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ATTENTIONAL IMPAIRMENT IN ANXIETY: INEFFICIENCY IN EXPANDING THE SCOPE OF ATTENTION

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Abstract

Background—The ability to attend to relevant visual information in a proficient manner is central to most day-to-day tasks. Research suggests, however, that this ability is compromised by anxiety such that anxiety results in narrowing the focus of visual attention.

Method—In the current study (N=58), we used the Attention Scope Task [1999: Gerontology 45:102–109] to examine the hypothesis that low-anxious individuals would be more proficient than high-anxious individuals in their scope of attention, that is, high-anxious individuals would have a larger scope of visual attention than low-anxious individuals. Additionally, we hypothesized that low-anxious individuals would be more proficient than high-anxious individuals in their ability to expand their scope of attention.

Results—Results revealed that, compared to low-anxious individuals, high-anxious individuals were impaired only in their ability to expand their scope of attention from a small area to a larger one. Inclusion of a depressed control group in the study revealed that our findings are specific to the effect of anxiety and not depressive symptoms.

Conclusion—Thus, high-anxious individuals do not appear to have a smaller absolute scope of attention but instead seem to have difficulty expanding their attention scope dynamically. We discuss our results in relation to cognitive inflexibility in anxiety.

Keywords

attention scope; attention; anxiety; attention narrowing; attention constriction

INTRODUCTION

The ability to attend to and process relevant visual information in an efficient manner is integral to most everyday activities. Early research suggests, however, that this ability is compromised by anxiety.[1–3] More specifically, it appears that anxiety results in constricting the focus of visual attention. For instance, people driving cars in an anxious state have been shown to be slower and less accurate at processing information that is in the periphery of their visual field even if this information is relevant to their driving performance.[4] This phenomenon—the narrowing of attention under anxiety—has been described in a classic article by Easterbrook,[5] who argued that high anxiety reduces the range of cues that an individual processes, resulting in narrowing the scope of attention to a central location and impairing attention for stimuli that are located in the peripheries of the visual field.

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The Easterbrook phenomenon specifies that the presence of threat, and presumably, high state anxiety, narrows the scope of attention. This narrowing of attention in the face of threat, rather than being dysfunctional, likely represents an adaptation in the service of the fight-or-flight response. In the current study, we are interested in examining the effects of chronically heightened anxiety on attention scope. In particular, we are interested in assessing attention scope in the absence of threat, where attentional narrowing is more likely to be dysfunctional than adaptive. Thus, we have chosen to focus on the effects of trait anxiety on the scope of attention for neutral stimuli.

Much of the extant research on attention in anxiety has focused on the effect of anxiety on attentional bias for processing threatening stimuli.[6,7] These studies have shown, by and large, that anxious individuals demonstrate preferential attentional processing of threat-related stimuli.[8] In other words, anxious individuals tend to constrict their focus of attention on the threatening stimuli when these stimuli compete for attentional resources with nonthreatening information.

Several studies have found that positive affect broadens attention.[9] In comparison, few studies have examined the effect of anxiety on the scope of attention. Some prior research has explored the relationship between anxiety and neuropsychological measures more generally using neutral information.[10–12] More specifically, however, only a few studies have examined the effect of anxiety on the narrowing of attention for neutral information.[13–15] These studies demonstrate an association between an anxiety and a narrowing of attention. For instance, Derryberry and Reed[13] found that high-trait anxious individuals exhibit significant attentional narrowing on a global-local task[16] using letter stimuli, compared to nonanxious individuals. This task consists of various composite letter stimuli composed of smaller letter stimuli (e.g. a large T composed of small Ls). Participants were required to press different keyboard keys to indicate the letter that appeared at either a global (large letter) or a local (small letters) level. Trait-anxious individuals in an anxious state exhibited facilitated identification of local stimuli when compared to nonanxious participants.

In another study examining the effect of anxiety on attentional processing, Finucane and Power[14] administered the Attention Network Test[17] to a group of healthy female participants. In this task, participants are required to respond to central, neutrally valenced stimuli while inhibiting distracting information. All participants completed both a fear and a control condition, which were identical except for the fact that in the fear condition pictures of threatening stimuli were interspersed with the task trials. Participants' fear scores were significantly higher in the fear condition than in the neutral condition. Results of this study showed that, in the fear condition, participants demonstrated enhanced focus on the central task, being less distracted by peripheral information. These findings are consistent with the Easterbrook phenomenon in which high anxiety reduces the range of cues that the individual processes, resulting in enhanced attention on a central location and impaired processing of peripherally located stimuli.

However, not all research suggests that anxious individuals exhibit attentional narrowing in the context of neutral stimuli. For example, Moritz and Wendt[15] found no differences between patients with Obsessive-Compulsive Disorder (OCD) and a group of nonanxious controls in performance on a global-local task.[16]

Thus, the limited research on the effect of anxiety on attention for neutral stimuli suggests a narrowing of attention scope in anxiety, although conflicting findings warrant continued research in this area. Moreover, the precise mechanism of this narrowing of attention is not clear. More specifically, it is possible that anxiety is associated with a narrowing of attention such that anxious individuals are less proficient at processing larger visual areas than smaller ones. Alternatively, it is also possible that anxiety is associated with an inflexibility in ability to change the scope of attention from a small area to a larger one. Thus, anxiety may be associated with a rigidity of attention such that anxious individuals are impaired in expanding the scope of attention dynamically (i.e. as required by the task at hand). A paradigm that allows us to parse out differences in *absolute* scope of attention from differences in *ability to change* the scope of attention is the Attention Scope Task designed by Kosslyn et al.[18]

In this computerized task, participants are presented with a square display that is either small or spread out. In each trial, participants are required to study the display and then press the space bar to indicate that they are ready for the test phase of the trial. Their task in the test phase of the trial is to indicate whether one or two X marks appear in the display. The size of the display in the study phase of the trial relative to the test phase is critical to the experiment: the display may start small and remain small, start large and remain large, start small and expand, or start large and contract. Thus, the size of the display in the study phase of the trial relative to the test phase allows the evaluation of participants' performance when the scope of attention is small versus large, and when it expands or contracts.

In explaining their findings using the global-local task, Derryberry and Reed suggested that both high-and low-anxious individuals may initially focus on global stimuli, but that high-anxious individuals may be more proficient in "zooming in" their attention on local stimuli, when compared to low-anxious individuals.[13] In other words, high-anxious individuals may be better able to contract their attention scope. Additionally, Derryberry and Reed indicated that high-anxious individuals demonstrate a more general cognitive inflexibility, which suggests that they may also have difficulty in expanding their attention from small to large regions of space.

In the current study, we used the Attention Scope Task to examine the hypothesis that low-anxious individuals would be more proficient than high-anxious individuals in their scope of attention, that is, low-anxious individuals would have a larger scope of attention than high-anxious individuals. Furthermore, we hypothesized that low-anxious individuals would be more proficient than high-anxious individuals in their ability to expand their scope of attention. We did not have a specific hypothesis regarding ability to contract scope of attention: it may be the case that anxiety facilitates "zooming in" of attention and hence high-anxious individuals are more proficient than low-anxious individuals in contracting their scope of attention; alternatively, it is possible that anxiety is characterized by a general inflexibility of attention scope such that high-anxious individuals are less proficient than low-anxious individuals in both expanding and contracting their scope of attention. Additionally, we were interested in examining the specificity of these hypotheses to anxiety. Thus, we added a third group of participants matched to our high-anxious group in symptoms of depression, but not anxiety.

MATERIALS AND METHODS

PARTICIPANTS

Participants were 58 individuals who were drawn from a large pool of undergraduate students at a large university and received course credit for their participation. Participants were included in the high-anxiety, high-depression group (HAD, n=22) if they scored in the top tenth percentile on the STAI-trait[19] or the nonanxious, nondepressed group (NAD, n=20) if they scored in the bottom tenth percentile. We chose to examine extreme groups because of our interest in examining attention in psychopathology. The resulting STAI-trait score in the HAD group is comparable to what we have reported in clinical samples of patients with Generalized Anxiety Disorder.[20] To examine the specificity of our findings to anxiety, we also included a group high in depression only (HDO, *n*=16), with individuals who were matched to the HAD group in level of depression (score above 20 on Beck Depression Inventory-II; BDI-II)[21] but differed in anxiety.

MATERIALS AND TASKS

Self-Report Measures—The STAI-S/T[19] is a 40-item questionnaire which assesses level of anxiety. Participants completed the state and trait versions of the measure. This measure has adequate psychometric properties.[22] Participants also completed the BDI-II,[21] which is a reliable and well-validated 21-item self-report measure of symptoms of depression. The BDI-II has been shown to have good psychometric properties in college populations.[21,23]

Attention Scope Task (adapted from Kosslyn et al.)[18]—The purpose of the Attention Scope Task was to measure participants' relative visual scope of attention, and the extent to which they have the ability to adapt their focus to changing regions of space within their visual field.

The task comprised 120 trials. Each trial began with a fixation cross, followed by a study phase (Fig. 1). In the study phase of each trial, four empty dark gray boxes appeared on a light gray computer screen. The size of the four boxes remained constant in all trials; however, the distance between boxes varied depending on trial type. In half of the trials, the tips of the boxes formed a small imaginary plus sign with a diameter of 2.2 cm; in the other half of trials, the tips of the boxes formed a larger imaginary plus sign with a diameter of 3.4 cm. Participants were instructed to study the locations of the boxes, and then to press the space bar when ready to begin the test phase of the trial. After pressing the space bar, either one or two black X marks appeared in one or two of the boxes. The participants' task was to identify with a right or left mouse click whether one or two X marks appeared on the screen. In half of all trials, participants saw one X mark, and in the other half, participants saw two X marks. The color similarity of the computer stimuli (light gray computer screen, dark gray boxes, and black X marks) required participants to focus their visual attention in order to distinguish the X marks against the boxes.

In two-thirds of trials, the boxes remained in the same position from the test phase to the study phase. This allowed us to compare participants' visual scope of attention in displays in which the size of the display remained constant. In the remaining one-third of trials following the study phase, the boxes either became more spread out across the computer screen or became more compacted. These trials allowed us to examine how flexible participants were in changing their visual attention scope because they were required to either expand or contract their scope of attention. Hence, there were a total of four trial types based on the locations of the boxes in the study and test phases of the trial: small–small (one-third of the trials), large–large (one-third of the trials), small–large (one-sixth of the trials), and large–small (one-sixth of the trials).

To prevent participants from learning the locations of the squares in each trial, the entire display of blocks was shifted in position by 11° increments, creating five distinct displays for each size (five large displays and five small displays): 0, 11, 22, 33, and 44°. For each trial, these displays were used in the study phase. The same display angle was used within each trial for both the study and test phases.

The computer-recorded response latencies from the space bar press (beginning of test phase, when the X mark(s) first appeared on the screen) to when the participants identified the number of X marks. Following Kosslyn et al.,[18] we calculated three measures from the four types of trials: Attention Scope, Attention Expansion, and Attention Contraction. Attention Scope measures participants' ability to attend to large versus small regions of space. Attention Expansion measures participants' relative ability to shift their focus of attention from small to large regions of space, i.e., ability to zoom out. Attention Contraction measures participants' relative ability to shift their focus of attention from large to smaller regions of space, i.e., ability to zoom in.

PROCEDURE

All procedures were approved by the institutional review board. Participants completed an informed consent form, a demographics questionnaire, STAI-S/T, and BDI-II, followed by the Attention Scope Task. Participants were then debriefed and assigned course credit for their participation.

DESIGN

The design of the study was a 3 (Group: HAD, HDO, NAD) ×3 (Measure: Attention Scope, Attention Expansion, Attention Contraction) multivariate analysis of variance.

RESULTS

DEMOGRAPHICS AND SELF-REPORT DATA

Table 1 summarizes the demographic and self-report data for the HAD, HDO, and NAD groups. The three groups did not differ on age [$F(2, 55)=0.06$, $P>.94$], education [$F(2, 55)=0.72$, $P>.49$], and sex [$\chi^2(2)=2.37$, $P>.30$]. One participant declined to report ethno-racial group. For the remaining participants, however, the groups were found to differ on ethno-racial categories [$\chi^2(8)=18.86$, $P<.02$][1]: In the HAD group, 11 participants identified as Asian-American, 0 as Black, 3 as Caucasian, 4 as Hispanic, and 1 as Other; in the HDO group 3 participants identified as Asian-American, 1 as Black, 3 as Caucasian, 5 as Hispanic, and 3 as Other; in the NAD group, 2 participants identified as Asian-American, 0 as Black, 13 as Caucasian, 4 as Hispanic, and 1 as Other. As expected, the comorbid HAD group had significantly greater BDI scores [$t(40)=8.50$, $P<.001$], STAI-trait scores [$t(40)=27.30$, $P<.001$], and STAI-state scores [$t(40)=8.73$, $P<.001$] than did the NAD group. The HDO group did not differ significantly from the HAD group on BDI scores [$t(36)=0.14$, $P>.89$] and on STAI-state scores [$t(40)=0.32$, $P>.75$], but had significantly lower STAI-trait scores than did the HAD group [$t(36)=7.08$, $P<.001$].[2]

ATTENTION SCOPE MEASURES

Response latencies ±2.5 *SD* from each participant's mean response latency were eliminated from analysis (2.02% of total trials). Trials with incorrect responses were removed (3.02% of remaining trials). Additionally, only those participants whose mean accuracy was greater than 75% were included in the analysis, resulting in the exclusion of two participants. There was no significant difference between accuracy rates in the three groups, $F(2, 55)=0.47$, $P=$.

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[1]We included ethnicity as a covariate in our analyses. The effect of ethnicity was not significant in any of the analyses, nor did entering the covariate alter our findings for the attention scope variables. Furthermore, we coded ethnicity into three dichotomous variables (Caucasian or not; Asian-American or not; Hispanic or not) and entered these as covariates in our analyses. Again, the effects of these variables were not significant in any of the analyses, nor did entering the covariates alter our findings for the attention scope variables.

[2]In response to a reviewer's suggestion, we classified participants into a High- or Low-State Anxious group if they scored in the top or bottom tenth percentile on the STAI state, respectively. We conducted a multivariate ANOVA with State Anxiety Group (High-State Anxious; Low-State Anxious) as the between-subjects factor and Attention Scope, Attention Expansion, and Attention Contraction, as the dependent factors. Neither the overall ANOVA [Pillai's Trace=.06, $F(3, 49)=1.09$, $P>.36$, $\eta^2=.06$], nor the univariate F tests for Attention Scope [$F(1, 51)=2.37$, $P=.13$, $\eta^2=.04$], Attention Expansion [$F(1, 51)=2.28$, $P>.13$, $\eta^2=.04$], and Attention Contraction [$F(1, 51)=0.05$, $P>.82$, $\eta^2=.001$], was significant.

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63 (mean accuracy for the HAD group=.97, mean accuracy for the HDO group=.97, mean accuracy for the NAD group=.97).

In keeping with Kosslyn et al.'s[18] computations, we calculated Attention Scope as the difference between response latencies for trials with larger displays and response latencies for trials with smaller displays when the display size did not change. This measure reflects the proficiency of attending to displays of different sizes. A small value for this measure indicates that processing speed is comparable for different scopes of attention, whereas a large value reflects a disparity in processing efficiency between large and small scopes of attention. We calculated Attention Expansion as the difference between response latencies for trials that began with a small display that then changed to a large display, and response latencies for trials in which the display stayed small. This measure reflects the ability to expand the scope of attention. A small value for this measure indicates proficiency in expanding the scope of attention from a smaller to a larger display. We calculated Attention Contraction as the difference between response latencies for trials that began with a large display that then changed to a small display, and response latencies for trials in which the display stayed large. This measure reflects the ability to contract the scope of attention. A small value for this measure indicates proficiency in contracting the scope of attention from a larger to a smaller display.

A multivariate ANOVA with Group (HAD, HDO, and NAD) as the between-subjects factor and Attention Scope, Attention Expansion, and Attention Contraction, as the dependent factors was significant [Pillai's Trace=.25, $F(6, 108)=2.55$, $P=.02$, $\eta^2=.12$]. Univariate F-tests showed that the groups differed in Attention Expansion [$F(2, 55)=4.08$, $P=.02$, $\eta^2=.13$] but not in Attention Scope [$F(2, 55)=1.38$, $P=.26$, $\eta^2=.05$] or Attention Contraction [$F(2, 55)=0.38$, $P>.68$, $\eta^2=.01$]. Follow-up two-tailed t-tests for Attention Expansion showed that the HAD group was marginally less proficient in expanding the scope of attention than was the NAD group [$t(40)=1.91$, $P=.06$, $d=.60$]. Furthermore, the HAD group was also less proficient in expanding the scope of attention than was the HDO group [$t(36)=2.62$, $P=.01$, $d=.87$], which was not significantly different from the NAD group [$t(34)=1.00$, $P>.32$, $d=.34$], indicating specifically that high anxiety and not high depression was associated with difficulty expanding the scope of attention (Fig. 2).

DISCUSSION

In the current study, we found that, compared to the low-anxious group, high-anxious individuals were impaired in the ability to expand their scope of attention dynamically. However, they did not show impairment in absolute size of attention scope, nor in the dynamic contraction of attention scope. The fact that the high-anxious group was impaired in ability to expand but not in ability to contract attention scope suggests that anxiety is associated with an inflexibility specifically in broadening the scope of attention instead of a more general inflexibility of changing the size of attention scope dynamically. Moreover, we found that the high-anxious group was less proficient in expanding the scope of attention than was the depressed only control group, which was no different from the nonanxious, nondepressed control group, indicating specificity of the effect for anxiety. Given that our depressed only group differed from the high-anxious group in trait anxiety but not in state anxiety, we can further specify that these results are specific to the effects of trait anxiety.

Our findings are consistent with the previous research related to attention narrowing in anxiety as well as research suggesting that anxiety may be associated with deficits in cognitive flexibility more generally.[24] For instance, patients with OCD[25] as well as individuals with schizophrenia who are high in social anxiety[26] may have difficulty with tasks requiring set-shifting abilities. Furthermore, cognitive flexibility may actually increase after successful treatment of anxiety, as shown by Walter et al.[27] in their study of individuals with Post-Traumatic Stress Disorder. These general deficits in cognitive flexibility may account for some of the difficulty anxious individuals have in expanding their scope of attention from small to large displays.

However, if general cognitive inflexibility was the only explanation for impairment in expanding attention scope, we might also expect high-anxious individuals to exhibit difficulty contracting their attention scope from large to small displays, which we did not find. Alternatively, one might expect that anxious individuals exhibit enhanced contraction of attention scope, consistent with Derryberry and Reed's[13] hypothesis that anxious individuals may preferentially "zoom in" on smaller regions of space. According to this hypothesis, high anxiety, rather than promoting a smaller scope of attention, enhances the ability to narrow in on the details of an object, which may signal whether or not the object is threatening. It may be the case that these conflicting cognitive processes essentially function to cancel each other's effects in high-anxious individuals, thus yielding no differences in ability to contract attention scope between high- and low-anxious individuals.

The finding that high-anxious individuals are impaired in the ability to expand their scope of attention—if replicated in a sample of individuals diagnosed with an anxiety disorder—has important clinical implications. Information processing models of anxiety suggest that anxious individuals focus their attention on threat-relevant information.[8] Thus, the extent to which anxious individuals are impaired in expanding the scope of attention to include the processing of other nonthreat cues in the environment is likely to maintain anxiety. Furthermore, in cognitive behavioral therapy for anxiety, the ability to expand the focus of attention to attend to both threat-relevant and corrective cues in the environment is integral to the success of the treatment.

Our findings of impairment in expansion of attention scope appear to be specific to anxiety, and were not present in the depressed only control group. However, previous research suggests that cognitive inflexibility is associated with both anxiety and depression.[28,29] It is possible that inflexibility in depression is related to different domains of cognition (e.g. cognitive flexibility as measured using the Wisconsin Card Sorting task, i.e., set-shifting) but not to visual attention scope. Furthermore, it has been suggested recently that cognitive inflexibility in depression may not be related to neutral stimuli but instead may be specific to emotionally valenced stimuli.[30] Future theoretical and empirical study should explore specific differences in cognitive flexibility in general and attention scope in particular between depressed and anxious individuals.

Our study has limitations. First, our study comprised a small sample size, particularly for the matched depressed only group, and thus should be followed up with replication using a larger sample. In particular, given that the group means for attention scope were in the hypothesized direction, it may be the case that the small sample size prevented us from obtaining significant group differences on the attention scope variable. Second, although the anxiety severity reported by our high-anxious group is comparable to what is reported by clinical samples of patients with Generalized Anxiety Disorder, our findings are nevertheless in an analogue sample of undergraduates and therefore may not generalize to individuals with a clinical diagnosis. Follow-up studies conducted with individuals diagnosed with an anxiety disorder would greatly improve the conclusions that can be drawn regarding the narrowing of attention in anxiety-related psychopathology. Third, we recognize that our high depression only group is actually a high-depression/medium-anxiety group, when compared to the nonanxious nondepressed control group. Indeed, it would have been possible for us to create a small group of individuals high in depression and low in anxiety, but given the co-occurrence of at least moderate levels of anxiety with depression, this sample would not unlikely be unrepresentative of the depressed population. Fourth, we did not have a threat condition in our study design. It may well be the case that attention scope for neutral and threat stimuli function differently in anxiety. Future studies should include a condition to examine the effect of threat on attention scope, expansion, and contraction. Fifth, our groups differed in ethno-racial composition, likely reflecting a problem of having a small sample size. Although supplemental analyses revealed that the effect of this difference on attention scope was not significant, future research should nonetheless match groups based on ethno-racial identification to ensure the generalizability of results. Finally, to our knowledge, this is the first study to investigate attention scope in anxiety using Kossyln et al.'s[18] Attention Scope Task, and hence the evidence presented here should be treated as preliminary until our findings are replicated.

These limitations notwithstanding, our study demonstrates the first attempt to elucidate the precise nature of attention scope in anxiety. Recent successes in cognitive bias modification techniques suggest the possibility of correcting cognitive impairments in anxiety.[31] Given the potential risks associated with the inability to expand scope of attention dynamically (e.g. when driving in an anxious state), a promising direction for future research might be to develop programs to train individuals to expand the scope of their visual attention more flexibly.

CONCLUSIONS

High-anxious individuals do not appear to have a smaller absolute scope of attention but instead seem to have difficulty expanding their attention scope dynamically. These findings are consistent with the idea of cognitive inflexibility in anxiety. Moreover, they appear to be specific to trait anxiety and not to state anxiety or depressive symptoms.

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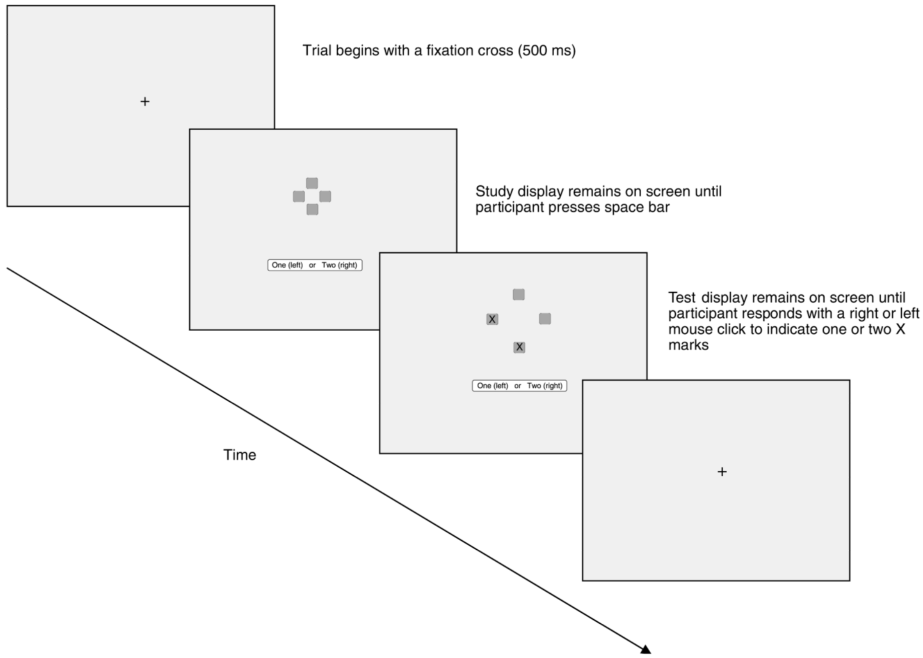

Figure 1.
Attention Scope Task: example of small–large trial.

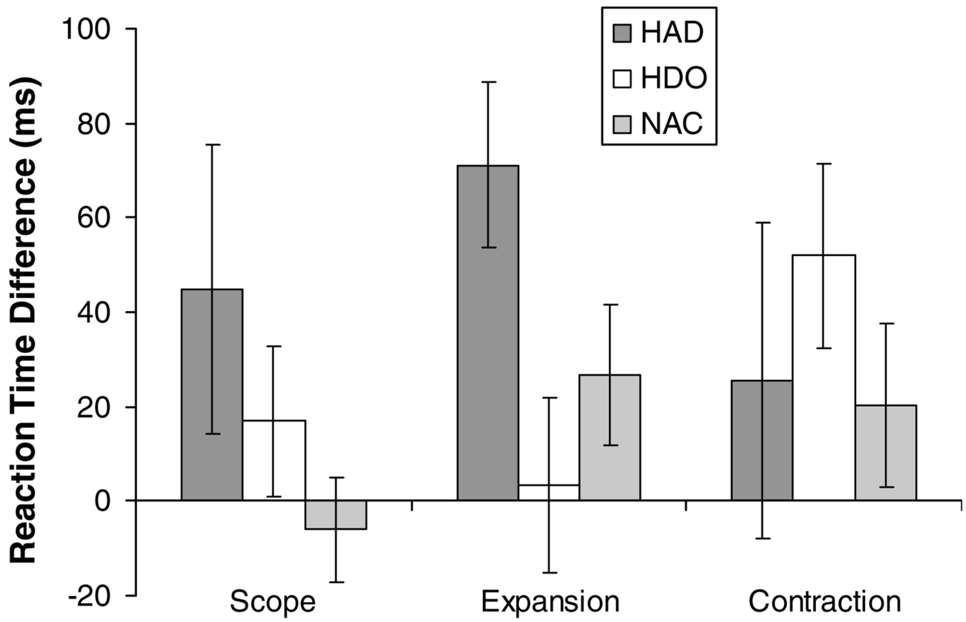

Figure 2.
Attention scope, expansion, and contraction by group.

TABLE 1

Demographics and questionnaire data

	Group		
	HAD (*n*=22)	**HDO (*n*=16)**	**NAD (*n*=20)**
% Female	64	50	40
Age	18.73 (1.24)	18.69 (1.54)	18.60 (0.82)
Education	13.45 (1.41)	13.13 (1.03)	13.05 (0.95)
STAI-trait	60.41 (5.86)	48.25 (4.19)	23.65 (1.42)
STAI-state	47.86 (10.95)	46.81 (8.62)	24.75 (4.71)
BDI	24.77 (11.40)	24.38 (3.00)	2.40 (3.02)

STAI, Spielberger trait anxiety inventory; BDI, Beck Depression Inventory.