Metacognitive abilities in adults with substance abuse treated in therapeutic community

Habilidades metacognitivas en adultos con abuso de sustancias bajo tratamiento en comunidad terapéutica

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Abstract

Background: The term metacognition reflects a spectrum of psychological activities that allows people to form and integrate representations about their own mental states and those of others. The main goal of this study was to examine whether people with substance abuse disorders (SUDs), and treated in therapeutic community regime, displayed specific patterns of metacognitive deficits on Self-reflectivity, Understanding others' mind, Decentration, and Mastery, comparing their scores with two clinical groups of patients with schizophrenia spectrum disorders (SSDs) and anxiety disorders.
Method: A mixed-methods (qualitative-quantitative) study was designed. Two hundred and sixteen adults aged 18-65 with principal diagnoses of SUDs ($n = 52$), SSDs ($n = 49$), and anxiety disorders ($n = 115$) were recruited. Qualitative data were obtained with the Metacognition Assessment Interview, which was then rated using a quantitative scale, the Metacognition Assessment Scale–Abbreviated (MAS–A).
Results: The anxiety disorders group had significantly higher MAS–A total scores than the SUDs group, and the SUDs group obtained significantly higher MAS–A total scores than the SSDs group. Concerning the MAS–A subscale scores, the SUDs group displayed significantly lower scores only on the Mastery subscale compared to the anxiety disorders group, with the SUDs and SSDs groups obtaining equivalent Mastery scores.
Conclusions: According to these findings, current interventions for addiction should focus more specifically on improving metacognitive Mastery.
Keywords: Addiction; Metacognition; Metacognition Assessment Scale–Abbreviated (MAS–A); Rehabilitation; mixed-methods.

Resumen

Antecedentes: El término de metacognición hace referencia al conjunto de procesos psicológicos que permiten a los individuos desarrollar e integrar representaciones sobre los estados mentales propios y de los demás. El objetivo principal de este estudio fue examinar si los pacientes bajo tratamiento por consumo de sustancias, en régimen de comunidad terapéutica, presentan un perfil específico de déficits metacognitivos en las áreas de Autorreflexividad, Diferenciación, Descentramiento y Dominio, comparando sus puntuaciones con las obtenidas por dos muestras clínicas de pacientes con trastornos del espectro esquizofrénico y trastornos de ansiedad.
Método: Se diseñó un estudio con metodología mixta (cualitativa-cuantitativa). Se seleccionaron un total de 216 participantes con diagnósticos principales por consumo de sustancias ($n = 52$), espectro esquizofrénico ($n = 49$) y trastornos de ansiedad ($n = 115$). Los datos cualitativos se obtuvieron con la Entrevista de Evaluación de la Metacognición (MAI) y, posteriormente, estos fueron cuantificados con la Escala Abreviada de Evaluación de la Metacognición (MAS-A).
Resultados: Las puntuaciones totales en la MAS–A del grupo con trastornos de ansiedad fueron estadísticamente superiores a las del grupo con trastornos por consumo de sustancias (TCS), y éstas, a su vez, fueron significativamente superiores a las del grupo con trastornos del espectro esquizofrénico. Por subescalas de la MAS-A, sólo hubo diferencias estadísticamente significativas entre las puntuaciones de Dominio del grupo con ansiedad y TCS, obteniendo el grupo con TCS puntuaciones estadísticamente equivalentes a las del grupo con trastornos del espectro esquizofrénico.
Conclusiones: De acuerdo con estos resultados, los programas actuales de intervención en drogadicción deberían orientarse más específicamente a mejorar las habilidades metacognitivas de Dominio.
Palabras clave: Drogadicción; Metacognición; Escala Abreviada de Evaluación de la Metacognición (MAS–A); Rehabilitación; metodología mixta.

Originally, the term metacognition was used in the educational literature to refer the capacity to reflect on one's own thinking while learning (Flavell, 1979). Subsequently, the use of this concept has been extended to many fields of research, such as attachment, psychopathology, human development, or cognitive psychology (Bacon & Izaute, 2009; Dinsmore et al, 2008; Tarricone, 2011). Broadly speaking, this construct refers both to simple mental processes, for example, identifying one's own desires, thoughts, or emotions, and to complex processes that allow us to integrate intersubjective information to create broad representations about oneself, others, and the world (Semerari et al., 2003). Although this set of skills has received multiple denominations in the literature (e.g., social cognition, theory of mind, emotional intelligence or mentalizing), all of them indicate mental processes underlying interpersonal experience. In an attempt to unify the field, Lysaker et al. (2005) have proposed a general definition of metacognition that includes four large skills: (1) *Self-reflectivity* or the capacity to think about one's own mental states; (2) *Understanding others' mind* or the capacity to think about others' mental states; (3) *Decentration* or the capacity to understand that one is not the center of the world and that there are different ways of understanding reality; and (4) *Mastery* or the capacity to integrate intersubjective information in broad definitions of problems that allow one to respond adaptively.

In spite of the fact that there are numerous tests to assess low-order metacognitive skills (e.g., with tasks to measure the capacity to recognize and express specific emotions; Caletti et al., 2013), to date, there are few measurement instruments to appraise the higher order processes that involve addressing how individuals integrate and respond in interpersonal situations of high emotional content. In order to overcome this limitation, the *Metacognition Assessment Interview*, MAI; Semerari et al., 2012) was recently developed. The MAI is a semistructured interview that appraises individuals' metacognitive activity when faced by relevant autobiographical episodes of intersubjective nature. Specifically, the MAI requests interviewees to describe in detail the worst psychological event they experienced in the past months. The main goal is to provoke vivid narratives that allow identifying all the metacognitive processes deployed by the subject in that situation. Once the narration is obtained, the information of the responses is ordered and scored with the *Metacognition Assessment Scale–Abbreviated* (MAS–A; Lysaker et al., 2005). The MAS-A is a brief scale that was developed specifically to analyze qualitative data. As shown in Table 1, the MAS-A consists of four subscales measuring the four above-described metacognitive skills. High scores indicate a greater capacity to create broad representations about oneself, others, and the world, as well as to use these representations to respond appropriately to psychological and social challenges (Lysaker et al., 2005). Recent studies

Table 1. *Structure of the Metacognition Assessment Scale brief version (MAS–A; Lysaker et al., 2005).*

Level	Self-reflectivity (S)	Understanding others' mind (O)	Decentration (D)	Mastery (M)
0	Total lack of awareness of their own mental activity	Total lack of awareness of others' mental activity	Considering that one is the center of everything	Lack of awareness of problems
1	Slight awareness of own mental activity	Slight awareness of others' mental activity	Recognizing that others have independent lives	Awareness of problems as intractable
2	Awareness that thoughts are one's own	Awareness others have their own mental activity	Awareness that there are different ways to understand the same event	Awareness of problems as resolvable but with lack of response
3	Distinction of one's own different cognitive operations (thoughts, fantasies, memories…)	Distinction of others' different cognitive operations (thoughts, fantasies, memories…)	Awareness that facts are the result of multiple and complex factors	Passive responses
4	Distinction of different emotional states	Recognition of others' different emotional states	—	Responses of seeking help
5	Recognition that one's own thoughts are fallible	Plausible assumptions about others' mental state	—	Responses with specific actions
6	Recognition that desire is not reality	Complete descriptions of others' thinking over time	—	Responses with changes
7	Integration of one's own thoughts and emotions in a narration	Complete descriptions of others' thinking throughout their lives	—	Responses based on one's own knowledge
8	Integration of various narrations recognizing patterns over time	—	—	Responses based on others' knowledge
9	Recognition of thoughts and emotions connected throughout one's own life	—	—	Responses based on a broad comprehension of life

found that MAS-A scores correlate significantly with clinical variables such as symptom severity or the level of functioning in various mental disorders, including schizophrenia (McLeod et al., 2014), personality disorders (Semerari et al., 2014), or depression (Ladegaard, Lysaker, Larsen, & Videbech, 2014).

In the case of substance-use disorders (SUDs), it was observed that alexithymia, that is, the difficulty to name and express one's own emotions, correlates significantly with substance abuse (Thorberg, Young, Sullivan, & Lyvers, 2009). In this sense, Highland, Herschl, Klanecky, and McChargue (2013) concluded that the expression of certain genes increases the relationship between alexithymia and substance abuse. However, Lysaker et al. (2014) found that metacognitive skills related to the use of mental states to resolve social problems (or capacity of Mastery) moderate the effect of alexithymia on substance abuse. At the same time, Wasmuth et al. (2015) corroborated that people with SUDs present more pronounced deficits in Mastery skills compared with controls with HIV+ without a history of SUDs. Inasmuch as the type of substance is concerned, Roser et al. (2012) associated the consumption of cannabis with significant deficits in the capacity to infer mental states in others. Moreover, this study found that the chronic consumption of cannabis caused patterns of neuronal arousal very similar to those of people at risk for psychosis. In another study of Gizewski et al. (2013), it was observed that abusive alcohol consumption affected brain areas related to cognitive and affective empathy. There is empirical evidence showing that deficits in metacognition correlate with poorer results in drug dependency treatments (Saladin et al, 2012; Thorberg et al., 2011), the type of substance consumed, abstinence, risk of relapse (Toneatto, 1999), self-injuries (Verrocchio, Conti, & Fulcheri, 2010), emotional distress (de Rick, Vanheule, & Verhaeghe, 2009), and alcohol abuse in nonclinical samples (Lyvers, Onuoha, Thorberg, & Samios, 2012).

Ultimately, the results of the literature to date seem to underline the relevance and interest of studying this set of skills in people with substance abuse. The fact that it is not yet clear whether there are different metacognitive profiles depending on the type of disorder, or the effects of current interventions on metacognition requires further research of these issues in order to improve our comprehension of the psychological processes underlying drug addictions and their treatment. With regard to types of intervention, although there is evidence that drug addictions provoke important neuropathological changes, the capacity to act on them still is fairly limited (Bart, 2012). In this sense, an analysis in terms of metacognitive abilities can contribute new psychotherapeutic treatment options and/or help to optimize the existing ones. For example, it has been observed that people who score low on Self-reflectivity respond better to individual interventions (Lysaker et al., 2013). Conversely, it can

be assumed that people with low scores on Decentration will benefit more from group interventions that allow them to improve their comprehension of others' mental states (Wasmuth et al., 2015). Low scores in all the metacognitive areas would justify the use of both intervention formats, as well as other multidisciplinary interventions to act on all the deficits and their functional implications.

Within this context of research, the purpose of this study was to examine the metacognitive skills of a group of patients with SUDs under treatment for drug addiction in therapeutic community regime. Specifically, we aimed to determine whether the patients with SUDs displayed differences in metacognitive skills assessed with the MAS-A, in comparison with patients with schizophrenia spectrum disorders and with mild anxiety disorders. These comparison groups were selected for the following reasons. Recent studies suggest that healthy controls—that is, individuals with no specific health problems—are not an adequate control group to compare the metacognitive capacity of patients with mental health problems, such as the case of the SUDs group (Wasmuth et al., 2015). Specifically, this proposal argues that the use of healthy controls could lead to underestimate the other group's metacognitive capacity simply because they present a health problem (e.g., Lysaker et al., 2012). Therefore, the inclusion of the group of patients with minor anxiety disorders sought to ensure that all the participants of the study had some health problem, and that, moreover, they received some kind of mental health treatment (psychotherapeutic and/or psychopharmacological), although of low intensity, at the time of the assessment. The patients with schizophrenia spectrum disorders is included as the group with more clearly established metacognitive deficits in the literature (e.g., see Bacon & Izaute, 2009), providing relevant data mainly from the lower levels of the construct. In line with these findings, the hypotheses of the study were as follows. Firstly, it was expected that the group of patients with schizophrenia spectrum disorders obtained the lowest scores on the subscales of the MAS–A. Secondly, based on the higher functioning level of patients with mild anxiety disorders compared with patients with SUDs, it was expected that the anxiety disorders group presented higher scores than the SUDs group on the MAS-A.

Method

Participants

The study included three groups of patients. The first group was comprised of a of total of 52 adults with SUDs treated in therapeutic community regime, and who were clinically stabilized (no hospitalizations or changes of medication in the last month). Within this group, 21 participants presented a primary diagnosis of polysubstance dependence, 13 of alcohol dependence, 10 of opiate dependence, and 8 of cocaine dependence.

A second group included 49 adults with schizophrenia spectrum disorders, specifically: schizophrenia (n = 33), schizoaffective disorder (n = 15), and delusional disorder (n = 1), according to ICD-10 criteria (WHO, 1992), under day-hospital regime and clinically stable (no changes in antipsychotic medication in the last 6 months).

The third group comprised 115 adults with mild anxiety disorders from two outpatient community mental health services and with principal diagnoses of, at least, an anxiety disorder, according to ICD-10 criteria. Within this third group, 42 participants presented a main diagnosis of panic disorder with agoraphobia, 24 of generalized anxiety, 19 of panic without agoraphobia, 18 of social phobia, and 12 of agoraphobia without panic. The sociodemographic characteristics of the participants are presented in Table 2.

All the diagnoses and clinical assessments were made by psychiatrists or clinical psychologists external to the investigation. The general exclusion criteria of the study were: suspected or diagnosis of intellectual disability or pervasive developmental disorders, presence neurological syndromes (dementia, epilepsy, multiple sclerosis, etc.), sensory problems (blindness, deafness, etc.), or comprehension difficulties (e.g., not speaking Spanish), and not signing or not having the capacity to consent to research participation. We also excluded participants with severe or extreme positive psychotic symptoms [scores ≥ 4 in any item of the Scale for the Assessment of Positive Symptoms (SAPS; Adrenasen, 1984)] and participants with moderate or severe anxiety disorders [total scores ≥ 30 in the Beck Anxiety Inventory (BAI; Sanz & Navarro, 2003)]. Lastly, the presence or suspicion of SUDs was an exclusion criterion in the schizophrenia spectrum and anxiety groups.

Instruments

Metacognition Assessment Interview (MAI; Semerari et al., 2012). The MAI is a 30-60 minutes semistructured interview. In the context of the interview, individuals are elicited to narrate the most unpleasant experience or event undergone in the last 6 months. The requirements are that the episode should be of an autobiographic nature, personally relevant, and should include interactions with other people. At first, the questions are intentionally open to allow free narrative; this leads to the spontaneous emergence of the metacognitive skills deployed by the interviewee. Then, concrete questions are asked in order to specifically appraise each metacognitive skill. All the interviews were audio-recorded for subsequent transcription and quantification with the MAS-A.

Metacognition Assessment Scale–Abbreviated (MAS–A; Lysaker et al., 2005). The MAS-A assesses the four types of metacognitive activity described above (Lysaker et al., 2005; Semerari et al., 2003). This instrument is a brief adaptation of the MAS (Semerari et al., 2003) that quantifies the implicit metacognitive skills in the verbal responses of the interview. It consists of four subscales: Self-reflectivity, which includes nine levels of the capacity to think and form increasingly plausible and integrated ideas about oneself; Mind of Others, which consists of seven levels of the capacity to think and form increasingly complex and plausible ideas about others; Decentration, consisting of three levels that measure the capacity to form integrated ideas about oneself and others; and, lastly, Mastery, which includes nine levels of the capacity to use one's own and others' mental states to respond to psychological and social problems (see Table 1). Higher scores on the subscales indicate higher capacity to integrate and effectively use intersubjective information. The data obtained to date with the North American version of the MAS-A indicate acceptable values of internal consistency and test-retest and inter-judge reliability, with intraclass coefficients between .71 and .91 (Lysaker et al, 2005; Lysaker, & Salyers, 2007). With regard to the evidence of the validity of the theoretical construct, the MAS-A scores correlate significantly with other tests measuring the awareness of disease, cognitive insight, complexity of social schemas, or the preference for active coping strategies in people with psychosis (Lysaker et al., 2015).

Given that neither the MAS-A nor the MAI are validated into Spanish, in this study, pilot versions of both instruments

Table 2. *Sociodemographic characteristics of the participants.*

Variable	Group 1 Anxiety (n = 115)	Group 2 Drug Addiction (n = 52)	Group 3 Schizophrenia (n = 49)			
	f or Mean (*SD*)	*f* or Mean (*SD*)	*f* or Mean (*SD*)	*F*	η^2_p	Post hoc analysis
Gender						
Male	32	41	26			
Female	83	11	23			
Age	43.07 (15.54)	36.86 (9.18)	37.69 (12.62)	4.94*	0.07	1 › 2. 3
Education in years	13.42 (1.97)	12.64 (1.92)	12.44 (2.73)	4.57*	0.05	1 › 2. 3

Note. f = frequency; η^2_p = partial eta-squared. **p* ‹ .05

were used (more information on the translations can be requested from the main author, F.I.). The Spanish translation and adaptation was performed following the International Test Commission guidelines (Muñiz, Elosua, & Hambleton, 2013). The quantification, with the MAS-A, of the qualitative data obtained in the MAI was conducted by two raters external to the research who were experts in the use of both instruments. The judges scored each participant according to the MAI transcripts, so they were blind to the hypotheses of the study and the participants' characteristics at all times. The inter-raters reliability of the MAS-A scores was .91.

Procedure

The protocol of the study was approved by the institutional ethics committee of the centers where the data were collected. After explaining the goals, benefits, and possible risks of the investigation to all the participants, those who voluntarily agreed to participate were requested to sign an informed consent prior to gathering the data. Participation in the study did not lead to any type of consideration or reward. The information obtained was stored ensuring the total confidentiality of the data. Data were collected in a single interview lasting approximately 30 to 60 minutes, within the context of the general assessment sessions or the clinical follow-up of the cases. All the interviews were conducted by two clinical psychologists trained in the use of the MAI.

Data Analysis

Data analysis was carried out in two stages using the SPSS statistical package version 21 (IBM Corp., 2012). Firstly, sociodemographic variables, age, and educational level of the participants of the three groups (SUDs, schizophrenia spectrum, and anxiety) were compared to determine whether it was necessary to use one of these variables as covariate in the subsequent analyses. Secondly, analysis of variance (ANOVA) or analysis of covariance (ANCOVA) were performed to compare the total mean score of the MAS-A in the target groups. If these differences were statistically significant ($p <$ .05), the mean scores of the MAS-A subscales were compared. As estimator of the magnitude of the effects, the partial squared eta (η^2_p) statistic was used.

Results

Table 3 presents the means of the MAS-A total and subscales scores obtained by the participants of the SUDs, schizophrenia spectrum, and anxiety disorders groups. The ANOVAs indicated that the groups differed in age and educational level; specifically, the group with anxiety disorders scored higher, in avarage, on age and educational level than either group ($p <$ .05). To control the possible effect of these two variables in the subsequent comparisons, age and educational level were included as covariates.

The participants of the anxiety group obtained significantly higher total scores in the MAS-A than the SUDs group, and this group scored significantly higher than the schizophrenia spectrum group ($p <$ .001). By subscales, after controlling the effect of age and educational level, the participants of the anxiety disorders and SUDs groups obtained significantly higher scores on Self-reflectivity, Understanding others' thoughts, and Decentration than the group with schizophrenia spectrum disorders. The participants of the anxiety disorders group scored significantly higher on the Mastery subscale in comparison with the other two groups of participants. Lastly, equivalent scores on Mastery were found in the SUDs and schizophrenia spectrum groups (see Table 3).

Discussion

The main goal of this study was to examine the metacognitive skills assessed with the MAS-A in a group of patients with SUDs. This research also intended to determine whether their metacognitive skills differ from those observed in other patients with schizophrenia spectrum and mild anxiety disorders. For this purpose, a sample of 216 adults in treatment for SUDs, schizophrenic-spectrum disorders, or anxiety disorders were selected. All the participants were interviewed first with the MAI and subsequently, their responses were quantified by two blinded raters using the MAS-A. In the light of the results obtained, it can be stated that: (a) patients with SCD obtained scores on Mastery statistically equivalent to those of patients with schizophrenia spectrum disorders; and (b) participants with SUDs showed a poorer metacognitive performance on Self-reflectivity, Understanding others' thoughts, and Decentration than patients with mild anxiety disorders.

These findings are far from the conceptualization of drug addictions as impulsive or compulsive behaviors strongly associated with a poor capacity for self-awareness (Chambers & Potenza, 2003; O'Brien, 2008).) For example, many current addiction recovery programs, such as Alcoholics Anonymous (2001), are based on a model that characterizes this type of disorders as closely linked to lack of self-control and self-perception of one's mental states. The high prevalence of alexithymia (Lysaker et al., 2014), scarce cognitive flexibility (Luoma, Drake, Kohlenberg, & Hayes, 2011), difficulties in interpersonal relations (Greene et al., 1999), or poor self-concept (Chelton & Bonney, 1987) shown in SUDs could support this type of definitions of addictions. However, the results of this study point in the direction of other recent findings suggesting that the problem of people with SUDs would not be much in their difficulties to describe and understand their own and others' thoughts, emotions, or intentions, but in their poor capacity to regulate and integrate this information and to perform adaptive behaviors (Lysaker et al., 2014; Wasmuth et al., 2015).

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Table 3. *ANCOVA, effect sizes and post hoc analysis of metacognition scores, controlling for age and educational level of the participants.*

	Group 1 Anxiety (*n* = 115)	Group 2 Drug Addiction (*n* = 52)	Group 3 Schizophrenia (*n* = 49)			
	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	*F*	η^2_p	Post hoc analysis
MAS-A						
Self-reflectivity	6.05 (1.61)	6.00 (1.66)	4.08 (1.19)	32.74**	0.17	1. 2 > 3
Others	4.00 (1.26)	3.91 (1.01)	2.69 (0.98)	29.81**	0.15	1. 2 > 3
Decentration	1.52 (0.98)	1.14 (1.22)	0.99 (0.92)	6.06**	0.09	1. 2 > 3
Mastery	4.70 (1.71)	3.51 (1.34)	3.36 (1.56)	18.24**	0.14	1 > 2. 3
Total	16.26 (4.96)	14.56 (4.72)	11.12 (4.01)	26.95**	0.19	1 > 2 > 3

Note. MAS-A = Metacognition Assessment Scale brief version; η^2_p = partial eta-squared. **$p < .001$.

Likewise, the results of this study support the idea that substance abuse per se does not alter metacognitive functions (Wasmuth et al., 2015), offering an alternative hypothesis to understand the etiology of the functional deficits often associated with SUDs. This hypothesis is based on the fact that substance abuse can be explained as a compensatory behavior for deficits in the metacognitive skills of Mastery (Wasmuth et al., 2015). Substance consumption, as a known, controllable, and easily manageable activity, does not require important metacognitive efforts, in contrast to other social and occupational activities. As the underlying neurobiological circuits of rewarding and substance abuse are similar (Chambers, Bickel, & Potenza, 2007), it is reasonable to assume that addictions could compensate the difficulties to earn rewards in other more complex contexts. However, the alternative hypothesis—that deficits in Mastery skills are a partial or total consequence of chronic substance abuse (Lysaker et al., 2014)—should not be discarded.

Nonetheless, the similarities observed on Mastery in participants with schizophrenia spectrum disorders and with SUDs could lead to suspect the presence of underlying common neural mechanisms or, at least, of certain similarities in the way of processing information in both groups of disorders. Nevertheless, this may also be due to many other causes, such as attachment styles (Fonagy & Bateman, 2006), genetic variables (Highland et al., 2013), motivation (Bachiller et al., 2015), or the experience of traumatic events (Pec, Bob, & Lysaker, 2015). Future studies should clarify whether these types of deficits share similar neural mechanisms and/or whether they have a common etiology.

As main limitations of this study can be identified as follows. Firstly, the reduced size of the groups, especially the schizophrenia spectrum and SUDs groups, and the over-representation of women in the anxiety group and of men in the SUDs group that clearly affect the validity and extrapolation of these results to other samples of interest. Moreover, as consumption behaviors like, for example, alcohol or cannabis, are very widespread and deeply rooted in our society, these problems often go unnoticed and are not diagnosed. The risk that the data could be contaminated by the presence of participants with comorbid SUDs in the schizophrenia spectrum and anxiety groups is a potential limitation of the validity of the results. Secondly, the fact that the conclusions are supported by the scores obtained with pilot versions of the MAI interview and the MAS-A scale (neither instrument has been yet validated into Spanish) is a limitation that can affect the validity of the estimations of the metacognition construct. Likewise, the two assessment techniques used are based on verbal information provided by the individuals, so there may be discrepancies between real metacognitive skills and those described in the interview. Future studies should use other methods of convergent assessment, such as those based on the analysis of social interaction or individual non-verbal techniques that allow inferring the use of metacognitive strategies from repeated patterns in observed behavior while performing certain tasks. The current level of development in the field of metacognition indicates that no single technique is sufficient to assess these processes, but instead that various metacognitive markers should be used. Thirdly, and from a practical viewpoint, although this study shows how important it is for future studies to examine the effectiveness of treatments based on metacognition in SUDs, for example, metacognitive training (van Oosterhout et al., 2015) or metacognitive-oriented social skills trainning (Ottavi et al., 2014), this findings does not provide detailed information about the variables that could improve metacognition or the potential effects of metacognitive-focused interventions could have in concrete clinical populations. It should also be noted that, although substance abuse could be a compensatory behavior for metacognitive deficits, it is quite possible that these deficits emerge in an exaggerated manner as a consequence of neuropathological changes associated with chronic drug abuse (Chambers, 2013; Volkow, Fowler, Wang, Baler, & Telang, 2009). Lastly, although the selection of the groups was carried out to attenuate the possible effects of (mental) health problems and of the psychological and/or psychopharmacological treatment received,

none of these variables (specific diagnosis, treatment type and duration, medication, etc.) or their potential impact on participants' metacognitive capacity (López-Duran et al., 2006) were specifically controlled.

Future lines of research should explore more closely the relations between addictive behaviors, metacognitive skills, the level of personal, occupational, and social functioning, as well as the implicated neurobiological bases. It also seems relevant to analyze in more detail the role played by metacognition in general and Mastery in particular in the prediction of the maintenance of abstinence. In this line, it can be assumed that improvements in the Mastery skills would help to improve general coping strategies in the face of problems associated with drug abuse, risk situations, abstinence, or relapses, as suggested by Marlatt and Donovan (2005).

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Conflict of interests

The authors declare no conflict of interest

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