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Explicit and implicit attitudes toward heights: relationship with acrophobic symptoms and sensitivity to cognitive-behavioral treatment. A preliminary report

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This study aimed to test whether implicit and explicit attitudes toward heights differ between individuals with low and high fear of heights, and whether the implicit and explicit attitudes toward heights are sensitive to a one session cognitive-behavioral treatment (CBT) in the second group. In addition, we also explored the relationships between implicit and explicit attitudes, as well as the effect of retesting on implicit attitudes. Both explicit and implicit attitudes toward heights were assessed in individuals with low (n = 49) and high levels of fear of heights (n = 83) prior to treatment, and reassessed in the second group after one session of CBT intervention in virtual reality. Results show that there are differences in both implicit (F(1, 96) = 25.155, p < .005, partial η^2 = .208) and explicit attitudes (F(1, 96) = 90.970, p < .001, partial η^2 = .487 for cognitive evaluation; F(1, 96) = 69.542, p < .001, partial η^2 = .420 for dangerousness) between fearful and non-fearful individuals. As expected, implicit ($t(48)$ = 3.712, p = .001) and explicit attitudes ($t(56)$ = 4.071, p < .001 for dangerousness; $t(57)$ = 5.002, p < .001 for cognitive evaluation) favorably changed following treatment, with medium effect sizes. These findings suggest that both explicit and implicit attitudes are cognitive factors related to acrophobic symptoms and might play a role as mechanisms in the cognitive-behavioral treatment of heights related fear.

Keywords: Attitudes, Heights, Anxiety, Cognitive Behavioral Treatment, Virtual Reality.

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Introduction

Anxiety disorders represent a major issue for public health. Recent surveys have confirmed that specific phobias are among the most prevalent psychological disorders, indicating high rates (9.4%-12.8%) in the general population throughout the lifespan (Becker, Rinck, Türke, Kause, Goodwin et al., 2007; Bijl, Ravelli, van Zessen, 1998; Kessler, Chiu, Demler, Merikangas, Walters, 2005; Stinson, Dawson, Chou, Smith, Goldstein et al., 2007). Among anxiety disorders, acrophobia is the type of specific phobia with the highest prevalence in the category of natural environment, with reported estimated lifetime rates ranging from 1.1 to 5.9% (Becker et al., 2007; Stinson et al., 2007; Depla, ten Have, van Balkom, de Graaf, 2008). Given the aforementioned high prevalence and the high social (Buist-Bouwman et al., 2006) and economic costs (Smit et al., 2006) associated with anxiety disorders, identifying factors that might contribute to the onset and maintenance of anxiety is of paramount importance. Moreover, testing the ability of different interventions to impact on these factors is also needed.

Implicit and explicit cognitive processing

Cognitive models of anxiety disorders stressed the importance of cognitive processes on the etiology and maintenance of anxiety disorders (Barlow, 1988; Beck, Emery & Greenberg, 1985; Eysenck, 1992; Foa & Kozak, 1986). However, studies assessing the relations between specific anxiety disorders and information processing (e.g., interpretations, evaluations, attitudes) have mainly focused on self-report measures. Although very valuable in social sciences, self-report measures are not without limitation given that the relevant cognitions might be unavailable to introspection and/or might be distorted by self-presentational biases (Schwarz & Oyserman, 2001; de Jong, Pasman, Kindt, & van den Hout, 2001; Dovidio & Fazio, 1992). More recently, a particular emphasis has been placed in dual-process models on the importance of distinguishing between ruled-based, explicit cognitions and more automatically activated associations (i.e., implicit) (e.g., Gawronski & Bodenhausen, 2006).

Automatic associations are assumed to be simple connections between a category (e.g., heights) and its associated concepts in memory (e.g., dangerousness), that are automatically activated in response to a relevant stimulus (Gawronski & Bodenhausen, 2006). These processes do not involve an evaluative intention, nor many cognitive resources (Cunningham, Raye, & Johnson, 2004) and are independent of truth value assignments (Gawronski & Bodenhausen, 2006). Unlike implicit attitudes, explicit attitudes are seen as evaluative judgments based on propositional reasoning that are dependent on their subjective validity (Gawronski & Bodenhausen, 2006). On other words, while implicitly measured attitudes reflect the activation of associations in memory, explicit attitudes reflect the result of a validation process (Gawronski, LeBel & Peters, 2007). Therefore, although one may rate as false the proposition "heights are dangerous", an association between heights and dangerousness may still be activated in memory.

Considering these conceptual differences, whereas explicit attitudes are usually evaluated with self-report scales, studies on implicit attitudes propose a complementary assessment tool based on response time performance in seemingly unrelated tasks (Ellwart, Rinck & Becker, 2006). Although free of evaluative intention, the association between a certain category and evaluative concepts is used as a proxy for implicit attitudes. Hence, implicit attitudes are typically inferred from the performance on response latency measures. Even though a relative large number of implicit tests have been recently proposed, the Implicit Association Test (IAT) (Greenwald, McGhee & Schwartz, 1998) appears to be one of the most suitable, adequate psychometric properties being reported for this instrument (see De Houwer, 2003; Fazio & Olson, 2003 for a review).

IAT assesses implicit attitudes (Greenwald, McGhee & Schwartz, 1998) by measuring the association between two attribute and two target dimensions. In this computerized task, participants are asked to press one of two response keys to categorize a stimulus appearing in the center of the screen in one of the categories presented in the two opposite top corners of the screen. The assumption of the IAT is that faster responses are obtained in tasks where strongly associated concepts share the same response key (i.e., compatible block; e.g., heights related and negative words require pressing one key, while ground related and positive words the other key) as compared to tasks where the opposite assignment (i.e., incompatible block) is used (e.g., heights related and positive words share the same key, while ground related and negative words share the other response key). The implicit association is computed as the difference in average response time between the compatible and the incompatible blocks.

Implicit and explicit attitudes in fearful and non-fearful individuals

Considering the claim that implicit and explicit attitudes toward a phobic stimulus play a role in the onset and maintenance of anxiety, it would be expected for these variables to clearly distinguish between highly and low/non-fearful individuals. Previous studies (de Jong, van den Hout, Rietbroek & Huijding, 2003; Ellwart, Rinck, & Becker, 2006; Huijdin, de Jong, 2009; Teachman & Woody, 2003) tried to test this hypothesis, but their findings are somewhat mixed. Teachman & Woody (2003) reported stronger fear related implicit evaluative associations toward spiders for spider phobic individuals, as compared to non-phobic individuals, but only for two of the four IATs they used. In opposition, de Jong, van den Hout, Rietbroek & Huijding (2003) found more negative attitudes toward spiders at the explicit level, but not at the implicit level, while Huijdin & de Jong (2009) reported more negative attitudes at both explicit and implicit levels in phobic than in non-phobic individuals. Even though acrophobia is the most prevalent specific phobia in the natural environment category, to our knowledge no study compared implicit and explicit attitudes toward heights between fearful and non-fearful individuals. Only one study (Teachman et al., 2008) used IAT to assess automatic associations with heights, but it focused on the association between heights and fear (i.e., "afraid" versus "unafraid") and not on evaluative associations. Therefore it is unclear whether implicit attitudes toward heights differ between anxious and non-anxious individuals.

Changing implicit and explicit attitudes

Previous studies have shown that both implicit and explicit attitudes can be considered a result of conditioning, given that repeated conditional stimulus (CS) – unconditional stimulus (UC) pairing impacted on subsequent evaluations of CS (for reviews, see De Houwer, Thomas & Baeyens, 2001; De Houwer, Baeyens & Field, 2005; Walther, Nagengast, & Traselli, 2005). Therefore, according to these findings, in order to change negative attitudes toward a phobic stimulus it may be required to break the conditioned response, by creating a new CS – UC connection. These results are in line with the theory of Foa & Kozak (1986) that stresses the importance of implicit information processing, stating that exposure based interventions work through replacing the associations acquired in anxiogenic experiences with new associations. Thus, it would be expected for exposure based interventions that are efficient in reducing anxiety to also impact on information processing (e.g., attitudes). Not surprisingly, foregoing studies have proven that exposure based CBT interventions are effective in improving explicit attitudes toward heights in highly anxious individuals (Coelho, Silva, Santos et al., 2008; Emmelkamp, Krijn, Hulsbosch, De Vries, Schuemie, Van der Mast, 2002; Emmelkamp, Bruynzeel, Drost & Van der Mast, 2001; Krijn , Emmelkamp, Biemond et al., 2004). However, little is known about the impact of exposure based interventions on implicit attitudes. Three studies assessed the impact of exposure interventions for specific phobias on implicit attitudes (Huijdin, de Jong, 2009; Teachman, 2007;

Teachman & Woody, 2003). All the three studies focused on spider phobia, and their findings are mixed. Only Teachman (2007; Teachman & Woody, 2003) reported positive findings, while Huijding & de Jong (2007) showed a similar decrease in implicit attitudes among participants who received treatment and those from the wait list group. This may suggest a possible effect of time and/or retesting. Thus, the treatment sensitivity of implicit attitudes toward phobic stimuli, as well as potential effects of retesting on implicit assessment tools are still to be determined. In this context, taking into account that some studies showed that implicit attitudes are resistant to extinction (Hermans et al. 2002; Diaz et al. 2005), and that implicit information processing can influence one's behavior (e.g., avoidant behaviors), it would be important to assess the impact of exposure based interventions on implicit attitudes toward heights, complementary to explicit attitudes.

Present study

As part of a study assessing the efficacy of four Virtual Reality based (VR) interventions in reducing the level of anxiety in individuals with high levels of heights anxiety, we address both explicit and implicit attitudes toward heights. We aim to test whether individuals with high levels of heights anxiety have more negative implicit and explicit attitudes toward heights than individuals with low levels of heights anxiety, prior to intervention. In addition, we aim to evaluate whether explicit and implicit attitudes toward heights are improved in highly anxious individuals following the intervention. We also explore the relationships between explicit and implicit attitudes toward heights, and whether there is an effect of multiple testing for implicit association test.

Method

Participants

A total of 230 individuals were screened with the Acrophobia Questionnaire. Subsequently, all participants willing to continue were invited to a laboratory session to complete a series of measurements. To be included in the highly anxious group, participants had to score 45 or higher on the anxiety subscale, and 10 or higher on the avoidance subscale of the Acrophobia Questionnaire. One hundred participants (43.47%) met these criteria. Those scoring under the cut-offs (n = 130) were included in the low anxiety comparison group.

From 100 highly anxious subjects, data for 83 participants (mean age = 22.75 years, SD = 5.772, range = 18, 49, 86.74% female) who completed at least the initial evaluation in the current phase of the study was included. In addition to exhibiting high anxiety and avoidance toward heights, participants were required to be over 18 years old and not to suffer from any neurological problems.

From the 130 participants eligible for participation in the low anxiety control group, 49 were assessed in the current preliminary phase of this study. Similar to the highly anxious sample, most of those who already completed the assessment tools were also female (79.59 %), with a mean age of 23.08 years (SD = 5.314, range = 18, 38).

Measures

Acrophobia Questionnaire (AQ; Cohen, 1997) comprises two subscales: one for anxiety (with scores between 0 – 120), and one for avoidance (with scores between 0 – 60). The questionnaire describes 20 heights related situations. Anxiety across these situations is assessed on a seven-point scale (0: not at all anxious, 6: extremely anxious), while avoidance behaviors across these situations related to heights is assessed on a three point scale (0: I would not avoid this situation, 2: I would definitely avoid this situation). Previous studies (Cohen, 1977; Baker, Cohen & Sanders, 1973) reported mean values for acrophobic outpatients ranging from 48 to 60 for the anxiety subscale, and from 4 to 14 for the avoidance subscale. A good internal consistency was found in our sample (Cronbach's alpha, r = .81 for Anxiety Subscale and r = .67 for Avoidance Subscale).

Attitudes Toward Heights Questionnaire (ATHQ; Ableson & Curtis, 1989) includes six semantic differential scales on which subjects rate their general opinion toward high places, using six visual analog scales. The questionnaire provides a measure of two attitude variables: cognitive evaluations (good-bad, awful-nice, pleasant-unpleasant) and dangerousness (safe-dangerous, threatening-unthreatening, harmful-harmless). Acceptable internal consistency was found in our sample ($r\alpha$ = .75 for Cognitive Evaluation and $r\alpha$ = .77 for Dangerousness).

Implicit Association Test (IAT, after Greenwald, McGhee & Schwartz, 1998) is a response-time task in which participants had to classify words and pictures into superordinate categories. The task was designed to assess implicit attitudes by measuring the relative strengths of automatic associations between two contrasted target concepts and two attribute concepts. The IAT designed by the authors of in this study consists of items from four categories: the main target concept (heights), the relative target concept (ground), and two attribute concepts (positive-negative). For the target concepts we used both words and images, while in the evaluative categories we included just the words used in ATHQ, in order to ensure that the same attitudes were measured at the explicit and the implicit levels. Thus, in the "positive" category we included the words "good", "nice", "pleasant", "safe", "unthreatening" and "harmless", while in the "negative" attribute category we included the words "bad", "awful", "unpleasant", "dangerous", "threatening" and harmful.

The IAT designed for this study consists of seven blocks: three training blocks (i.e., B1, B2, B5) and four critical blocks: (B1) target discrimination, (B2) attribute discrimination, (B3) first combined block, (B4) second combined block, (B5) reversed target discrimination, (B6) first reversed combined block, and (B7) second reversed combined block (see Table 1). For each critical block, we presented two sets of category pairs simultaneously. Each pair comprised a target and an attribute category. Stimuli representing one of the four categories were randomly presented in the center of the screen, on each trial, while the two pairs of target and attribute categories appeared simultaneously in the opposite top corners of the screen. Participants were asked to indicate on which side of the screen (corresponding to one pair of categories) each stimulus belongs to by pressing a key to indicate the left (i.e., "Z" key) or the right (i.e., "/" key) side. The assumption of the task is that one classifies easier (i.e., shorter response time) in trials where his automatic associations with the target categories (heights/ground) match the target and attribute pairings, as compared to trials where the target and attribute pairings are mismatched (i.e., longer response time). It is thus expected for people with negative attitudes toward heights to classify faster the presented items when "heights" target

category is paired with the "negative" attribute concept (i.e., B3 and B4) than when "heights" target category is paired with the "positive" attribute concept (i.e., B6 and B7). Higher scores indicate more negative implicit attitudes toward heights (i.e., longer response times for blocks where "heights" are associated with "positive" attribute). Previous studies reported satisfactory internal consistency estimates that generally ranged from .7 to .9 (Greenwald & Nosek, 2001; Schmukle & Egloff, 2004). The test-retest reliability of IAT (r = .56) is somewhat lower than recommended (see Schmukle & Egloff, 2004), but considerably higher than the estimates reported for other implicit measures (Bosson, Swann, & Pennebaker, 2000).

Table 1. Blocks included in IAT

Block	Left corner concepts ("Z" key)	Right corner concepts ("/" key)
B1	heights	ground
B2	positive	negative
B3	heights + negative	ground + positive
B4	heights + negative	ground + positive
B5	ground	heights
B6	ground + negative	heights + positive
B7	ground + negative	heights + positive

Procedure

Therapists involved in this study were graduate students, licensed in clinical psychology and cognitive-behavioral psychotherapy. All of them received intensive training for exposure and cognitive restructuring in anxiety disorders.

Therapists met three times with each highly anxious participant enrolled in the study. In the first session, the pre-intervention assessment was individually conducted and the rationale of the treatment was explained. In the second session, the intervention was carried out, while the third session was allocated for post-intervention evaluation.

The effectiveness study in which the data presented here were collected used a 2x2 design with two levels of treatment virtual environment (Head Mounted Display – HMD and Computer Automatic Virtual Environment – CAVE) and two types of interventions (exposure – BT and exposure + cognitive restructuring – CBT). Participants were randomly assigned to one of the four treatment groups.

VR exposure was provided in a dark laboratory at the International Institute for the Advanced Studies of Psychotherapy and Applied Mental Health. Participants from all intervention groups were exposed to four different locations. In the CAVE environment, participants were gradually exposed to: (1) a balcony, (2) the edge of a wall, (3) the edge of a versant, and (4) the roof of a house placed on a versant. In the HMD environment, participants were gradually exposed to a deck placed at the (1) first floor, (2) second floor, (3) third floor, and (4) fourth floor of a building. During each exposure, participants were instructed to stay focused on the aspect perceived as the most frightening/dangerous. Participants had to rate their anxiety level on a 0-10 scale (subjective units of discomfort – SUDS) every two minutes. Each exposure ended when the anxiety diminished to at least half of the maximum level reported. In both VR environments, the therapist controlled the VR exposure using a joystick. However, participants were free to move within the pre-established exposure scenario.

In the two CBT intervention groups, participants were also asked to monitor their thoughts during exposures. Cognitive restructuring (i.e., logical, empirical and pragmatic) was used in addition to exposure, after each exposure phase.

Implicit and explicit attitudes were assessed one week prior to (i.e., pre) and one week after (i.e., post) the intervention. To assess the effect of multiple assessments on IAT, a subsample of participants (n = 20) were re-tested (i.e., intermediate) right before the intervention, when no change in attitudes could be attributable to intervention.

Data analysis

Although there were multiple interventions, for the aims of this study, we chose to combine data from the four groups, as no group effect was found on implicit or explicit attitudes pre or post-intervention (see Table 2). One way MANOVA was used to test differences between highly anxious and low/non anxious individuals concerning implicit and explicit attitudes, followed by three one way ANOVAs for implicit attitudes, and the two explicit attitudes subscales. Repeated measures t tests were used to assess the impact of intervention on implicit and explicit attitudes, as well as the stability of IAT.

Results

Highly versus low anxious individuals

There was a significant difference in attitudes between highly anxious and low/non anxious individuals ($F(3, 94)$ = 38.824, p < .001, Wilk's Λ = 0.447, partial η^2 = .55) on both implicit ($F(1, 96)$ = 25.155, p < .005, partial η^2 = .208) and explicit attitudes ($F(1, 96)$ = 90.970, p < .001, partial η2 = .487 for cognitive evaluation; $F(1, 96)$ = 69.542, p < .001, partial η^2 = .420 for dangerousness). Results indicate more negative implicit and explicit attitudes toward heights in anxious individuals, as compared to low/non anxious individuals.

Associations between implicit and explicit attitudes

Although both implicit and explicit attitudes are changed following the CBT interventions, there is no significant correlation between the two measurements (see Table 3).

Impact of intervention on implicit and explicit attitudes

Both implicit ($t(48)$ = 3.712, p = .001) and explicit attitudes ($t(56)$= 4.071, p < .001 for dangerousness; $t(57)$ = 5.002, p < .001 for cognitive evaluation) were improved after the intervention. The effect sizes were found to be medium for both implicit (Cohen's d = 0.527) and explicit attitudes (Cohen's d = 0.543 for dangerousness; Cohen's d = 0.661 for cognitive evaluation). To further explore the impact of treatment on attitudes, we conducted a one way MANOVA to compare the attitudes toward heights of anxious individuals after the intervention to those of non-fearful individuals. Results showed that after the intervention fearful individuals maintained more negative attitudes toward heights than non-fearful individuals ($F(3, 76)$ = 12.469, p < .001, Wilk's Λ = 0.670, partial η^2 = .33) concerning explicit attitudes ($F(1, 78)$ = 33.539, p < .001, partial η^2 = .301 for cognitive evaluation; $F(1, 78)$ = 28.795, p < .001, partial η^2 = .270 for dangerousness), but

not implicit attitudes ($F(1, 78) = 1.705$, $p = 019$, partial $\eta^2 = .021$).

Stability of the IAT measurement

Our data provide some support for the stability of the IAT. Results revealed no significant differences between the two measures (i.e., pre and intermediate) taken before any intervention was implemented ($t(19) = 0.876$, $p = .392$), but remained significant between the intermediate and the post-intervention measurements ($t(16) = 2.872$, $p = .011$), as expected if IAT was to be stable. Moreover, there was no significant difference after the intervention between those who had an intermediate measurement and those who had not ($t(52) = 0.641$, $p = .524$).

Table 2. Comparisons between treatments for implicit and explicit attitudes

Variable	χ^2	*df*	*p*	Group	Mean rank
IAT pre	2.677	3	0.444	1	34.94
				2	32.98
				3	43.33
				4	34.94
IAT post	0.068	3	0.995	1	27.14
				2	28.25
				3	27.81
				4	26.75
ATHQ-CE pre	1.349	3	0.717	1	33.38
				2	41.64
				3	37.05
				4	39.43
ATHQ-CE post	1.721	3	0.632	1	31.6
				2	34.46
				3	26.84
				4	31.88
ATHQ-D pre	1.585	3	0.663	1	33.67
				2	40.53
				3	34.74
				4	40.55
ATHQ-D post	3.198	3	0.362	1	28.9
				2	36.71
				3	26.2
				4	32.75

Notes: IAT = Implicit Association Test, ATHQ-CE = Attitudes Toward Heights Questionnaire-Cognitive Evaluation Subscale, ATHQ-D = Attitudes Toward Heights Questionnaire-Dangerousness Subscale, pre = prior to intervention, post = post intervention.

Table 3. Correlation matrix

	IAT pre	IAT post	ATHQ-D pre	ATHQ-D post	ATHQ-CE pre	ATHQ-CE post
IAT pre	-					
IAT post	.13	-				
ATHQ-D pre	.03	.12	-			
ATHQ-D post	- .04	.10	.51**	-		
ATHQ-CE pre	- .18	- .06	.58**	.29*	-	
ATHQ-CE post	.06	- .13	.11	.55**	.46**	-

Notes: IAT = Implicit Association Test, ATHQ-CE = Attitudes Toward Heights Questionnaire-Cognitive Evaluation Subscale, ATHQ-D = Attitudes Toward Heights Questionnaire-Dangerousness Subscale, pre = prior to intervention, post = post intervention.

Discussion

This study mainly aimed to investigate whether there is a difference in implicit and explicit attitudes toward heights between highly anxious and low/non anxious individuals, and to evaluate whether explicit and implicit attitudes toward heights among individuals with high levels of heights anxiety would change after the intervention.

The results of our study indicate that this version of IAT is a useful method to assess implicit attitudes toward heights, considering its ability to distinguish between highly anxious and low/non anxious individuals. We found that both implicit and explicit attitudes toward heights are more negative in fearful than non-fearful individuals. These findings are similar to those reported by Huijdin & de Jong (2009) and Teachman & Woody (2003) for spider phobia, but partially contradict the results of de Jong, van den Hout, Rietbroek & Huijding (2003) who found differences in attitudes toward spiders between fearful and non-fearful individuals only at the explicit level, and not at the implicit level. Therefore, somehow in line with the findings from other phobias, this is, to our knowledge, the first study to show that both explicit and implicit attitudes toward heights distinguish between fearful and non-fearful participants.

We also found that a one session of CBT had a medium effect on both implicit and explicit attitudes. However, exploratory analyses indicate that after the intervention only implicit attitudes were similar to those reported by non-fearful individuals, while explicit attitudes were still more negative in highly anxious than in low/non anxious individuals. These findings raise the question of clinical significance. Even though explicit attitudes improved significantly following the intervention, it is unclear whether this change is clinically relevant. Results of the exploratory analyses are somewhat surprising,

considering that implicit attitudes are assumed to be more resistant to change than the explicit ones. A previous study (Huijdin & de Jong, 2009) provided data in line with the abovementioned assumption, by showing that only explicit, but not implicit attitudes significantly improved after an exposure intervention.

A possible explanation for the difference in results could be related to the assessment tool used for implicit attitudes in the two studies. Unlike us, Huijdin & de Jong (2009) used the Extrinsic Affective Simon Task (EAST). Given that a series of studies reported better psychometric properties for IAT than for EAST (see De Houwer & De Bruycker, 2007) it is possible for IAT to be better suited for testing change in implicit attitudes than EAST. On the other hand, our results might also reflect some differences between the psychometric properties of the explicit and the implicit measurements. Since the IAT appears to be a somewhat less reliable assessment tool than the explicit measurements, the measurement error could have contributed to the observed differences.

Potential clinical implications might follow from these results showing that attitudes seem to be sensitive to treatment. Based on cognitive behavioral theories it can been hypothesized (see Teachman & Woody, 2003) that those who maintained highly negative attitudes toward heights might be at risk for relapse, given that biased information processing may act as a vulnerability. Future studies should address this hypothesis.

Our findings concerning the relationship between implicit and explicit attitudes toward heights are somewhat different from those reported in other specific phobias. Although we found no significant relationship between the two variables, other studies (e.g., Ellwart, Rinck & Becker, 2006) found that implicit and explicit attitudes toward spiders tend to be strongly positively associated. In fact, our negative but insignificant results show more similar patterns to the negative associations reported often in social psychology between implicit and explicit racial attitudes (e.g., Fazio, Jackson, Dutton, & Williams, 1995). This may be explained by self-representational biases.

Given that IAT is a relatively new tool in psychopathology research and some studies suggested possible effects of time/retesting on IAT (Huijding & de Jong, 2007), we explored these possible effects in our sample and provide some data in support for the stability of results after repeated measures. However, future studies should include an additional heights fearful group with no intervention to serve as control in order to assess a possible time effect.

The main limitation of this study is the non-experimental nature of the design. In the absence of a heights fearful waitlist group, the impact of the intervention on explicit and implicit attitudes should be interpreted with caution, given that a time effect could not be excluded based on our design. However, as previously noted, attitudes are considered to be resistant to change, especially over a short period of time (i.e., three weeks between pre and post-evaluation). Thus, although a time effect on these variables is unlikely in this study, it could not be excluded as we did not control for this effect.

To sum up, the present study supports the importance of assessing both implicit and explicit attitudes toward phobic stimuli, providing evidence that both variables distinguish between highly anxious and low/non anxious individuals. Moreover, this is the first study to show that implicit and explicit attitudes toward heights improve after one session of virtual reality based CBT in highly anxious individuals. We also offer some support for the stability of IAT. Overall, our findings suggest that both explicit and implicit attitudes are cognitive factors related to acrophobic symptoms and might play a role as cognitive mechanisms in the cognitive-behavioral treatment of heights related fear.

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