 were classified as not having ADHD.

With regard to the CTT indexes, we note the increase in specificity of our proposal and the lower difference between false positives and false negatives. Both proposals fit globally, although the items and persons fit the Rasch model better for the items dichotomized according to our criterion. The Person Separation index is higher in the original proposal because the difficulty values of the items are between −1.27 and 0.85, a large item-difficulty range. Whereas, as expected, in our recoding, the values are grouped around the intermediate values: from −0.41 to 0.65. This grouping contributes more information to these intermediate values where the cutoff point is found. This implies more accuracy when classifying people above or below this point. Thus, we

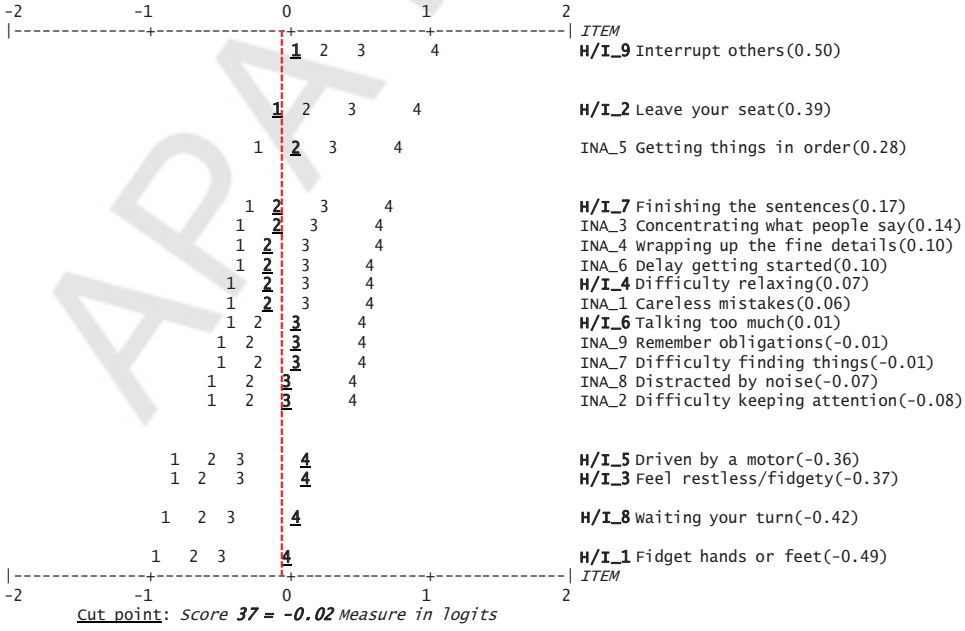

Figure 1. Equal-cumulative-probability Rasch-Thurstone thresholds. The severity level on attention-deficit hyperactivity disorder of the items—in logits—is in brackets.

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decided to use the 18 dichotomized items according to our proposal.

Insert Table 2. Comparison of the Dichotomization Proposals

Selection of Screening Items

From the IRT framework, the best criterion to select items to include in a screening scale is the amount of information these items provide at the established cutoff point to classify people as having or not having ADHD. The more information an item provides, the more useful the item is for that classification, leading to an increase in the accuracy of the diagnosis.

To select the six most appropriate items, we obtained the information functions of each dichotomized item, both for the total scale (ADHD) and for its subscale. The items with the highest mean information values at the cutoff point were selected. Thus, we ensured the utility of the screening instrument not only to detect the disorder but also to identify classifiable people within the inattentive or hyperactive presentation.

Taken conjointly, the best items, from most to least informative, are Items 9, 8, 7, and 5 from INA, and Items 6 and 3 from H/I. Thus, as with the scale proposed by Kessler et al. (2005), this one is basically made up of Inattention items. Given that the authors take a score of 4 as cutoff point, in practice, this means that people with predominantly INA symptomatology would be diagnosed as ADHD. Therefore, we decided to select a screening instrument with more solid evidence of validity based on test content by including three items from each one of the subdimensions. The three INA items were Items 7, 8, and 9, and the H/I items were Items 3 and 6. To these items must be added one of these two items: H/I_5 or H/I_7. As a result, three screening scales (S3, S4 and S5; see Table 3) were proposed, from which one was chosen as a function of its psychometric properties, both from IRT and from CTT. We add to these three scales two additional ones (S1 and S2) based on the original screening scale. The dichotomization criteria proposed by Kessler et al. was used in one of them (S1). The values presented in Table 3 indicate that, in general, the S5 proposal is preferable to the rest.

T3, AQ: 10, 11

Screeners S3, S4, and S5 are the most informative and those with the least misfit. However, Screeners S4 and S5, with a balanced distribution of items on subscales, produced estimations of subjects' values with higher correlations with INA and H/I than the rest of the screeners, which had lower correlations, especially with H/I. This same structure of correlations was found when the scores were not generated following IRT procedures, but as the unweighted sum of detected symptoms.

The CTT analyses show that S5 is the most adequate: It presents the highest alpha value (.59); a higher degree of relation with the scores (or classifications) of ADHD, INA, and H/I (mean correlations = .75 and mean κ = .63); and the highest correlations between INA and H/I items (.39). A close correlation between both halves is to be expected if they are meant to measure a syndrome defined by the presence of both parts.

Discussion

The goal of this study was the psychometric analysis of the 18 ASRS items in SUD patients, using two Rasch IRT models. In addition, we intended to (a) confirm or, if necessary, modify the dichotomization criteria of the items proposed by the authors, and (b) identify the most informative items near the cutoff point to generate a screening version or, if applicable, confirm the use of the six items that make up Kessler et al.'s (2005) short version. On one hand, our data confirm the good metric properties of the scale; on the other, we propose some new dichotomization criteria for the items and a new screening scale. We have demonstrated that these proposals are more suitable than the originals because they take into consideration the position of the items on the continuum (for dichotomization) or the discriminating ability of the items at the cutoff point used for classifying patients as ADHD (for screening).

The analyses confirm the good psychometric qualities of the ASRS from the perspective of IRT models and its utility to detect ADHD in patients with SUD. The scale adequately fits the models used, in its polytomous version and in the original dichotomous version, as well as in the one proposed in this work. This means

Table 3
Indicators of Screening Quality

	Screeners and items				
	S1[a] INA: 4, 5, 6, 9 H/I: 1, 9	S2 INA:4, 5, 6, 9 H/I: 1, 9	S3 INA:5, 7, 8, 9 H/I: 3, 6	S4 INA: 7, 8, 9 H/I: 3, 5, 6	S5 INA: 7, 8, 9 H/I: 3, 6, 7
IRT psychometric properties					
Information	1.20	1.31	**1.32**	**1.32**	**1.32**
$r_{\theta\theta}$	.80/.79/.60 **[.73]**	.80/.78/.57 [.72]	.80/.81/.56 [.72]	.79/.67/.69 [.72]	.80/.72/.67 **[.73]**
Fit	3.04/1.48	1.46/1.27	**1.42**/1.10	1.47/1.15	1.48/**1.07**
CTT psychometric properties					
$r_{INA,H/I}$	.11	.00	.32	.31	**.39**
Alpha	.53	.50	**.59**	.57	**.59**
Correlations	.79/.80/.58 [.72]	.80/.78/.55 [.71]	.83 /.81/.58 [.74]	.81/.66/.71 [.73]	.84/.73/.69 **[.75]**
Kappa	.50/.69/.31 [.50]	.58/.51/.41 [.50]	.65/.73/.44 [.61]	.57/.43/.68 [.56]	.67/.60/.61 **[.63]**

Note. ~~IRT~~ indices: Information = value of the information function at the cutoff point (four symptoms); $r_{\theta\theta}$ = correlation between Rasch-estimated subjects' ~~ADHD, INA, and H/I~~ scores, respectively, and the Rasch-estimated subjects' screening scores (mean); Fit = maximum fit values [OUTFIT] for persons and items, respectively. ~~CTT~~ indices: $r_{INA,\ H/I}$ = correlation between the INA and H/I items that make up the screening instrument; Alpha = internal consistency reliability; Correlations = correlation between the subjects' ADHD, INA, and H/I scores, respectively, and the subjects' screening scores (mean); Kappa = screening classification versus ADHD, INA, and H/I classifications, respectively (mean). Boldface indicates the best values: high values for correlations (kappa and *r*), alpha coefficient, information and separation values, and lower values for fit measures.
[a] Original dichotomization.

that the items are distributed along an ADHD dimension, referring to different degrees of ADHD severity.

This item distribution should have implications for the dichotomization of the scores, as was done in this work. In clinical practice, dichotomizing the original polytomous item scores in order to diagnose people is habitual. Our dichotomization proposal takes into account the different weights of the items in this process. In this regard, Purpura et al. (2010) indicate that different response options may correspond to the same level of the underlying construct. Our proposal is different from the original one (Kessler et al., 2005) in eight of the 18 items: two items from the INA presentation and six from the H/I presentation. For five of these eight items, the dichotomization criterion was shifted to the next highest response option, whereas for the other three items, it was shifted to the next lowest option. All this leads to a reduction in the mean difference between false positives and false negatives and more specificity of our items (see Table 4). It is therefore expectable that the specificity of the overall scale with regard to an external criterion should increase as well. This quality is noteworthy because of the low specificity that this scale has shown in some substance-abusing populations (Chiasson et al., 2012).

Furthermore, we have created a new version of the screening scale with better psychometric qualities and more diagnostic usefulness than the original screening scale. After dichotomization, using the information function of the items, the six most discriminatory items at the cutoff for diagnosis established by Kessler et al. (2005) were selected for our screening scale. The selected screening version showed better metric properties than the remaining versions, from both the CTT and IRT perspectives. Moreover, to select the screening version, we considered the balanced distribution of items in both dimensions. The scores and classifications generated with our proposal are therefore not only closer to the global scores and classifications but also more useful for identifying predominantly inattentive or hyperactive presentations.

In addition, from the point of view of item contents and of the behaviors involved, we believe that our proposal is more appropriate for the study population. With regard to the INA items, the four items that made up the original screening instrument refer to situations closely linked to work activity (e.g., *Difficulty to complete complex jobs* or *Failure to program daily activity*). Taking into account that patients in treatment for SUD are habitually unemployed (European Monitoring Centre for Drugs and Drug Addiction, 2012), these items are not very meaningful for this population. The three INA items included in our proposal (*Misplacing things*, *Becoming distracted*, *Problems remembering appointments*) are applicable to different situations and daily activities not necessarily related to work. This may explain its greater discriminatory capacity. With regard to the H/I items, the greater adequacy of the items of our screening proposal in this population versus the original proposal may lie in the fact that the H/I_6 and H/I_7 items refer to verbal impulsivity, which is a typical manifestation of ADHD in people with SUD (Crunelle, Veltman, et al., 2013), in contrast to the symptoms of motor hyperactivity tapped by the original screening instrument.

Previous studies have shown the suitability of IRT models to analysis, either with ADHD scales (Gomez, 2011; Purpura et al., 2010), with drug-user populations (Sayans, Fernández, Vidal, & Rojas, 2012), or with SUD patients (Lozano Rojas, Rojas Tejada, & Pérez Meléndez, 2009). This work contributes evidence supporting the use of IRT models derived from the Rasch family in the context of item analysis, dichotomization of response options, and selection of the most adequate items to classify subjects.

Despite the contributions made by this study, some considerations should be kept in mind. The first contribution relates to the sample: The majority of participants in the study were men, which might introduce some bias. Nevertheless, this is the usual distribution among patients treated for SUDs, in which the ratio of men to women is approximately 80% to 20%, respectively (European Monitoring Centre for Drugs and Drug Addiction, 2012; Observatorio Español sobre Drogas [Spanish Observatory on Drugs], 2009).

Furthermore, this study was carried out with a sample of Spanish SUD outpatients. The standards of the ~~American Educational Research Association (AERA), American Psychological Association (APA), and National Council on Measurement in Education (NCME)~~ (2004) recommend providing new psychometric evidence at other treatment centers, in other cultures, and with other patient profiles. As many studies have shown (Smith, Gates, & Foxcroft, 2006; Vanderplasschen et al., 2013; Vergara-Moragues et al., 2013), inpatients show more drug-related problems than outpatients, as characterized by MSUDs, more mental health problems, poor family and social relations, and involvement with the criminal justice system. In this sense, future studies should analyze the psychometric properties of the ASRS from the perspective of IRT models, and its usefulness in detecting ADHD in inpatients.

Similarly, as the American Educational Research Association et al. (2004) recommend regarding test translations, it would be appropriate to verify that our results hold in samples with similar

Table 4
Comparison of the Dichotomization Proposals

	Rasch indices					Conventional indices (CTT)			
	Items	Persons			Information[a]	Mean values			
	Max. OUTFIT	Max. OUTFIT	Separation	$r_{\theta p \theta d}$	$I_T(\theta=0)$	Sensitivity	Specificity	Kappa	FP–FN
Kessler et al. (2005)	1.38	1.65 (6)	**1.56**	.89	4.17	**67.6**	75.2	**.395**	13
Our proposal	**1.26**	**1.25 (0)**	1.44	**.90**	**4.42**	65.4	**76.9**	.393	**10.3**

Note. OUTFIT = maximum fit values for items and persons (number of persons who do not fit the model); Separation = person separation: checks that the items discriminate different levels of person performance; $r_{\theta p \theta d}$ = correlation among the parameter estimations of the subjects in the polytomous and dichotomous scores; Information = value of the information function at the cutoff point; Kappa = classification as a function of items with different dichotomization versus classification criterion (see text); FP–FN = difference between false positives and false negatives.
[a] The cutoff point is the same for the two groups of scores: An ability level of 0.00 corresponds to a score of 9.

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features but whose primary language is not Spanish. Further research using other language versions of the ASRS could provide empirical evidence of the cross cultural validity of the proposed scoring system and screener.

The ASRS cutoff points for diagnosis of ADHD were relevant to our work because the proposed screener was based on the precision and discriminatory power of ASRS items at those cutoffs. We use the widely accepted cutoffs proposed by Kessler et al. (2005). However, the diagnostic accuracy of those cutoffs in patients with SUD has only been partially supported (for positive results, see Daigre Blanco et al., 2009, and van de Glind et al., 2013; for contrary results, see Chiasson et al., 2012). Hence, the validity of the ASRS cutoff points for SUD populations should be the focus of further research. Moreover, because the Kessler et al. cutoffs were established using only the *DSM–IV–TR* criteria for ADHD (American Psychiatric Association, 2000), new research should also take into account the slightly looser *DSM–5* criteria for adult ADHD (American Psychiatric Association, 2013; van de Glind et al., 2013).

Finally, an additional limitation is that ADHD diagnostic criteria in this study were based only on ASRS scores: No other standardized diagnostic instrument was used. Previous research has shown the usefulness of other self-report instruments, such as the Conners Adult ADHD Rating Scale (Conners, Erhardt, & Sparrow, 1999) or the Wender Utah Rating Scale (Ward, Wender, & Reimherr, 1993), for ADHD diagnosis in SUD patients. Furthermore, the Conner's Adult ADHD Diagnostic Interview for DSM–IV–TR (Epstein, Johnson, & Conners, 2000) is usually used as a gold standard for the diagnosis of ADHD in SUD populations (Daigre Blanco et al., 2009; Dakwar et al., 2012; van de Glind et al., 2013). As different diagnostic measures may provide complementary diagnostic information, more than one of these diagnostic instruments should be used in future research testing of our ASRS screener. This would enable us to verify the good diagnostic properties shown by our version of screening in samples of SUD patients, especially its specificity.

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