

Kretschmer revisited: Mental fatigue and ideas of reference. Contributions from reinforcement sensitivity theory

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Abstract: Our aim was to find out the relationship of cognitive/somatic fatigue, sensitivity to punishment (SP)/sensitivity to reward (SR) (Gray) with ideas of reference (IR), and to analyze the mediator role of SP/SR between cognitive/somatic fatigue and IR. The sample was comprised of 79 patients and 329 controls, evaluated with the Referential Thinking Scale (REF), the Fatigue Scale (CFQ) and the SP/SR Questionnaire (SPSRQ). The Baron and Kenny (1986) model and the Preacher and Hayes (2008) procedure were used to test mediation. The model explains 42% of the variance. The direct effect decreased significantly, mainly for SP, and the analysis of the indirect effect is valid for SP but not for SR. Cognitive and somatic fatigue predispose IR (Kretschmer) with participation of the SP system which may act as a mediator, more than a moderator. Cognitive/somatic fatigue may activate a system alerting of aversive (social) stimuli and thus increase the IR.

Keywords: Ideas of reference; mental fatigue; cognitive fatigue, sensitivity to punishment; sensitivity to reward; behavioral activation/approach system; behavioral inhibition system.

Kretschmer revisitado: Fatiga mental e ideas de referencia. Contribuciones desde la teoría de la sensibilidad al refuerzo

Resumen: Se analiza la relación entre la fatiga cognitiva/somática y las sensibilidades al castigo (SC)/recompensa (SR) (Gray) con las ideas de referencia (IR). Se estudia el papel mediador/moderador de los procesos SC/SR entre la fatiga cognitiva/somática y las IR. La muestra fueron 79 pacientes y 329 controles, evaluados con la Escala de IR (REF), Escala de Fatiga (CFQ) y Cuestionario de SC/SR (SPRSQ). Se utilizó el modelo de Baron y Kenny (1986) y el procedimiento de Preacher y Hayes (2008). El modelo explica un 42% de la varianza. El efecto directo disminuyó y el análisis del efecto indirecto es válido para la SC pero no para la SR. La fatiga cognitiva y somática predisponen a las IR (Kretschmer), con la participación de la SC, pudiendo ser más moderadora que mediadora. Quizá la fatiga cognitiva y somática activen un sistema sobre los estímulos (sociales) aversivos y se incrementen las IR.

Palabras clave: Ideas de referencia; fatiga cognitiva; sensibilidad al castigo; sensibilidad al refuerzo; sistema de activación conductual; sistema de inhibición conductual.

Introduction

Referential thinking is a self-focus (or self-focused attention) process which is important because of its sub-

jective and pre-reflexive nature (Zahavi, 2000), which enables self-regulation of behavior (Lemogne et al., 2009). A particular example of this processing is self-references or ideas of reference (IR).

The presence of IR is considered normal in human beings, given the possible role of social activity in the regulation and control of human behavior. It is also recognized that IR are stronger in emotional overload, in new and uncertain situations, and in certain stages de-

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fined by personal change (such as adolescence), and particularly, in psychopathological states (Cicero & Kerns, 2011; Mojtabai, 2006; Senín-Calderón, Rodríguez-Testal, & Perona-Garcelán, 2014). IR may be found in various clinical diagnoses, particularly in schizophrenia and other psychotic disorders, personality disorders, or mood state disorder diagnostic classes. In some diagnostic classes, such as anxiety disorders, IR are not especially strong, except in cases where social evaluation or scrutiny are important, such as in social phobia (social anxiety disorder). In more severe cases, IR are revealed to be delusional: delusional ideas of reference, or, when they have more structure, organization and stability, as delusions of reference. Allusions, offences or mockery, malicious looks, laughter or murmuring, become unquestionable, hard to set aside, continual, and true for the person, all of which causes great suffering (Colori, 2015).

Historically, one of the obligatory mentions is what Ernst Kretschmer (1966) called a sensitive delusion of reference. This author suggested a psychological type, characterized by strong reactive lability, a biological tendency to fatigue, and a style characterized by self-observation and self-criticism. He differentiated, on this constitutional basis, a character he called the sensitive asthenic type (tendency to fatigue) from a sensitive sthenic type (aggressive or expansive). The first may lead to delusion of reference, the second to persecutory delusions (paranoia).

Furthermore, Jeffrey Gray studied the role of reward and punishment in learning, intending to identify the brain systems that take part in developing behavior. He created a neurophysiological theory of personality (Gray, 1982; 1987), or the Theory of Sensitivity to Reward (Pickering, Díaz, & Gray, 1995), in which he proposed the existence of three motivational systems that influence and regulate human response: the Behavioral Activation/Approach System (BAS), the Behavioral Inhibition System (BIS), and the Flight/Fight/Freeze System (Corr, 2013; Gray, & McNaughton, 2000). The BAS (Gray, 1987) is sensitive to or activated by targets or signs of reward, is involved in extraversion and is related to the search for reward stimuli (and ending punishment) (Pickering, & Gray, 1999). Increased BAS activity is associated with positive affect (Carver & White, 1994), interest and maintenance of the reward, and aggression (proactive) (Corr, Hargreaves-Heap, Tsutsui, Russell, & Seger, 2013). However, the BIS is activated by conditioned aversive stimuli, signs of absence of reward, new stimuli, or targets in conflict (e.g., faced with past experiences, or a difficult situation in which the BIS and the BAS both intervene, that is, it works as a comparer).

The BIS can lead to inhibiting execution of behavior (not fleeing actively or fighting against the aversive stimulus as this would favor the Flight/Fight system associated with fear or panic). This involves focusing attention on new and environmental stimuli and facilitating a certain type of controlled action (Gray, 1993). The BIS is proposed as the basis of anxiety, showing individual differences in susceptibility to punishment.

When a stimulus has previously been associated with the reward, the comparer is in “verification mode” and the BAS prevails over the BIS. But if the stimulus has previously been associated with negative experiences, it goes into “control” mode (Gray, 1981; 1983), and the BIS is the comparer that prevails in starting up behavior, leading to an anxiety response, and beginning to process the information to resolve the conflict. The balance and relationships between the BIS and the BAS (as well as the flight/fight system) are essential to understanding human behavior, although research is still needed to determine how this regulation is established (Corr, 2013).

As a result, following the classic proposal by Kretschmer, the prominent states of fatigue, physical/somatic or cognitive/mental (CFQ-S or CFQ-C), could be related to the significant presence of IR, although the CFQ-C is the one related to the various psychopathological indicators (Fuentes-Márquez, Senín-Calderón, Rodríguez-Testal, & Carrasco-Ortiz, 2015). It has been verified that the presence of psychopathology, and particularly, depressive or somatic anxiety, are related to a certain response on somatic and cognitive fatigue, so the consideration of suffering from a diagnostic condition has to be kept in mind. However, in addition to recurring to typological resistance with little overall strength or integrity of the CNS, specific neurobiological systems related to the history of rewards and associated with response to the setting, and thus systems that consolidate progressively throughout development, could participate. Both the BIS, related to sensitivity to punishment (SP), and BAS, related to sensitivity to reward (SR), are expected to mediate the presence of IR as a psychopathological indicator, whether from fear of social rejection or perception of threat (BIS or SP, thus related to negative affect) or the need for social reinforcement (BAS or SR, related to positive affect) (Senín-Calderón et al., 2014).

The first goal of this study was to find out the relationship of the CFQ-C, the CFQ-S, and SP/SR sensitivities to IR. We predicted that a significant positive relationship would be found among all these measurements, which would have to be particularly strong between the CFQ-C and the frequency of IR. The second goal was to verify the mediating role of SP/SR processes between

the CFQ-C and CFQ-S (as predictor variables) and the IR as a psychopathological indicator. It was predicted that the highest percentage of variance would be explained by SP, as a means of control (given the essentially negative connotation of the IR; Rodríguez-Testal, Senín-Calderón, Perona-Garcelán, Ruiz-Veguilla, & Scurtu, 2013). Further, this SP mediates the significant relationship between the CFQ-C and the CFQ-S on the IR, taking into consideration the variables to be controlled for such as age, gender or having some psychopathology at the time of evaluation.

Method

Participants

A total of 408 subjects from the city of Seville (southern Spain) participated in this study (74% women). The patients ($n = 79$, 19% of the total sample) were recruited incidentally from a private psychology clinic (51 women, 65%; $M_{age} = 35.9$, $SD = 12.1$; mean social status, $M = 41.96$, $SD = 22.57$). The Control Group ($n = 329$, 81%) was taken from the general population (251 women, 76%; $M_{age} = 22.8$, $SD = 6.7$; mean social position, $M = 39.84$, $SD = 18.53$).

Five types of diagnoses were found in the group of patients: personality disorders (8 patients), mood disorders (20 patients), adjustment disorders (14 patients), somatoform disorders (11 patients), eating disorders (1 patient), anxiety disorders (17 patients), and psychotic disorders (8 patients).

Instruments

First self-reported evaluation (by authors). Questionnaire designed to assess demographic information on the index of social position (ISP) (Hollingshead, 1975), current illnesses, psychopathological background, history and duration of symptoms, psychopharmacological treatments and use of other drugs. The purpose of this test is to collect general descriptive information on the participants.

Referential Thinking Scale (REF) (Lenzenweger et al., 1997). This self-reported questionnaire consists of 34 true/false items on ideas of reference (IR), has an internal consistency of .83 to .85, a reliability retest (four weeks later) of .86, and adequate validity indicators. The scale provides a schizotypy indicator with saturation of .75 to .85 in the principal components analyses (similar to magic thought or anomalous perceptions) and to a lesser extent, with anxiety and depression (.33 to .17) (Lenzenweger et al., 1997). The Spanish adaptation of

the REF scale has an internal consistency of up to .90 (.83 and .82 for each half) and a retest reliability of .76 (average interval of 44 days in patients). The validity of criterion (with regard to the instrument of clinical monitoring BPRS) had a cut-off of 7 points for 66% specificity and sensitivity of 58% (Senín-Calderón et al., 2010). The Cronbach's alpha was calculated for each group: In the patients group, .89; in the control group, .82.

Questionnaire of Fatigue, Chalder Fatigue Questionnaire (CFQ) (Chalder et al., 1993). Spanish version by Hernández, Berrios & Bulbena (2000). It consists of 14 items that evaluate the severity or intensity of fatigue experienced using two factors: physical/somatic fatigue (CFQ-S) and mental/cognitive fatigue (CFQ-C). The instrument also provides a total score. Each item is scored on a four-point Likert scale based on the last 15 days before the test. The scale's overall measurement shows adequate internal consistency (.89), as well as its mental and physical fatigue factors (.82 and .85, respectively) (Chalder et al., 1993). It is an instrument sensitive to changes in treatment (Deale, Chalder, Marks & Wessely, 1997). The Cronbach's alpha was calculated for each group and factor: in the patients group, .88 for physical fatigue and .85 for cognitive fatigue; in the control group, .82 for physical fatigue and .79 for cognitive fatigue.

The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) (Torrubia et al., 2001). This scale has 48 items with true/false answer choices. It is comprised of two subscales, each of them having 24 items, which measure the concepts of Gray's original theory (1982; 1987) related to Sensitivity to Reward (SR) and Sensitivity to Punishment (SP). The Cronbach's alpha for the SP scale is .83 for men and .82 for women, and for SR it is .78 for men and .75 for women. Cronbach's alpha was calculated for each group and factor: In the patients group, .88 for SP and .66 for SR; in the control group, .84 for SP and .75 for SR.

Procedure

An ex-post-facto design was carried out with one measure (cross-sectional study). The patients were selected by incidental sampling from those who requested psychological intervention at a private psychological clinic. The control group was selected from the general population of the city of Seville using the snowball method, with the help of student assistants from a clinical psychology course at the University of Seville (School of Psychology). Criteria for inclusion were based on understanding the tests, that the medication prescribed did not interfere in general functioning, and

that the participants did not show indication of substance dependence. The diagnostic groups were established following DSM-IV-TR criteria (APA, 2000) by two authors with over 20 years of clinical experience. These diagnoses were based on a clinical interview with each patient. Controls were checked to see that they had no current psychopathology and that they were not in treatment at the time of evaluation, by means of specific questions on the first self-reported evaluation. Five subjects were excluded from the group of the general population because they were under psychological treatment at the time.

Each participant was given a dossier which included the evaluation instruments. All the tests were in a self-report format taken under adequate conditions of lighting and space, and the researchers intervened only to solve doubts or questions during the evaluation.

Participation in the study was voluntary and required written informed consent to use the results of the tests in the study. All participants were informed of the confidentiality of their data and the purpose of the study.

Statistical analyses

Descriptive statistics and comparison of means (*t* test) were used to compare the following characteristics of patients and controls: age, index of social position (ISP), answers on the SPSRQ (SP and SR), the CFQ (cognitive and somatic fatigue), the REF (frequency of IR) and Pearson's Chi-squared for gender and group (2 x 2), using contingency tables. For the first goal of this study, a two-tailed Pearson's correlation coefficient was done for the CFQ-C and CFQ-S, SP and SR, REF variables and age for later consideration as covariance. All the analyses were accepted for at least a $p < .05$. The SPSS statistical package version 22 was used.

For the second goal, although no causal relationship may be established between variables based on a statistical procedure with an *ex post facto* design, the mediation analysis can approach the association and magnitude of variables typical of a causal phenomenon (Hayes, & Preacher, 2013). We started out with a possible cause-effect relationship between two independent variables X (CFQ-C and CFQ-S), and a response variable Y (REF). The idea is to find the role of other intervening variables M, SR and SP, as mediator variables in the relationship between X and Y, controlling for any contribution of covariance. The Baron and Kenny (1986) model was used for this, based on a significant relationship between the independent variables (CFQ-C and CFQ-S) and the dependent variable (REF) (the total effect was estimated, significant coefficient *C*). Besides, there must be a significant rela-

tionship of mediator variables (SR and SP) with independent variables (significant *a* effect), and the same with the dependent variable (significant *b* effect). The relationship of independent variables and the dependent variable that must be influenced by inclusion in the regression of mediator variables to the point of losing significance (full mediation, $C' = 0$) or decreasing it (partial mediation, $C' \neq 0$) (C' less than the indirect effect $a \cdot b$) (García, & Vallejo, 2011).

A multiple mediation analysis was done by the Preacher and Hayes (2008) resampling procedure (bootstrapping) using a 95% confidence interval and 5000 bootstrapped iterations to calculate the coefficient of the indirect effect. This procedure is powerful for identifying effects even in small samples that do not have a normal distribution. The *MEDIATE* macro for SPSS version 22 was used to estimate the significance of the mediators as well as control for the possible influence of covariates (<http://www.afhayes.com/public/mediate.sps>). All the analyses were accepted at $p < .05$.

Results

Preliminary analyses

The participants in the study, differed by whether they were patients or controls, in age $t(89.87) = 9.25$ ($p < .05$), ISP $t(104.83) = 2.56$ ($p < .05$), and sex $X^2 = 4.56$ ($p < .05$). As expected, statistically significant patient/control differences were found in both predictor variables, CFQ-C $t(94.01) = 9.42$ ($p < .05$) and CFQ-S $t(406) = 7.13$ ($p < .05$), and mediators: SP $t(406) = 4.35$ ($p < .05$), and measurement (IR) $t(89.97) = 7.42$ ($p < .05$), except for the SR mediator variable $t(195.16) = -0.36$ ($p > .05$). It was decided to take the variables in which there were significant differences as covariates: age, sex and group (patient/control). The ISP was excluded from analysis because in these first analyses it was not found to be a variable connected to the model presented.

Descriptive differences by diagnostic class were observed in the clinical sample ($F(5, 74) = 5.220$, $p = .001$; $F_{Levene} = 1.291$, $p = .285$, Bonferroni, $p < .05$: The schizophrenia and other psychotic symptoms diagnostic class significantly differed from anxiety disorders and adaptive disorders). In the anxiety disorders, where the average IR for the diagnostic class was 6.35 points (SD=4.68), social phobia (average 11.00 points; SD=1.41) was very different from anxiety disorder (average 4.66 points; SD=2.30), and very different again from the schizophrenia and other psychotic disorders diagnostic class (average 17.75 points; SD=7.49).

First goal: Relationship between the measures studied

In Table 1, as a preliminary step to the study of the variables presumably mediating, the bivariate correlations were displayed between the measurements and the whole sample. Given that age correlated significantly with CFQ-C and CFQ-S as well as with IR (REF), it was corroborated as covariance to be taken into consideration.

It does not significantly correlate with SP or SR. Statistically significant correlations were observed between the two fatigue factors and REF, mainly CFQ-C, with a result of .51 ($p < .01$). The relationships of the possible mediator variables with CFQ-C and CFQ-S are statistically significant, especially for SP and CFQ-S (.43, $p < .01$). For SR, this correlation is lower, and rather a result of the sample size, for example, for CFQ-C (.12, $p < .05$).

Table 1. Descriptives and Pearson's bivariate correlations for the different measurements considered ($N = 408$)

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6
1. Age	25.36	9.56	1					
2. CFQ-S	7.38	5.53	.17**	1				
3. CFQ-C	5.20	4.51	.38**	.61**	1			
4. SP	10.89	4.94	.04	.43**	.35**	1		
5. SR	9.35	3.50	-.09	.17**	.12**	.17**	1	
6. REF	4.86	5.13	.12*	.40**	.51**	.37**	.31**	1

Note: CFQ-C: cognitive fatigue; CFQ-S: somatic fatigue; SP: sensitivity to punishment; SR: sensitivity to reward; REF: frequency of ideas of reference. As a reference on IR (Senín-Calderón et al., 2010): patients $M = 7.58$ ($SD = 6.72$); controls $M = 3.82$ ($SD = 4.08$). * $p < .05$; ** $p < .01$

Second Goal: Analysis of SP and SR as mediator variables

In the analysis of the mediator variables, as observed in Table 2, the total effect (C) of the relationship between the CFQ-C and CFQ-S with frequency of IR (REF) is statistically significant, $F(4, 403) = 44.51$, $p < .01$, explaining 34.84% of the variance. The non-standardized coefficient β of the CFQ-C variable is 0.38 ($t = 5.92$; $p < .01$) and for the CFQ-S it is 0.10 ($t = 2.19$; $p < .05$). The omnibus test, considering the set of covariances, is equally significant ($F = 38.60$, $p < .01$).

The relationship of the CFQ-C and CFQ-S variables with the theoretical mediator variables (M) showed statistically significant results. For SP, it explained 20.17% of the variance ($F(4, 403) = 21.56$, $p < .01$) and with respect to SR, 5.32% ($F(4, 403) = 5.56$, $p < .01$). The relationships of SP with CFQ-C ($t = 2.51$, $p < .05$) and CFQ-S ($t = 5.80$, $p < .01$) were significant. Sex and group variable covariances were not significant ($p > .05$), but age covariance was ($p < .05$). The relationship of SR to CFQ-C was not significant ($t = 1.44$, $p > .05$), but CFQ-S was ($t = 2.50$, $p < .05$). No statistical significance was observed in group covariance ($p > .05$), but it was in the age and sex covariances ($p < .05$).

The model as a whole explained 42% of variance, so there was a slight improvement in the percentage of variance explained with inclusion of the mediator variables (SP and SR) and covariance ($F(6, 402) = 43.17$, $p < .01$).

In the omnibus test, the direct effect (C'), including the mediator variables (SP, SR), was significant ($F = 20.97$, $p < .01$). There was a drop in the direct effect to 0.32 (the total effect C mentioned above was 0.38) with respect to the non-standardized coefficient b of the CFQ-C variable, so it may be assumed that there is a mediation effect. For the CFQ-S variable, the non-standardized coefficient b for the indirect effect was .02 (the total effect C mentioned above was 0.10). In the overall model, sex covariance lacked significance ($p > .05$), and group and age covariance remained unchanged ($p < .01$) (the original t tests showed a higher average age in the group of patients).

The homogeneity test of the interaction regression ($X \cdot M$) showed that variance in the scores of these variables was adequate for each mediator variable (SP, SR) as well as for the omnibus test ($F = 1.64$, $p > .05$). The non-standardized coefficient b of the mediator variables was .02 for SP and .01 for SR (omnibus test), calculated after 5000 bootstrapped iterations, with confidence intervals above zero better for SP than for SR. Therefore, the indirect effect for the SP mediator variable is based on more reliable values.

Discussion

Based on Kretschmer's (1966) classic psychopathology reference on sensitive delusion of reference, we wondered whether a state/trait characterized by mental

Table 2. Analysis of mediation of the SP and SR variables in the relationship between cognitive fatigue (CFQ-C) and somatic fatigue (CFQ-S) on IR (REF)

Independent variables (<i>X</i>)	Mediator variables (<i>M</i>)	Dependent variable (<i>Y</i>)	Effect of <i>X</i> on <i>M</i> (<i>a</i>)	Effect of <i>M</i> on <i>Y</i> controlling for <i>X</i> (<i>b</i>)	Direct effect	Indirect effect bootstrap		Total Effect <i>C</i>
					<i>C'</i>	<i>a</i> x <i>b</i>	95% IC	
CFQ-C	SP	REF	0.17*	0.14**	0.32**	0.02	0.01-0.05	0.38**
CFQ-S			0.29**			0.04	0.02-0.07	
CFQ-S	SR	REF	0.09*	0.35**	0.02**	0.03	0.01-0.06	0.10**
CFQ-C			0.07			0.03	0.00-0.06	
			Covariance	group	-4.80**			-4.80**
				age	-0.09**			-0.11**
				sex	0.71			0.40

Note: The data show the non-standardized coefficient β and are based on bootstrapping for 5000 iterations. CI: confidence interval. *CFQ-C*: cognitive fatigue; *CFQ-S*: somatic fatigue; *SP*: sensitivity to punishment; *SR*: sensitivity to reward; *REF*: frequency of ideas of reference; *group*: patients/controls. * $p < .05$; ** $p < .01$

(CFQ-C) and somatic (CFQ-S) fatigue could be related to the presence of ideas of reference (IR), that is, whether there is underlying sensitivity to them related to a tendency to tire easily. The authors of the *Referential Thinking Scale* (REF) (Lenzenweger et al., 1997) stated that this instrument does not give exact delusional ideas of reference, although high scores on it suggest proximity to the delusional contents referred to by Kretschmer in his clinical descriptions. Furthermore, this instrument can include participants in the general population with whom self-referential processing can be analyzed from a dimensional perspective.

Our data suggest a significant positive relationship of the CFQ-C and CFQ-S with IR as predicted in the first hypothesis. This is important, because, although there is no way to verify the temporal relationship between fatigue (somatic or cognitive) and IR with the design used, an important association is shown in the measurements which developed very differently. Based on the correlation analysis, the relationship of the CFQ-C and CFQ-S with the IR is rather solid. Moreover, it is a stronger relationship than the one observed between the REF scale with factors related to Sensitivity to Reward (punishment and reward), or the CFQ-C and the CFQ-S with respect to both reward sensitivities. A relationship of all these measurements is therefore confirmed, so the next hypothesis leads us to analyze the order of the relationship of these variables.

If Kretschmer described a typology based on tendency to fatigue, we wondered if its relationship with the IR as a product or result could be mediated by systems that are comprised of both general functional characteristics

(neurobiological: Behavioral Inhibition System, BIS, and Behavioral Activation System, BAS), and a history of reward that is related to a particular sensitivity, like personality characteristics or Sensitivity to Punishment (SP) and Sensitivity to Reward (SR) (Gray 1982; 1987). This relationship of the IR with SP, especially, and also with SR, has been observed in other studies (Senín-Calderon et al., 2014). This was interpreted, respectively, in the sense of negative content of most of the IR, without its being exempt from a positive connotation for some of them (Cicero, & Kerns, 2011; Rodríguez-Testal et al., 2013). In any case, both sensitivities are motivational, because of the importance of social activity to the human being.

The BIS enables identification of conflict, and is activated when there is insecurity, directing action toward the threat (Corr, 2008; Gray & McNaughton, 2000), so high SP means rapid detection of threat, assigning resources more efficiently to their solution (Berkman, Lieberman, & Gable, 2009). This processing is not synonymous with anxiety (Ávila & Torrubia, 2006), and is the basis of many cognitive biases related to social activity (memory, expectations, negative beliefs, etc.) (Kimbrel, 2008). Kimbrel, Nelson-Gray & Mitchell (2012), had already suggested that both the BIS and the BAS have important indirect effects on social anxiety through cognitive biases. Therefore, it makes sense for these systems to mediate the appearance of the IR, due to the relevant nature of the stimuli themselves and because of the person's history of reinforcement which propitiates response to them. These comments would be in agreement with the importance of IR in disorders such as social

phobia, but not in other manifestations in the same diagnostic class (anxiety disorders), while at the same time it would be very high in diagnostic classes such as schizophrenia and other psychotic disorders (Wong et al., 2012) due to the participation of BIS and BAS (Senín-Calderón et al., 2014).

The data show that there is a mediator relationship between the CFQ-C and CFQ-S and the IR by SP. Although this mediation by SP has been verified in a statistically significant manner, even controlling for variables such as patient/control, sex, and age, it should be pointed out that the change in coefficient of the direct effect to total effect is very modest. Therefore, although the conditions for taking SP as a mediator variable are there, its partial mediation (the direct effect is still very outstanding) must be considered. For SR, the significant relationship between the predictor variables (CFQ-C and CFQ-S) and the mediator variable is met only by the sample size, and the *b* coefficient is significant only for the CFQ-S, verifying, however, a change indicating partial mediation, with limitations that advise such consideration.

In short, the most parsimonious explication is that the variables that recur to neurobiological processes related to the learning history do not fully mediate the relationship between underlying variables such as the CFQ-C and CFQ-S and the presence of IR (delusional or not). SP is especially important, with the highest percentage of explained variance, as a variable related to both general fatigue and IR, which recurs to a possible connection with an anxiety-like response (Bijttebier, Beck, Claes, & Vandereycken, 2009), orienting the person toward the context to monitor danger or threat (McNaughton & Corr, 2004).

The final results for SR are intriguing. SR is important due to the intrinsic need for social reward and presumably directs the individual toward evaluation (the IR: they are watching me, they are talking about me, etc.) to achieve this reward. Even though the conditions as mediator variable for CFQ-C and CFQ-S were not met, its relationship with the IR was similar to SP. However, this relationship of SR and IR (and thus possible appetitive stimuli) (Cicero, & Kerns, 2011; King & Hicks, 2009; Rodríguez-Testal et al., 2013; Senín et al., 2014), may be too heterogeneous, depending on the context and psychopathological conditions (e.g., IR may be evaluated as desirable for patients with certain personality disorders) (Rodríguez-Testal et al., 2013; Senín-Calderon et al., 2014). This result could also be explained by a stronger association of SR with impulsivity (Sava & Sperneac, 2006), and therefore, processes that differ from self-focused attention, more characteristic of the IR. In any case, no mediating process is evident.

Therefore, although the two sensitivities alone have to do with IR as motivational processes related to social situations in the aversive or appetitive sense, the CFQ-C and CFQ-S are underlying factors partially mediated, but more clearly so by SP. Physical/somatic and mental/cognitive fatigue (constitutional, as shown by Kretschmer, 1966) automatically activate a system of sensitivity already consolidated by learning toward potential signs of punishment (Corr, 2013), partially modulating the relationship between the tendency to fatigue and presence of IR.

This study has a series of limitations concerning generalization of its results which should be considered. In this sense, the analysis of mediator variables enables approach to a causal relationship (Hayes, & Preacher, 2013), but must be understood as strictly tentative. To improve the limitations of the design, a group of patients in remission could be included, or even another group which has completely recovered, which would enable analysis of the role of the predictor variable as a true underlying variable. Apart from this, the proportion of patients to controls in the sample is unequal, although participants who exhibited different pathologies were sought for this group of patients. A larger group, or one with a very specific group of patients would be useful for verifying the results in later studies. Moreover, it would be particularly relevant to select several groups with specific pathologies related to fatigue (e.g., chronic fatigue syndrome), mood state (e.g., major depressive syndrome), and population with no pathology, to compare the different responses to fatigue'.

The differences in descriptive characteristics of the two groups should also be kept in mind, although it was attempted to control for them by taking covariance into consideration in the statistical analyses. Finally, in future studies, the presence of stressful situations and situations with emotional response could be taken into account as factors favoring both the starting fatigue variables and ideas of reference.

This study approaches for the first time Kretschmer's (1966) clinical observations to find out the complex relationships between certain states (constitutional) of fatigue (somatic and cognitive) with the appearance of such an important psychopathological indicator as the ideas of reference, including variables related to neurobiological systems which may have been sensitized throughout the person's experience. Therefore, analysis of these characteristics is clinically useful for taking high-risk clinical variables into consideration. This study may also be useful in improving the design of assessment and intervention. Accurately describing the meaning of cognitive and physical fatigue may help to differentiate

their expression under different clinical conditions, and thereby specify interventions, at the same time as observing when certain states of fatigue could contribute to the appearance of pathological states, such as showing an increase and stabilization of IR.

Declaration of competing interest

None.

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