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Selective intentional forgetting in adolescents with social anxiety disorder

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ABSTRACT

Anxiety in young adults has recently been linked to reduced capacities to inhibit the processing of non-affective perceptual distractors. However, no previous research has addressed the relationship between social anxiety disorder (SAD) and the ability to intentionally inhibit no longer relevant memories. In an experimental study with adolescents diagnosed with SAD and matched nonclinical controls, a selective directed forgetting procedure was used to assess the extent to which anxious individuals showed lower memory impairment for to-be-forgotten information than their non-anxious counterparts. The results revealed that while the nonclinical sample group demonstrated the ability to selectively forget when instructed, the anxious adolescents demonstrated good memory for to-be-forgotten material and therefore failed to forget. Interestingly, more severe SAD symptomatology inversely predicted a degree of forgetting. We conclude that the main difference between socially anxious and non-anxious participants is specifically related to the ability to intentionally forget and could reflect cognitive functioning that is associated with vulnerability to anxiety. Impairment of the ability to make unwanted memories less retrievable could prompt some individuals to initiate or maintain anxiety disorders. Future psychological treatments could benefit from including modules on memory control training.

1. Introduction

Over the last 25 years, research on anxiety has focused on characterizing its underlying cognitive functioning (MacLeod et al., 1986; Cloitre and Liebowitz, 1991; Beck and Clark, 1997; Bishop, 2009; Pacheco-Unguetti et al., 2010). Thus, influencing theories on anxiety such as those by Eysenck (1992) or Beck and Clark (1997) stress the presence of hyper-vigilance and cognitive biases in anxiety disorders. In this respect, some studies comparing people with anxiety disorders and control individuals suggest that anxiety entails attentional and memory biases for threat-related stimuli. Thus, for example, it has been shown that patients with generalized anxiety disorder have greater difficulty than control participants in disengaging attention from task-irrelevant information related to threat (Williams et al., 1996). Hence, it is not surprising that a leading theoretical stance states that anxiety is characterized by a hyper-vigilant threat-detection system (Mathews et al., 1997).

More recently, anxiety has been related to reduced executive control capacity (Airaksinen et al., 2005; Bishop, 2009; Pacheco-Unguetti et al., 2010). Executive (or cognitive) control refers to a variety of goal-oriented processes that regulate thought, action and emotion. Thus, for example, it has been proposed that executive control processes play a key role in overcoming conflicts[1] that occur during information processing (Botvinick et al., 2001). Evidence of the link between anxiety and executive control comes from studies wherein anxious people tend to show deficits across a variety of non-affective tasks that demand high levels of cognitive control (Fox, 1993; Bishop, 2009; Pacheco-Unguetti et al., 2010). For example, in a neuroimaging study, Bishop (2009) found that high-trait-anxiety individuals showed reduced recruitment of the control mechanisms in charge of inhibiting distracting information that competes for processing resources. In a similar vein, Pacheco-Unguetti et al. (2010) studied the efficiency of executive control processes in high-trait-anxiety and low-trait-anxiety individuals. By using an experimental procedure thought to draw on cognitive control (Callejas et al., 2004), the authors obtained measures of the amount of

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[1] For example, overriding a well-learned response in favor of a less dominant one or preventing non-relevant competing memories from hindering retrieval of relevant target memories would require executive control processes.

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interference experienced by participants while stimulation conflicting with targets was presented. It was assumed that more interference from distracting information stems from less efficient executive control mechanisms. Pacheco-Unguetti et al. showed that high-trait-anxiety individuals found it more difficult to control interference from distractors than their low-trait-anxiety counterparts. Interestingly, no such deficit in executive control was found when a high-state-anxiety group was compared with a low-state-anxiety group in the same task. Taken together, results by Bishop and Pacheco-Unguetti et al. suggest that trait anxiety entails an impoverished capacity to exert control over distracting information (i.e., by inhibiting it). Maybe more importantly, as this deficit was observed when the processing of non-affective information was required, it could be thought of as a general characteristic of trait anxiety rather than as a threat-based cognitive bias.

Executive control is also involved in controlling memory (Conway et al., 2000; Braver and Cohen, 2001; Anderson, 2003; Román et al., 2009; Anderson and Huddleston, 2011). Specifically, it has been put forward that updating memory contents may require an inhibitory mechanism in charge of rendering non-relevant memories less accessible (Bjork, 1998; Anderson, 2005). Results in experiments using the list method-directed forgetting[2] (LM-DF) procedure, for example, might be interpreted in terms of inhibitory executive control (Conway et al., 2000; Anderson, 2005). In a standard LM-DF experiment, participants are presented with a first list of items to study. Immediately after being presented with List 1, half of the participants are instructed to forget the whole list (forget group), whereas the remaining participants are told to continue remembering List 1 (remember group). After being provided with a second list for study, both groups perform a recall test that usually involves both studied lists. The typical DF effect is a lower recall for List 1 items in the forget group relative to the remember group. From an inhibitory framework, this memory impairment might reflect the after-effect of an inhibitory control mechanism that acts on List 1. Specifically, it has been suggested that the instruction to forget in the presence of two sets of information induces a temporary state of inhibition that makes to-be-forgotten items less retrievable in a subsequent recall test (Bjork, 1998; Pastötter and Bäuml, 2010).

A better understanding of memory control capacities in anxiety disorders may be relevant given that some theoretical models (more or less implicitly) highlight the role of memory retrieval in anxiety. Thus, for example, in a cognitive model of social phobia (Clark and Wells, 1995; Wells and Matthews, 1996), individuals engage in anticipatory processing concerning past social situations (which necessarily requires episodic retrieval) before coming across a new social event. Hence, LM-DF procedures could serve as marker tasks to assess memory control abilities in anxious people. However, little work has focused on examining the effect of an instruction to forget in people with anxiety disorders. An exception to this is a study by Power et al. (2000) aimed at exploring the ability of clinically depressed, clinically anxious and control individuals to intentionally forget. Unfortunately, the results of this study do not allow us to learn anything about the memory control capacities of anxious people since DF was not even observed in the control group. Hence, the present study aimed to examine the relationship between trait anxiety and memory control by using an LM-DF procedure. Specifically, we utilized a recently introduced variant of this experimental procedure we thought to be more suitable for exploring individual differences in memory control (Delaney et al., 2009). The rationale behind our choice lies on the fact that this new procedure requires participants to selectively forget part of List 1 (rather than forget the whole set of studied items) so that it can draw on higher executive control demands. To the best of our knowledge, there is no previous research addressing the link between selective directed forgetting and a particular anxiety disorder. Besides, while research on the relationship between anxiety and cognition has focused on young adults, studies on this relationship in children and adolescents are sparse (Mesa et al., 2011). To fill this gap, the present study focuses on a sample of clinically diagnosed adolescents with social anxiety disorder (SAD) as part of a broader clinical project. SAD is a disabling disorder characterized by a fear of negative evaluation in social situations, has a lifetime prevalence that usually ranges between 2% and 9% in adolescents (Vasa et al., 2007; Orgiles et al., 2008), and is associated with significant social and academic impairments (Silverman and Albano, 1996).

To summarize, we aimed to test the hypothesis that clinically anxious adolescents are less able to selectively forget outdated non-affective memories than non-anxious adolescents. If a structural general-domain deficit in executive processes characterized trait anxiety, one would expect people with anxiety disorders to be less efficient at exerting control over out-of-date memories, even if these episodic memories were not affective in nature.

2. Method

2.1. Participants

Two hundred adolescents (mean age = 15.16, S.D. = 1.38) originally participated in the study. Seventy-five of them met diagnostic criteria for SAD and 125 were nonclinical controls. Fifteen clinically diagnosed participants and 21 controls were, however, removed from analyses because either their post-experimental questionnaire revealed that they made no effort at all to comply with the instructions or it became evident from their performance that no attempt to learn material was made. Thus, the final sample for this study was composed of 60 adolescents with SAD and 104 nonclinical controls (see Table 1 for details). The inclusion criteria were as follows: (1) primary diagnosis of social anxiety disorder as diagnosed by the Anxiety Disorders Interview Schedule for the DSM-IV, Child and Parent Version (La Greca and Lopez, 1998); (2) ages between 10 and 17 years; and (3) written informed consent by adolescent and parents. Exclusion criteria were (1) current suicidal intent or risk and (2) a positive diagnosis of mental retardation, psychosis, or other psychiatric conditions that would limit the ability to understand the assessment procedures.

2.2. Measures

The Anxiety Disorders Interview Schedule for DSM-IV: Child Version (ADIS-IV-C) was conducted by PhD students in clinical psychology trained to diagnose social phobia in adolescents. This semi-structured interview assesses current and lifetime child psychopathology according to DSM-IV criteria. The social phobia

Table 1
Demographic information and symptom measures by diagnostic group.

	Clinical social anxiety	Nonclinical control	*t*	*p*
N	60	104		
% Female	63	56		
Age	15.03 (1.43)	15.29 (1.34)	1.15	0.25
CDI	24.81 (3.08)	25.02 (2.67)	0.43	0.67
SAS-A	56.69 (11.14)	49.06 (10.24)	4.28	< 0.01

CDI, Children's Depression Inventory.
SAS-A, Social Anxiety Scale for Adolescents.

[2] A related procedure is the so-called item method-directed forgetting paradigm. In this variant subjects view a series of items each immediately followed by an instruction to remember or to forget the item. After all of the items have been presented, participants' memory is tested. Typically this item-by-item instruction manipulation also leads to memory impairment for items cued to forget. Unlike list method-directed forgetting, however, the item method-directed forgetting effect is thought to reflect differential encoding for items cued to forget and remember, and it will no longer be considered here.

section (ADIS-SP) consists of 22 dimensional ratings that evaluate social fear and avoidance using a clinical severity rating (ranging from 0=none to 8=very severely disturbing/disabling). Participants are screened and must score at least one "yes" in any of the questions 1a–1c (mainly focused on symptoms included within criterion A of DSM-IV) and in at least one social performance or interaction situation in 2a or 2b (such as initiating and maintaining a conversation) with a rating of 4 or greater. Assignment of fear (1=I feel fine, 9=I feel extremely distressed) or an avoidance rating (1=I never try to avoid this situation, 9=I always try to avoid this situation) of 4 or higher involves the endorsement of one social situation. A diagnosis is finally assigned if a severity rating of 4 or greater on a 0–8 rating of distress/impairment is given. This instrument was used as a diagnostic tool.

Social Anxiety Scale for Adolescents (*SAS-A*): This questionnaire is an adaptation of the Social Anxiety Scale for Children-Revised (SASC-R) for an adolescent population (Olivares et al., 2002). Similar to the SASC-R, the SAS-A contains 22 items (Likert-type scale: 1–5): 18 descriptive self-statements and four filler items. The SAS-A includes three subscales: Fear of Negative Evaluation (FNE; eight items), Social Avoidance and Distress specific to new situations or unfamiliar peers (SAD-New; six items), and Social Avoidance and Distress that is experienced more generally in the company of peers (SAD-General; four items). A similar factor structure was found in a Spanish-speaking population (Olivares et al., 2002). The Children's Depression Inventory (CDI; Kovacs, 1992) contains 27 items and is used to assess the severity of self-reported symptoms of childhood depression. Subscales include negative mood, interpersonal difficulties, negative self-esteem, ineffectiveness, and anhedonia.

2.3. Material and procedure

Prior to the study, the adolescents and their parents were informed about the study and its goals. Active informed consent was obtained from the parents before the research was conducted, and the adolescents provided assent before participation. Research assistants explained the procedure and provided instructions before conducting the research and reiterated that participation in the study was on a voluntary basis only. Students completed the measures for social anxiety and depression symptomatology in a group classroom setting and were assisted as necessary by two trained research assistants. For the diagnosis of SAD, each adolescent was individually interviewed in a private room in the school by means of the ADIS-C. Inter-rater reliability was calculated using the kappa coefficient method. The results (mean kappa coefficient of 0.82) indicated an excellent inter-rater reliability (Landis and Koch, 1977).

As for the experimental task, a Spanish translation of the unrelated sentences used by Delaney et al. (2009) was used to make up the material for the present experiment. However, those sentences describing threat-related situations were adapted or replaced. Participants studied two lists of items. List 1 consisted of 16 sentences, eight about Tom and eight about Alex, presented in alternating order (e.g., "Tom watched television", "Alex brushed his teeth"). The character to be presented first as well as the character-action assignation were counterbalanced across participants. Thus, the predicates associated with Tom for half the participants in each group were associated with Alex in the other half. List 2 was always the same and consisted of 14 unrelated action sentences about Mario (e.g., "Mario took out the trash", "Mario woke up late"). Each sentence was presented on the screen for 8 s. The presentation of items and instructions was controlled by E-prime software (Schneider et al., 2002) by means of a PC connected to a multimedia projector. Items and instructions were displayed on a wide screen. The experimenter read the instructions aloud and asked for additional explanations.

Immediately after being assessed for anxiety, participants engaged in the experimental session in a different room. The experimenter was blind to the clinical status of the participants, who were randomly assigned to one of the two instruction conditions (Remember vs. Forget). Upon their arrival, participants were informed that they were participating in a memory experiment and that their memory would be tested after studying a set of sentences about different characters. Following the List 1 presentation, participants in the groups cued to remember were told the following: "Please, do your best to retain the just-studied sentences". After this, they were asked to perform a paper-and-pencil task for 90 s in order to avoid material rehearsal as much as possible. This task required participants to quickly and accurately find and draw circles around specific letters on a sheet containing an unknown text written in English. Performance on this distractor task was quite high, and post-experimental reports revealed that most participants found the task resource demanding yet enjoyable. None of the participants reported to have spent time rehearsing previously learned items while carrying out the distractor task. Finally, participants were told to study List 2.

On the other hand participants in the forget condition were told after list 1: "At this point you must know that the forthcoming recall task will only test your memory about Alex. Thus, Tom sentences are no longer relevant. To do your best in the memory test you should forget all you learned about Tom. Ignoring information about Tom will definitively help you to better recall information about Alex." After a 90-s delay performing the distractor task, participants studied List 2.

Following the List 2 study, all participants again performed a visual search task for 90 s and then were provided with a blank sheet of paper and asked to write down as many sentences as possible linked to the two characters in List 1. Another blank sheet was then handed out and they were to recall List 2. An interval of 180 s was set aside for participants to recall each list, which is 60 s longer than in Delaney et al.'s study. We introduced this change in order to make sure that selective forgetting, if observed, was not due to a reduced amount of time to recall 16 sentences.

At the end of the experimental session, the participants assigned to the forget condition were asked to report to what extent they took the forget instruction seriously and engaged in memory updating. To do, so they were provided with a Likert-like item (ranging from 0=not seriously at all to 5=very seriously).

3. Results

Recalled sentences were considered correct if they kept the gist of the original ones and were assigned to the right character (overall, assignation errors were less than 7%). Two independent coders scored the recall performance of each participant. The interrater agreement was greater than 95%. When agreement was not reached, two additional coders were considered to resolve the differences through discussion.

Since our hypotheses only concerned List 1, we only report detailed data analyses for that list.

3.1. Selective directed forgetting (SDF)

We first carried out a 2 (anxiety group: Clinical Disorder vs. Control) × 2(instruction: Remember vs. Forget) × 2(character: Tom vs. Alex) mixed analysis of variance (ANOVA) on recall rates. Results showed the higher order interaction to be marginally significant, $F(1,160)=3.28$, $p=0.072$, $\eta_p^2=0.020$, and separate ANOVAs were performed for each anxiety group (see Fig. 1).

A 2 (instruction) × 2 (character) mixed ANOVA on the non-clinical participants' recall rates showed a significant effect of the interaction, $F(1,102)=4.50$, $p=0.036$, $\eta_p^2=0.042$. Further analyses revealed reliable SDF; the group cued to forget recalled fewer items about Tom than the remember-cued group did, $F(1,102)=4.37$, $p=0.039$, $\eta_p^2=0.041$, whereas both groups tended to recall the same amount of items about Alex, $F(1,102)<1$.

The corresponding ANOVA on the anxious participants' recall rates, however, did not show significant effects (all with $ps>0.220$; Instruction × Character interaction with $F(1,58)<1$). Tom and Alex items were recalled to the same extent regardless of the instruction provided after the List 1 study. Interestingly, this pattern did not seem to be due to the clinical group's unwillingness to forget, as a two-tailed *t*-test on the responses to the post-

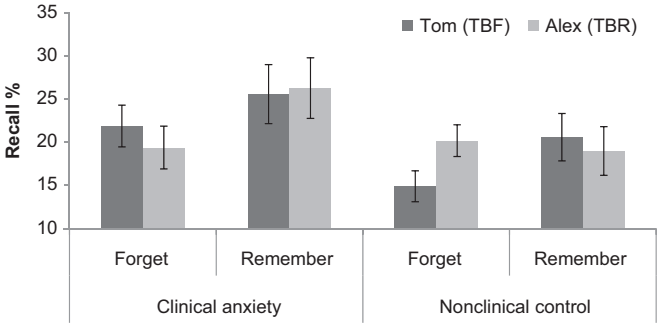

Fig. 1. Mean percentage of sentences correctly recalled as a function of diagnosis group, List 1 character and instruction provided to participants. Bars indicate standard error of the mean. *Note*: TBR=Character to be remembered in the forget condition. TBF=Character to be forgotten in the forget condition. In the remember condition both characters were to be remembered.

experimental Likert-type item revealed that anxious and control participants took the instruction to forget in a similar way ($M=1.78$, S.D.$=2.10$ and $M=2.06$, S.D.$=2.10$; $p=0.50$). Moreover, the absence of memory impairment in adolescents with SAD remained the same even after limiting the analyses to those participants who more clearly reported having followed the instruction to forget (values in the Likert-type item >2).

Additional analyses confirmed that there were no recall differences between the participants, with and without anxiety disorder, cued to remember all List 1 items, $F(1,49)=1.69$, $p=0.199$, $\eta_p^2=0.033$; (Character × Group interaction with $F(1,49)<1$). When comparing the two groups cued to forget, however, the interaction Character × Group was significant, $F(1,111)=5.32$, $p=0.022$, $\eta_p^2=0.046$. Whereas the nonclinical group showed a reliable memory impairment for Tom sentences relative to those for Alex, $F(1,111)=6.95$, $p=0.009$, $\eta_p^2=0.059$, this was not the case in the clinical group, which tended to recall sentences about the two characters at the same level, $F(1,111)<1$.

3.2. Relation between symptomatology and forgetting

To further explore the link between anxiety and memory control, we correlated the scores on the CDI and the SAS-A with individuals scores on selective forgetting. This latter variable was calculated for each of the participants with anxiety disorder in the forget condition by subtracting his/her recall rate for the to-be-forgotten character (Tom) from the recall rate for the to-be-remembered one (Alex) and dividing the result by the recall rate of Alex. The analyses showed a marginally significant correlation between the total SAS-A score and the score of selective directed forgetting, $r=-0.32$, $t(31)=-1.79$, $p=0.083$. Additional analyses revealed that the scores in the subscale SAD-G of the SAS-A were the only ones reliably predicting memory control, $r=-0.36$, $t(33)=-2.15$, $p=0.039$. In other words, the higher the level of anxiety and general social avoidance, the lower the ability to selectively forget. Scores on the CDI did not correlate with the measure of forgetting ($p=0.60$).

4. Discussion

This study aimed to explore the extent to which social anxiety involves impoverished inhibitory control over no longer relevant memories. By using a selective list method-directed forgetting procedure, we obtained support for this hypothesis. Selective memory impairment was observed in our nonclinical participants, which replicates with adolescents the basic SDF effect found with young adults by Delaney et al. (2009). However, no effect of the forget instruction was evident in the group of adolescents with SAD, who recalled more to-be-forgotten items than the nonclinical group. This finding suggests that adolescents with social anxiety disorder were less able to intentionally forget outdated memories than those without such a diagnosis.

Although SDF could arise from exerting selective rehearsal on the to-be-remembered items, which would become better learned (at the expense of the to-be-forgotten items), our data and those of Delaney et al. (2009) suggest that this is not the case. If selective rehearsal plays a relevant role in producing SDF, one would expect better recall of Alex items after the instruction to forget, since participants in this group could dedicate more encoding resources to those sentences than participants in the remember group (instructed to remember both Alex and Tom items). Instead, SDF could be understood in terms of capacity to inhibit non-relevant memories making them less retrievable (Bjork, 1998; Anderson, 2005). Specifically, we favor the idea that it reflects the operation of an intentionally driven inhibitory mechanism which is selectively targeted to some previously learned information and triggered in response to the forget instruction in conjunction with a subsequent learning episode (for a related argument see Pastötter and Bäuml, 2010). Thus, it should be noted that this proposal to account for SDF emphasizes the role of executive control on retrieval rather than on encoding processes. Hence, we suggest that while our nonclinical sample managed to inhibit the to-be-forgotten items after receiving the cue to do so, our sample of adolescents with SAD were unable to engage in such a control process to make those items less accessible.

Whatever the mechanisms producing SDF, the fact that we found a reliable inverse linear relationship between SAD symptomatology and selective forgetting supports the hypothesis that social anxiety entails a shortage of memory control. Thus, our data join the results from previous studies (e.g., Bishop, 2009; Pacheco-Unguetti et al., 2010) showing a negative relationship between social anxiety and executive control capacities and extend them to the memory realm.

Although consistent with the hypothesis that SAD involves impoverished memory control, the failure to observe intentional forgetting in our group of participants with SAD is hard to interpret in terms of cognitive biases limiting performance (e.g., Williams et al., 1996; Mathews et al., 1997). First of all, special attention was paid to prevent experimental material from conveying threat-related information. Second, socially anxious participants' overall memory performance was similar to that of controls (in fact the trend seems to favor adolescents with SAD). Hence, it would seem odd to attribute the lack of forgetting in the clinical group to a general cognitive deficit or to a reluctance to engage in the experimental setting. Rather, the main difference between socially anxious and non-anxious participants appears to be specifically related to the ability to intentionally forget and could reflect cognitive functioning which is associated with vulnerability to anxiety (Bishop, 2009).

Interestingly, our findings fit well into the Clark and Wells' cognitive model of social phobia (Clark and Wells, 1995; Wells and Matthews, 1996; Hodson et al., 2008). This model suggests that people with SAD, prior to encountering a social event, engage in anticipatory processing which includes negative thoughts on past social failures. In addition, one of the four primary variables in the model is post-event processing; namely, to which extent individuals find themselves thinking about social anxiety events and whether they manage to forget memories related to these events. Hence, our findings support the idea that a poor ability to make unwanted memories less accessible could prompt some individuals to initiate or maintain anxiety disorders. In the case of social anxiety, the putative deficit in memory inhibitory control might account for socially anxious adolescents' rigidness and difficulties in adapting to new situations.

The fact that trait anxiety involves inefficient cognitive control may have clinical implications. Individuals with SAD (and potentially other anxiety disorders) could benefit from psychological interventions that include executive control remediation, such as a module focused on training retrieval or post-event processing suppression. In this sense, clinicians could find the Directed Forgetting and Think/No Think procedures useful as tools to enhance memory control (for a review see Anderson and Huddleston, 2011), which could be used as part of cognitive behavioral therapy protocols.

Though suggestive, this study has some limitations that should be noted. Since our sample is restricted to adolescents with SAD, further studies should explore whether reduced capacity to intentionally forget is also present in other age ranges and anxiety disorders. While it would be predictable from the general hypothesis underpinning our study, it is also possible that some anxiety disorders are more prone to memory control deficits. In addition,

the relationship between the ability to intentionally forget and post-event processing is an empirical question to be directly investigated. Because we did not explicitly measure post-event processing, the connection of our findings with the Clark and Wells' model remains speculative. Future research could examine whether the frequency and contents of post-event processing in experimentally induced social situations are related to the ability to intentionally forget episodic memories. In turn, the extent to which the above-mentioned relationship is mediated by more general inhibitory control capacities is still to be clarified. Finally, we recognize that an alternative explanation of our results is that our adolescents with SAD were unwilling to forget rather than unable to do so. Although post-experimental reports and general memory performance go against this possibility, further research should clarify this point. Since memory inhibitory control has also been studied in nonclinical populations by using experimental procedures[3] that do not require participants to intentionally forget (e.g., Ortega et al., 2012), if clinical anxiety entails poor inhibitory control of memory, it should be observed with any task tapping this capacity.

To conclude, our findings suggest that clinical (social) anxiety is characterized by reduced ability to intentionally forget non-emotional memories. This finding supports the hypothesis that social anxiety involves a general deficit in cognitive control. The extent to which this executive impairment is associated with the onset and maintenance of anxiety disorders is to be addressed in future work. A better understanding of the cognitive correlates of clinical anxiety might provide insights into finer cognitive-behavioral treatments.

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[3] By using one of these experimental procedures, Amir et al. (2001) explored the capacity of adults with SAD to inhibit memories of neutral and threat-related words. Their results showed that while control individuals forgot positive, negative and nonsocial words, the sample of anxious participants only showed forgetting of positive and nonsocial items. Unfortunately, these findings are hard to interpret because the authors used a memory test that has been shown to reflect interference processes rather than memory inhibition (Soriano et al., 2009).