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Two Interventions Decrease Anxiety Sensitivity Among High Anxiety Sensitive Women: Could Physical Exercise Be the Key?

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A brief group-based cognitive behavioral therapy (CBT), with running as an interoceptive exposure (IE) component, was effective in reducing anxiety sensitivity (AS) levels in undergraduate women (Watt, Stewart, Lefaivre, & Uman, 2006). This study investigated whether the CBT/IE intervention would result in decreases in AS and emotional distress that would be maintained over 14 weeks. Female undergraduates, high (n = 81) or low (n = 73) in AS, were randomized to 3-day CBT plus forty-two 10-min running IE trials (n = 83) or 3-day health education control (HEC) with interactive discussions and problem solving on exercise, nutrition, and sleep (n = 71). The CBT/IE intervention led to decreases in AS, depression, and stress symptoms for high AS participants, which were maintained at 14 weeks. Unexpectedly, HEC participants experienced similar and lasting decreases in AS, depression, and anxiety symptoms. Furthermore, there were no post-intervention differences between CBT/IE and HEC participants in any of the outcomes. Low AS participants experienced few sustained changes. Clinical implications and the possible role of aerobic exercise in explaining outcomes of both interventions are discussed.

Keywords: anxiety; cognitive behavioral therapy; depression; interoceptive exposure; aerobic exercise; stress

Anxiety sensitivity (AS: "fear of fear") refers to the fear of arousal-related somatic sensations commonly associated with anxiety (e.g., rapid heartbeat, dizziness, trembling). The fear arises from the belief that these sensations portend harmful consequences (Reiss, 1991).

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Whereas low AS individuals may view such sensations as harmless and fleeting, high AS individuals tend to catastrophize about the meaning of these sensations, fearing that a rapid heartbeat signifies an impending heart attack (physical concerns), that dizziness will result in a loss of control (cognitive concerns), or that trembling will lead to social embarrassment (social concerns). Research indicates that AS is attributable to both genetic heritability (Taylor, Jang, Stewart, & Stein, 2008) and relevant learning experiences (Watt, McWilliams, & Campbell, 2005; Watt, Stewart, & Cox, 1998).

A large body of empirical evidence links high AS not only with mental health symptoms and disorders (Naragon-Gainey, 2010; Olatunji & Wolitzky-Taylor, 2009) but also with physical health concerns, such as reduced physical exercise and fitness levels (Sabourin, Hilchey, Lefaivre, Watt, & Stewart, 2011; Smits & Zvolensky, 2006). Indeed, high AS individuals tend to avoid stimuli that induce their feared arousal-related somatic sensations, so they avoid physical activity (Sabourin et al., 2008; Smits, Tart, Presnell, Rosenfield, & Otto, 2010), engage in physical activity for briefer durations of time (Smits et al., 2010), and at reduced levels of intensity (Boyle, Watt, & Gallagher, 2014).

Research shows that AS is amenable to cognitive behavioral therapy (CBT) interventions that include an interoceptive exposure (IE) component. With repeated exposure to the feared arousal-related sensations without the imagined catastrophic consequences (e.g., embarrassment, fainting), fear of the sensations eventually subsides (see Stewart & Watt, 2008). CBT/IE interventions have been successful in decreasing AS levels in patients with panic disorder (Arntz, 2002; Beck & Shipherd, 1997) and in nonclinical samples of high AS individuals (Keogh & Schmidt, 2012). Examples of IE exercises used in these trials have included chair spinning to induce dizziness and breathing through a straw to induce breathlessness. A meta-analysis conducted by Smits, Berry, Tart, and Powers (2008) confirmed that CBT plus IE interventions were successful in decreasing AS levels in both treatment seeking and high AS at-risk samples. Repeated exposure to aerobic exercise, which produces many of the same bodily sensations as acute anxiety (e.g., increased heart rate, perspiration), may serve to decrease fear of arousal sensations in the same way as other IE exercises (e.g., hyperventilation, chair spinning).

Broman-Fulks, Berman, Rabian, and Webster (2004) conducted the first documented aerobic exercise intervention specifically targeting AS levels. Physically inactive high AS individuals (i.e., ASI scores > 25) were randomly assigned to either a high-intensity aerobic or low-intensity exercise condition. Both conditions included six 20-min sessions walking or running on a treadmill over a 2-week period. Both high- and low-intensity exercise resulted in decreases in AS. High-intensity participants, however, experienced decreases in AS more quickly than low-intensity participants. Also, more high-intensity than low-intensity participants experienced a significant decrease in AS.

A follow-up study was conducted by Broman-Fulks and Storey (2008). Again, physically inactive high AS participants were randomly assigned to six 20-min exercise (IE) sessions or to a no-exercise control group. For participants in the IE group, AS levels decreased following the first bout of exercise and stabilized at the lower level throughout the rest of the sessions. For participants in the control condition, there was a slight (nonsignificant) decrease in AS but a rebound to precontact scores from the third session onward.

Smits, Berry, Rosenfield, et al. (2008) conducted a similar study examining the effects of aerobic exercise on decreasing AS levels. Physically inactive high AS (i.e., ASI score ≥ 25) individuals were randomly assigned to one of three conditions. The first condition consisted of aerobic exercise (EX), the second of aerobic exercise plus cognitive restructuring (EX + C), and the third of a wait-list control group (WLC). Exercise consisted of six 20-min sessions over a 2-week period at a prescribed intensity of 70% of age-adjusted maximal heart rate. In contrast to the Broman-Fulks et al. (2004) study, Smits, Berry, Rosenfeld, et al. (2008) provided participants with a treatment rationale prior to beginning the exercise participation. Specifically, participants watched a videotape that explained the construct of AS and how evidence showed that repeated exposure (via physical exercise) to the physiological sensations feared by high AS individuals could lead to AS reductions. In addition, participants were reminded to focus on the physiological sensations throughout the exercise sessions. The EX+C condition consisted of all of the aspects of the EX condition plus a specific explanation on the role of cognitive restructuring in decreasing AS. In addition, participants in the EX+C condition were exposed to Socratic questioning during the exercise sessions, based on their highest scoring ASI items, which formed the cognitive restructuring portion of the intervention. Both active interventions, but not the WLC condition, resulted in decreases in AS and in depression and anxiety symptoms. Unexpectedly, there were no differences between the EX+C and the EX conditions. The study also demonstrated that reductions in AS preceded and mediated reductions in anxiety and depression symptoms.

Together, the cited studies suggest that a brief intervention consisting of six sessions of high-intensity exercise decreased fears of arousal-related sensations. None of the studies, however, included a follow-up assessment that was longer than 3 weeks to ascertain if changes could be maintained over a longer term.

A study conducted with female undergraduates at two eastern Canadian universities used aerobic exercise (running) as the IE component of a brief group-based AS-focused CBT intervention. The treatment was effective in decreasing AS levels in high AS university women (Watt, Stewart, Conrod, & Schmidt, 2008; Watt et al., 2006). The study did not assess whether changes in AS levels were maintained over a follow-up period. Moreover, the study did not assess whether the intervention that was aimed at decreasing AS also led to improvements in general emotional distress. Finally, the study's design included a control condition consisting of a group discussion on ethics in psychology to control for nonspecific effects that could influence outcome (e.g., group exposure, therapist effects). The control condition's content, however, bore no similarity to the intervention's content and thus could not control for other factors that could potentially affect outcomes (e.g., discussions that were directly relevant to the participants' own health).

The Present Study

This study consisted of a replication and extension of Watt et al. (2008) to increase our understanding of the benefits of the brief CBT/IE intervention. Specifically, we examined the effects of the intervention on AS levels, extending the assessment period to a 14-week follow-up. We also examined the benefits of the intervention on general emotional distress by assessing changes in stress, depression, and anxiety symptoms. A more stringent control condition was employed—a health education control (HEC) comprised of a group discussion on health (i.e., exercise, diet, sleep). The CBT/IE intervention remained mostly unchanged other than the extended IE component. Increasing the frequency and duration of the IE trials from 10 trials over a period of 10 weeks to three IE trials per week for 14 weeks was intended to enhance the intervention's efficacy. Measurements were taken at pre-intervention, at the 10-week follow-up for replication purposes, and at the 14-week follow-up. There was no IE component or homework assignment for the HEC group.

Based on previous findings, it was hypothesized that only high AS participants randomized to the CBT/IE (vs. HEC) condition, and not low AS participants randomized to either condition, would experience significant reductions in AS levels. Second, it was expected that participating in the active CBT/IE intervention (vs. HEC condition) would lead to decreases in stress, depression, and anxiety levels for high AS participants specifically. Improvements in AS levels and in general emotional distress were hypothesized to persist at the 14-week follow-up. High AS participants randomized to the CBT/IE condition versus the HEC condition were not expected to differ on any outcome measures at pretreatment. However, participants in the CBT/IE condition were expected to exhibit lower scores than those in the HEC condition on all outcomes measures following the intervention and at follow-up.

Methods

Participants

Participants included 154 female undergraduates who scored one standard deviation above or below the mean for university women (i.e., 18 ± 7; see Watt et al., 2006) on the Anxiety Sensitivity Index (ASI; Reiss, Peterson, Taylor, Schmidt, & Weems, 2008). The ASI was completed as part of a screening battery either online or using paper-and-pencil format during an introductory psychology class. Exclusionary criteria included any physical or health problem (e.g., hypertension) that might prevent a participant from engaging in physical exercise. Women only were recruited to control for gender effects and to allow for attempted replication of findings from the previous study (Watt et al., 2008), which used only women.

High and low AS participants were randomly assigned to the CBT/IE or HEC group to form four separate groups: high AS-CBT/IE ($n = 44$), high AS-HEC ($n = 37$), low AS-CBT/IE ($n = 39$), low AS-HEC ($n = 34$). A 2 (AS group: high AS, low AS) × 2 (condition: CBT/IE, HEC) between-subjects analysis of variance (ANOVA) on initial ASI scores revealed that the high AS group had higher ASI scores than the low AS group, $F(1,146) = 1{,}018.62$, $p < .001$, but that there were no observed differences between conditions (nonsignificant main effect of condition, $F[1,146] = 0.21$, $p =$ NS; nonsignificant interaction, $F[1,146] = 0.74$, $p =$ NS). Participants ranged from 17 to 34 years of age ($M = 18.8$; $SD = 2.2$). A 2 (AS group: high AS, low AS) × 2 (condition: CBT/IE, HEC) between-subjects ANOVA on age revealed no significant effects (Fs < 2.31, ps $> .10$). Most (90%) participants self-identified as being White. A 2 (race: White, other) × 4 (group: high AS-CBT/IE, low AS-CBT/IE, high AS-HEC, low AS-HEC) chi-square analysis confirmed that race did not differ between groups, $\chi^2(3) = 1.08$, $p > .10$.

Of the original 154 participants, 125 (81%) completed all 3 days of treatment; 67 (43%) completed the intervention plus the 14-week follow-up (see Figure 1 for a breakdown of completers

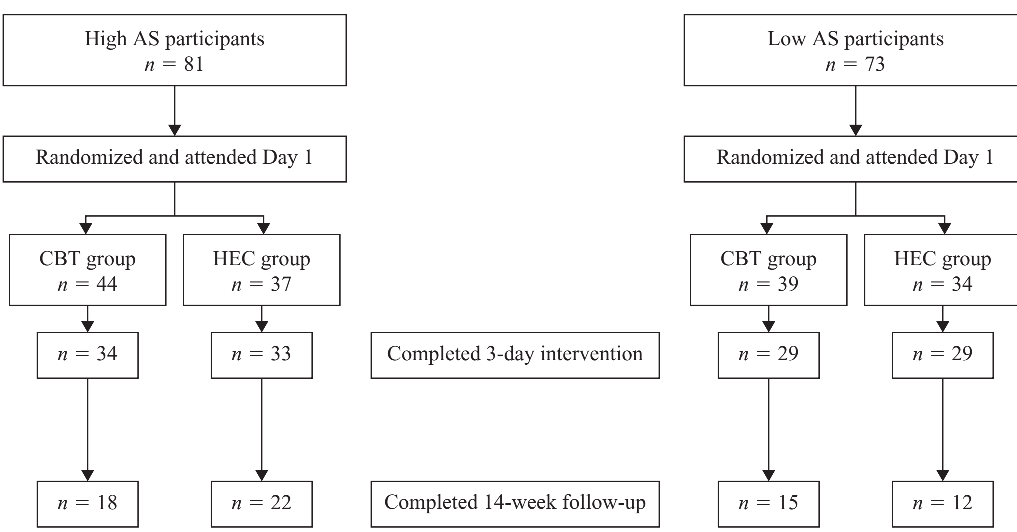

Figure 1. Diagram of participant flow. Reasons for attrition included snow storms, return to standard time, conflicting work schedules, and illness. AS = anxiety sensitivity; CBT = cognitive behavioral therapy; HEC = health education control.

by condition). Those who completed both the intervention and follow-up did not differ from those who either did not complete the intervention or were not available for follow-up on initial ASI scores: $F(1,148) = 1.11, p = \text{NS}$, age, $F(1,150) = 1.08, p = \text{NS}$, or race, $\chi^2(1) = 0.28, p = \text{NS}$.

Measures

Anxiety Sensitivity Index. The ASI (Reiss et al., 2008) is a widely used 16-item questionnaire that assesses trait AS levels. Participants rate each item on a 5-point Likert scale. The measure has shown strong psychometric properties (Reiss et al., 2008).

Depression Anxiety Stress Scales-21. The Depression Anxiety Stress Scales (DASS-21) is a 21-item self-report measure assessing participants' experiences of psychological distress over the past week, using a 4-point scale. The measure contains three 7-item subscales: stress, depression, and anxiety. The DASS-21 has shown good psychometric properties (Lovibond & Lovibond, 1995).

Beck Anxiety Inventory. The Beck Anxiety Inventory (BAI) is a 21-item self-report measure used to assess cognitive and somatic symptoms of anxiety over the past month. Participants rate each item on a 4-point Likert scale. The measure has shown excellent psychometric properties (Beck & Steer, 1993). The BAI was included in addition to the DASS-21 anxiety scores because the BAI's focus on somatic anxiety symptoms would potentially be well targeted by the CBT/IE intervention.

Procedure

The brief CBT/IE and the HEC conditions consisted of three 1-hour group sessions over 3 consecutive days. The manual for the CBT/IE intervention was adapted and used by Watt and colleagues (2006) from a manual originally developed by Conrod and colleagues (2000). During the first session, participants learned about anxiety, panic attacks, AS, and the anxiety cycle, and how their interpretations of arousal sensations could affect their reaction to the sensations (e.g., avoidance behaviors). During the second session, participants were taught strategies to identify, challenge, and restructure their dysfunctional thoughts consistent with accepted cognitive therapy for panic disorder (Craske & Barlow, 2001). The third session included the IE component of running. Participants ran as a group for 10 min, during which they were instructed to pay attention to the physical sensations and reflect on how these paralleled anxiety sensations. They then participated in a debriefing, completed the HVQ-B, and were instructed to complete the homework assignment on their own (i.e., 10 min of running three times per week for a period of 14 weeks, for 42 running trials).

The HEC condition focused on the importance of exercise, nutrition, and sleep on optimal health, using a brief video presentation previously used by Schmidt et al. (2007), followed by an interactive discussion of the topics. The interactive discussion was added to make the two groups comparable in format (therapist-led group interactive discussion) and duration.

The baseline measures of interest for this study were collected prior to participants taking part in the intervention (i.e., "pre"). Outcome measures were collected again after participants in the experimental group took part in the running component for 10 weeks or after an equivalent time had elapsed for those in the control group (i.e., "post") and again at the 14-week follow-up (i.e., "follow-up").

Data Analytic Plan

Per protocol completer (vs. intention-to-treat or ITT) analysis was conducted in this study to determine the effects of the intervention for participants who completed the treatment ("adherents") and to directly compare with the previous Watt et al. (2006) study. Proponents of this approach argue that the analysis tests the true efficacy of the intervention when used as directed (i.e., efficacy among those who are adherent and able to tolerate the treatment; Schwartz & Lellouch, 2009). Outcome variables (i.e., ASI, DASS-21, BAI) were analyzed in relation to study hypotheses by decomposing the full 3 (time: pre, post, follow-up) $\times$ 2 (condition: CBT/IE, HEC) $\times$ 2 (AS group: high AS, low AS) table of means into a series of a priori planned comparisons (cf., Birch et al., 2008). Eleven planned comparisons were used to examine the comparisons of primary interest first, using conventional alpha levels (Field, 2013; Ruxton & Beauchamp, 2008; Tabachnick & Fidell, 2007). First, polynomial contrasts were used to test for linear and quadratic effects of time for all treatment conditions (eight planned comparisons). When both a linear and a quadratic effect were found, this meant (in this study) that there was a general downward effect over time but that there was little further decline over the follow-up interval or perhaps, a rebound toward baseline levels. Next, specifically for HAS participants, comparisons were made between the CBT/IE condition and the HEC condition at each time point (three planned comparisons) with corrections being made for violations of homogeneity of variance. All analyses were conducted using statistical package for the social sciences (SPSS, Version 18).

Results

Intervention Effects on AS Levels From Pre to 10- and 14-Week Post-Intervention

As expected, for high AS participants, the CBT/IE intervention resulted in a linear decrease in AS that continued following the IE homework component, as demonstrated by a significant linear effect, $F(1,17) = 17.11$, $p = .001$, $\eta^2_p = .502$, and by a non-significant quadratic effect, $F(1,17) = 3.09$, $p = 0.10$, $\eta^2_p = .097$. By comparison, the HEC condition also resulted in a linear decrease in AS, linear effect, $F(1,21) = 47.07$, $p = .000$, $\eta^2_p = .691$, but the decrease leveled off over time, as demonstrated by a significant quadratic effect, $F(1,21) = 30.52$, $p = .000$, $\eta^2_p = .592$. For low AS participants in the CBT/IE condition, there were no temporal effects, as demonstrated by a non-significant linear effect, $F(1,10) = 0.29$, $p = 0.60$, $\eta^2_p = .028$; and a non-significant quadratic effect, $F(1,10) = 0.05$, $p = 0.82$, $\eta^2_p = .005$, suggesting no change in this measure over time. Low AS participants in the HEC condition had their scores initially increase following the intervention, but these scores leveled off to baseline levels by the 14-week follow-up, as demonstrated by a significant quadratic effect, $F(1,14) = 5.18$, $p = .04$, $\eta^2_p = .270$, and a non-significant linear effect, $F(1,14) = 0.08$, $p = 0.78$, $\eta^2_p = .006$. As expected, there were no differences in AS between high AS participants in the CBT/IE and HEC conditions at baseline, $F(1,79) = 0.55$, $p = 0.46$, $\eta^2_p = .007$. Unexpectedly, there were also no differences following the intervention, $F(1,50) = 2.38$, $p = 0.13$, $\eta^2_p = .045$ or at the 14-week follow-up, $F(1,38) = 2.33$, $p = 0.14$, $\eta^2_p = .058$ (see Figure 2).

Changes in Stress, Depression, and Anxiety Scores

As expected, high AS participants in the CBT/IE condition experienced a linear decrease in DASS-21 stress scores that also continued following the IE component, as demonstrated by a significant linear effect, $F(1,14 = 9.12$, $p = .009$, $\eta^2_p = .394$; and a non-significant quadratic effect, $F(1,14) = 3.34$, $p = 0.09$, $\eta^2_p = .193$. Also as expected, high AS participants in the HEC condition did not experience any decrease in stress level; no linear effect, $F(1,18) = 1.04$, $p = > 0.32$, $\eta^2_p = .055$; no quadratic effect, $F(1,18) = 0.65$, $p = 0.43$, $\eta^2_p = .035$. Similarly, low AS participants in both conditions did not experience any decrease in stress level; CBT/IE: no linear effect: F 1,11 $= 0.86$, $p = 0.37$, $\eta^2_p = .073$; no quadratic effect: $F(1,11) = 3.36$, $p = 0.09$, $\eta^2_p = .234$; HEC: no linear effect: $F(1,14) = 4.44$, $p = 0.054$, $\eta^2_p = .241$; no quadratic effect: $F(1,14) = 2.60$, $p = 0.13$, $\eta^2_p = .156$. As expected, there were no differences in stress scores between high AS participants in the

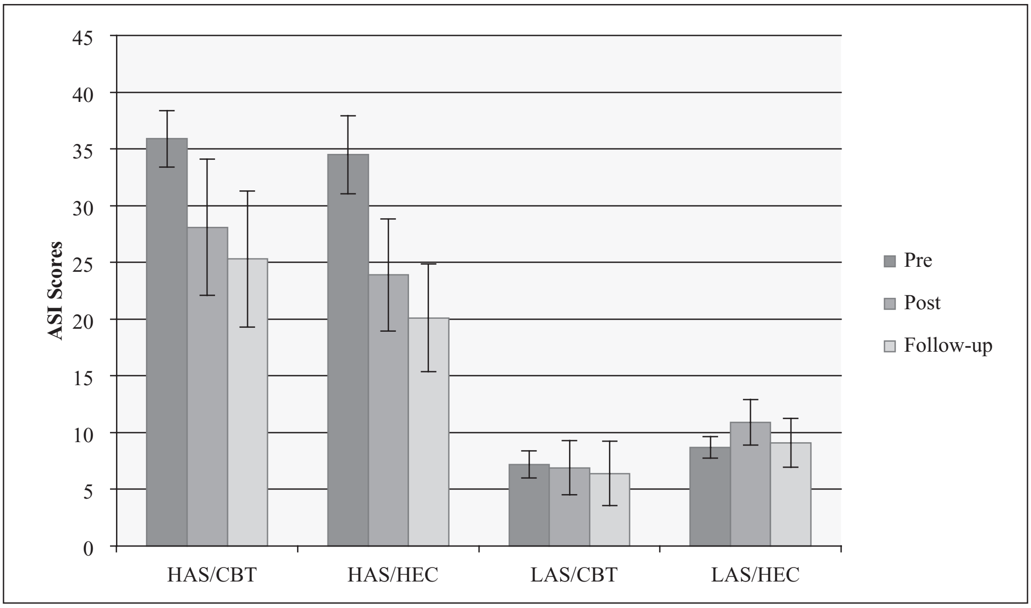

FIGURE 2. Scores on the Anxiety Sensitivity Index over time for High Anxiety Sensitivity (HAS) and Low Anxiety Sensitivity (LAS) participants in the CBT and HEC groups. CBT = cognitive behavioral therapy; HEC = health education control; ASI = Anxiety Sensitivity Index. Error bars represent standard deviations.

CBT/IE and HEC condition at baseline, $F(1,79) = 0.60, p = 0.44, \eta^2_p = .008$. Unexpectedly, there were also no differences following the intervention, $F(1,47) = 0.64, p = 0.43, \eta^2_p = .013$ or at the 14-week follow-up, $F(1,32) = 1.66, p = 0.21, \eta^2_p = .049$ (see Figure 3A).

High AS participants in the CBT/IE condition experienced an initial decrease in DASS-21 depression scores following the 3-day intervention that appeared to level off by the 14-week follow-up, as demonstrated by a significant quadratic effect, $F(1,14) = 6.52, p = .02, \eta^2_p = .318$, and a non-significant linear effect, $F(1,14) = 3.98, p = 0.07, \eta^2_p = .221$. Similarly, high AS participants in the HEC condition experienced an initial decrease in depressive symptoms that rebounded slightly by the 14-week follow-up as demonstrated by a significant quadratic effect, $F(1,18) = 5.89, p = .03, \eta^2_p = .246$, and a non-significant linear effect, $F(1,18) = 4.32, p = 0.052, \eta^2_p = .193$). As expected, low AS participants in both conditions did not experience any decrease in depressive symptoms; CBT/IE: no linear effect: $F(1,10) = 0.00, p > 1.00, \eta^2_p = .000$; no quadratic effect: $F(1,10) = 1.39, p = 0.27, \eta^2_p = .122$; HEC: no linear effect: $F(1,14) = 2.38, p = 0.15, \eta^2_p = .145$; no quadratic effect: $F(1,14) = 1.18, p = 0.30, \eta^2_p = .078$. As expected, there were no differences between high AS participants in depression scores between the CBT/IE and HEC conditions at baseline, $F(1,79) = 0.95, p = 0.33, \eta^2_p = .012$. Unexpectedly, there were also no differences following the intervention, $F(1,47) = 0.02, p = 0.89, \eta^2_p = .000$ or at the 14-week follow-up, $F(1,32) = 0.06, p = 0.81, \eta^2_p = .002$ (see Figure 3B).

High AS participants in the CBT/IE condition unexpectedly showed no decrease in DASS-21 (general) anxiety scores following the 3-day intervention: no linear effect, $F(1,124) = 0.025, p = 0.88, \eta^2_p = .002$; no quadratic effect, $F(1,12) = 0.20, p = 0.66, \eta^2_p = .016$. Similarly, high AS participants in the HEC condition showed no decrease in (general) anxiety: no linear effect, $F(1,17) = 0.015, p = 0.90, \eta^2_p = 0.001$; no quadratic effect, $F(1,17) = 0.025, p = 0.88, \eta^2_p = .001$. Interestingly, low AS participants in the CBT/IE condition revealed an initial decline in (general) anxiety

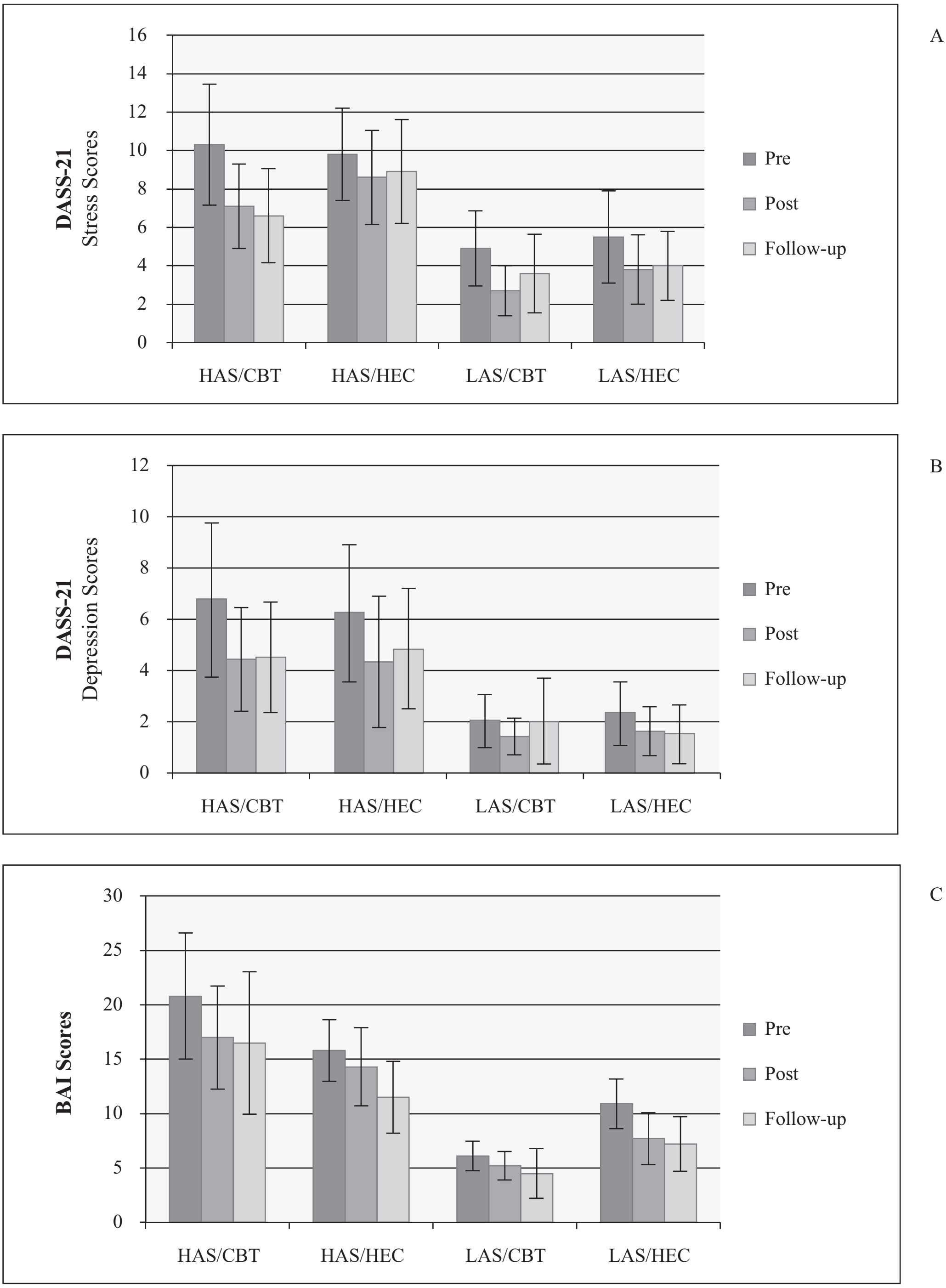

FIGURE 3. Change in DASS-21 and BAI Scores over time for High Anxiety Sensitivity (HAS) and Low Anxiety Sensitivity (LAS) participants in the CBT and HEC groups. Error bars represent standard deviations. CBT = cognitive behavioral therapy; HEC = health education control; DASS-21 = Depression Anxiety Stress Scales-21; BAI = Beck Anxiety Inventory.

scores following the 3-day intervention that rebounded by the 14-week follow-up: quadratic effect: $F(1,10) = 18.05$, $p = 0.002$, $\eta^2_p = .643$; no linear effect: $F(1,10) = 0.45$, $p = 0.52$, $\eta^2_p = .043$. Low AS participants in the HEC condition showed no decrease in (general) anxiety symptoms: no linear effect, $F(1,11) = 1.220$, $p = 0.29$, $\eta^2_p = .100$; no quadratic effect, $F(1,11) = 1.202$, $p = .30$, $\eta^2_p = .099$. As expected, there were no differences between high AS participants in DASS-21 (general) anxiety scores between the CBT/IE and HEC condition at baseline, $F(1,79) = 0.21$, $p = 0.65$, $\eta^2_p = .003$. Unexpectedly, there were also no differences following the intervention, $F(1,44) = -0.70$, $p = 0.41$, $\eta^2_p = .016$ or at the 14-week follow-up, $F(1,32) = 0.004$, $p = 0.95$, $\eta^2_p = .000$.

In addition to the DASS-21 anxiety scale, anxiety was assessed with the BAI. The BAI was included because of its more specific focus on somatic (vs. general) anxiety symptoms, which are targeted by the CBT/IE intervention. Indeed, BAI scores correlated highly ($r = .67$) with ASI scores in this study. High AS participants in the CBT/IE group did not experience any temporal decline in BAI somatic anxiety scores: no linear effect, $F(1,17) = 2.80$, $p = 0.11$, $\eta^2_p = .142$; no quadratic effect, $F(1,14) = 0.68$, $p = 0.42$, $\eta^2_p = .038$. High AS participants in the HEC group, however, experienced a sustained linear decrease in somatic anxiety symptoms with time, as demonstrated by a significant linear effect, $F(1,21) = 10.24$, $p = .004$, $\eta^2_p = .328$, and a non-significant quadratic effect, $F(1,21) = 0.40$, $p = 0.53$, $\eta^2_p = .019$. As expected, low AS participants in the CBT/IE condition did not reveal any decrease in somatic anxiety symptoms with time: no linear effect, $F(1,11) = 1.57$, $p = 0.24$, $\eta^2_p = .125$; no quadratic effect, $F(1,11) = 0.05$, $p = 0.83$, $\eta^2_p = .004$. Unexpectedly, low AS participants in the HEC condition experienced a sustained decrease in somatic anxiety symptoms with time, as demonstrated by a significant linear effect, $F(1,14) = 7.87$, $p = .01$, $\eta^2_p = .360$, and a non-significant quadratic effect, $F(1,14) = 1.21$, $p = 0.29$, $\eta^2_p = .079$. As expected, there were no BAI score differences between high AS participants in the CBT/IE and HEC condition at baseline, $F(1,78) = 1.93$, $p = 0.17$, $\eta^2_p = .024$. Unexpectedly, there were also no differences following the intervention, $F(1,50) = 1.20$, $p = 0.28$, $\eta^2_p = .023$ or at the 14-week follow-up, $F(1,38) = 2.47$, $p = 0.12$, $\eta^2_p = .061$ (see Figure 3C).

Post Hoc Analyses

Although there were no differences in the CBT/IE versus HEC treatment in impact on AS levels, the question arose as to whether the CBT/IE intervention might yield a greater impact on those high AS individuals who specifically fear the types of sensations brought on by running (e.g., rapid heartbeat and shortness of breath). To test this proposition, we examined correlations between change scores (pre- to 10-week) with fear of cardiorespiratory symptoms as assessed by ASI Items 6 (“It scares me when my heart beats rapidly.”), 9 (“When I notice that my heart is beating rapidly, I worry that I might have a heart attack.”), and 10 (“It scares me when I become short of breath.”) for high AS participants in both the CBT and HEC groups. These three items most closely fit with the specific arousal sensations evoked by running and are consistent with AS symptom groupings previously made in the literature (e.g., Taylor & Cox, 1998). Ten weeks was considered to be a good index of treatment response and allowed for comparison with our previous work (Watt et al., 2006) that used the same interval for assessing outcome. A significant correlation emerged between the 10-week change score and fear of cardiorespiratory symptoms for the CBT group ($r = .43$, $p = .03$; $n = 27$) but not the HEC group ($r = .32$, $p = .12$; $n = 25$).

We then tested the specificity of these findings by contrasting cardiorespiratory symptoms with other AS symptoms: (a) cognitive symptoms (Items 2, 12, 15, and 16; e.g., “When I cannot keep my mind on a task, I worry that I might be going crazy”), (b) social concerns symptoms (Items 1, 5, 7, and 13; e.g., “It embarrasses me when my stomach growls”), and (c) non-cardio physical symptoms (Items 3, 4, 8, 11, and 14). For the HEC group, no significant correlations were found between cognitive or social symptoms and 10-week change, but significant correlations were found between non-cardio physical symptoms and change scores at 10-week ($r = .43$, $p = .03$). No significant correlations were found for the CBT group. These findings suggest that people with higher cardiorespiratory symptoms do better with the CBT/IE intervention, and those with fear of other (non-running related) physical symptoms do better with the HEC treatment.[1]

Discussion

This study's aim was to replicate and extend findings from a previous study (Watt et al., 2006) demonstrating the therapeutic effects of a brief CBT/IE intervention for AS reduction. As hypothesized, the brief CBT/IE intervention resulted in significant decreases in AS for high AS participants, which were maintained over the 14-week follow-up period. The magnitude of reduction in AS levels from pre- to post- intervention (approximately 25% in overall ASI scores) resembled that found in previous studies using this intervention (see Olthuis, Watt, MacKinnon, & Stewart, 2014; Watt, Stewart, Lefaivre, & Uman, 2006), which is consistent with arguments that brief CBT with running as an IE component can be used to reduce fear of anxiety.[2]

Unexpectedly, high AS participants in the HEC condition (i.e., the intended "control"), which consisted of a group discussion on health, also experienced a decrease in AS. These results are consistent with previous research indicating that AS can be malleable, particularly in nonclinical or subclinical groups, and may be responsive to minimal intervention (e.g., normalizing information provided by a structured diagnostic interview; Maltby, Mayers, Allen, & Tolin, 2005). Indeed, participants in our HEC condition revealed almost a 30% reduction in overall ASI scores. This finding contrasts with that of Schmidt et al. (2007) from whom the video portion of our HEC was derived. They found no significant reduction in AS levels as a result of their HEC video in high AS participants (a nonsignificant 17% reduction in ASI scores). Our HEC differed from Schmidt et al.'s in three key ways, however, with three sessions (vs. Schmidt et al.'s single session); the inclusion of an interactive group discussion focused on the importance of physical exercise, diet, and sleep for optimal health (vs. information delivered via an audiovisual computer presentation); plus problem solving around barriers to enacting better healthy living practices. Although the content of the HEC intervention in this study was not specific to mental health benefits, such benefits were mentioned as a possible outcome of physical exercise, diet, and sleep. Whereas these discussions might have led to increased exercise participation for high AS participants in the HEC condition, contributing to decreases in AS, this was not assessed. Moreover, our analyses of AS subgroup do not support this speculation as the CBT/IE appeared to work best for those with high (vs. low) fear of cardiorespiratory (vs. other non-running physical) symptoms. This was not the case with the HEC intervention, which one would expect if the HEC was exerting its effects by encouraging exercise.

As hypothesized, high AS participants in the CBT/IE, but not the HEC, condition experienced a sustained decrease in general stress as measured by the DASS-21. It is possible that high AS participants in the CBT/IE group learned from the cognitive restructuring portion of the intervention more adaptive ways to deal with stressful situations, thereby decreasing levels of general stress in their lives. Participation in both interventions resulted in sustained decreases in depression scores for high AS participants. Both cognitive restructuring in the CBT/IE condition and the focus on physical and mental health in the HEC condition might have yielded improvements in mood for high AS participants. Anxiety scores, as assessed by the BAI (a measure of somatic anxiety symptoms) but not the DASS-21 (a measure of more general anxiety) decreased only for participants in the HEC condition. It is unclear why high AS participants in the CBT/IE condition did not experience decreases in anxiety by the 14-week follow-up. Given that Olthuis et al. (2014) found that the CBT/IE resulted in reductions in panic but not generalized anxiety symptoms, this study may have benefited from a more specific measure of panic symptoms (e.g., Panic Attack Questionnaire).

As hypothesized, the interventions resulted in few changes in low AS participants. Unexpectedly, the HEC treatment did lead to an initial increase in low AS participants' AS levels, but these were short lived (i.e., not persisting at follow-up). Furthermore, the increases did not bring low AS participants' scores to high AS levels but rather brought them closer to normative AS levels. It is not clear why the HEC condition had this short-lived effect. Perhaps discussing health issues made them transiently more aware of certain physiological arousal states. Also unexpectedly, low AS (like high AS) participants in the HEC condition experienced a decrease in anxiety scores on the BAI (but not the DASS-21). Whereas it is possible that the interactive discussion on health helped both low and high AS participants better manage anxiety by improving their health behaviors, this is speculative at best and needs to be tested in future studies.

As expected, high AS participants in the CBT/IE and the HEC conditions did not differ on their levels of AS, stress, depression, and anxiety symptoms before beginning the intervention. Unexpectedly, scores also did not differ following the intervention or at the 14-week follow-up. This appears to be, at least in part, because of the unanticipated apparent therapeutic effects of participating in the interactive discussion on health behaviors in the HEC condition. With respect to ASI scores and DASS-21 depression scores, participants in both conditions experienced similar decreases, as described earlier, explaining the lack of difference in scores at post-intervention and at follow-up. Similarly, because neither group experienced significant decreases in DASS-21 anxiety scores, it is not surprising that they would have similar post-intervention and follow-up scores. Interestingly, although participants in the CBT/IE group but not those in the HEC group experienced significant decreases in DASS-21 stress scores, it appears that the magnitude of this difference was not sufficient to significantly differentiate the two groups following the intervention. Similarly, the magnitude of the difference in changes in BAI anxiety scores between participants in the CBT/IE group, who did not experience any decrease, and in the HEC group, who did experience a decrease, does not appear to be large enough to significantly differentiate the two groups following the intervention.

Results of the post hoc analyses suggest that the CBT/IE (vs. HEC) more specifically targets the high (vs. low) fear of cardiorespiratory symptoms subgroup of high AS participants. The HEC, on the other hand, appears to yield effects more broadly across high AS participants but does not lead to lasting change for high AS participants with high fear of cardiorespiratory symptoms. Moreover, the positive effects of the CBT/IE were found to be specific to cardiorespiratory symptoms versus other (non-running related) physical symptoms, which seemed to respond better to the HEC treatment. These findings clearly argue for further research to determine whether the CBT/IE intervention might be specifically indicated when participants have a high fear of cardiorespiratory sensations such as rapid heartbeat or shortness of breath. It is also difficult to explain why other non-running related physical symptoms would respond preferentially to the HEC treatment.

Implications

Because the Watt et al. (2006) study did not assess the impact of the brief CBT/IE intervention on general psychological distress, results from this study provide new information regarding the potential benefits of this intervention. Our findings lend further support for the brief CBT/IE intervention's efficacy in targeting a known risk factor for various anxiety and anxiety-related disorders (i.e., AS). Our findings also indicate that, as compared to an educational control (i.e., HEC), the brief CBT/IE is particularly beneficial for people with elevated fears of cardiorespiratory (i.e., heart racing, shortness of breath vs. other non-running related somatic) symptoms. Finding a specific reduction in the very arousal-related sensations associated with running (i.e., cardiorespiratory) suggests that the IE may be the operational mechanism. Of course, a treatment "dismantling" study would be required before any definitive conclusions could be drawn. Certainly, previous research evidence supports the beneficial effects of exercise (e.g., Broman-Fulks & Storey, 2008). Smits, Berry, Rosenfeld, et al. (2008), using high AS participants, found that high-intensity exercise sessions were equally efficacious in reducing AS, whether delivered alone or with cognitive restructuring and were markedly better than the waitlist condition. Furthermore, the exercise conditions were associated with significant reductions in overall anxiety, compared with the waitlist condition. Future research could further assess participants' fears of specific types of somatic sensations, allowing for a more individualized plan (e.g., focus on X, Y, or Z physical sensation) when running and, thus, a more targeted exposure.

The potential benefits of using physical exercise as part of an intervention for AS are manifold. Given the myriad physical and mental health benefits of increasing exercise participation (Stathopoulou et al., 2006; Warburton, Charlesworth, Ivey, Nettlefold, & Bredin, 2010), encouraging individuals who otherwise shy away from exercise to become more open to engaging in physical exercise might lead to life-long additional benefits, including lower incidence of mental illness and increased longevity (see Sabourin et al., 2011). It would be of interest to examine a combination of the best of both interventions—CBT/IE and HEC. For example, exercise could be used as IE with a prelude of the HEC problem solving barriers to see if that increases compliance with the exercise regimen and thus results in further improvements in AS and associated distress symptoms. Given that physical exercise appears to provide even more pronounced protective effects in responding to physiological stressors for high AS than for low AS individuals (Smits, Tart, Rosenfield, & Zvolensky, 2011), it seems even more crucial to encourage high AS individuals to engage in physical exercise.

Limitations and Future Directions

The current investigation was not without its limitations. First, both experimental and control interventions revealed a large effect of time on high AS levels with participants in both conditions experiencing significant decreases in ASI scores. Whereas the magnitude of change in AS levels in the brief CBT/IE condition was consistent with previous published studies, we cannot confirm that either intervention was effective without an additional control condition (e.g., no treatment control, other nonspecific treatment) showing no (or weaker) change in ASI scores. Without such a control, we are unable to rule out the possibilities that the observed decreases over time in this study represented a regression to the mean, spontaneous remission, or some nonspecific therapeutic effect (e.g., therapist attention). On the other hand, the magnitude of decrease in the CBT/IE condition in this study was comparable, even slightly greater, than in the previous Watt et al. (2006) study with the same CBT/IE intervention. Watt et al. reported pre- to post-intervention changes in ASI scores for high AS participants in the CBT intervention condition of 6.7 ASI units. This study's high AS-CBT/IE participants' scores decreased by 7.8 ASI units from pre- to posttreatment and by 10.6 units from pretreatment to follow-up. It is unlikely that this similar magnitude of change experienced represents a regression to the mean given that we did not see an increase in ASI scores in the low AS group, and our previous study (Watt et al., 2006), which controlled for nonspecific therapy factors, suggests that changes in AS observed with this intervention are not simply secondary to therapist attention. Regarding the HEC condition, the magnitude of change resembled that of the CBT/IE condition and exceeded that of a previously tested noninteractive HEC (Schmidt et al., 2007). Future research with appropriate control groups (e.g., no treatment, nonspecific therapy control group) is required to test the efficacy (and mechanism of change) of the HEC intervention.

A second limitation was that the IE trials were performed unsupervised. Although participants were instructed to focus on sensations during the running and to abstain from listening to music while running, it is possible that participants did use music or other distractions, which might have decreased the IE's potential for producing fear habituation (Foa & Kozak, 1986). A third limitation was that exercise participation was not verified. Given that IE was assigned in the CBT/IE but not in the HEC group (thereby limiting direct comparability of the two interventions), one might assume that exercise levels would be higher in the CBT/IE group. This was not assessed, however. Moreover, the inclusion of discussion of barriers to healthy behaviors (including exercise) may have led the HEC participants to increase their involvement in physical activity, making them more comparable to the CBT/IE group in that regard. On the other hand, results of the AS subgroup analyses indicate that CBT/IE worked best for those with elevated fears of cardiorespiratory symptoms. This was not the case for the HEC intervention, which one would expect if increased exercise had been the operational factor. Future research would benefit from reliable and well-validated measures to report completed IE trials and engagement in total physical activity both prior to and during the intervention period.

Several participants did not complete the intervention or were lost to follow-up. The fact that the intervention was group-based over 3 days and provided once to twice per year, prevented easy rescheduling if participants had to miss a day. The rate of attrition resembled that of other similar intervention studies (e.g., Broocks et al., 1998). Although the final study participants did not differ from participants who dropped out on variables such as pre-intervention AS levels, age, and race, they may have systematically differed on other relevant unmeasured variables.

Participants in this study were undergraduate nonclinical women; thus, it is unclear whether these results would generalize to men and/or to clinical samples. On the other hand, the pre-intervention ASI scores in the high AS women (i.e., 35.5) reflect levels that are comparable to individuals with panic disorder (Meuret, Rosenfield, Seidel, Bhaskara, & Hofmann, 2010; M range = 35–36).

Conclusion

In conclusion, the present replication and extension study provided additional support for the potential therapeutic benefits of a brief group-based, CBT/IE intervention in reducing AS levels and improving symptoms of general stress and depression in high AS women. In addition, the study showed that providing a rationale and problem-solving barriers to engaging in health behaviors, including physical exercise, also results in improvements in AS and depression and anxiety symptoms. This study also demonstrated that these gains were mostly maintained at a longer term follow-up. Given the evidence linking high AS levels with emotional disorders, decreasing AS levels provides an important preventive type intervention. Finding that the CBT/IE more specifically targets a subgroup of high AS individuals; namely, those with high (vs. low) fear of cardiorespiratory symptoms opens up new possibilities for tailoring the intervention. Finally, given the positive effects of both the IE component and the health discussion, a promising avenue for future research would be to test the combination of both interventions for potentially conferring additional mental and physical health benefits for this at-risk population.

Notes

1. In addition to the correlational analyses we conducted to test whether the CBT/IE intervention might have had a greater impact for those high AS individuals who specifically fear the types of sensations brought on by running (e.g., rapid heartbeat and shortness of breath), we also compared high AS participants who reported higher (vs. lower) levels of fear of cardiorespiratory symptoms based on a median split of summed ASI Items 6, 9, and 10. Results revealed that, for the high fear of cardiorespiratory symptoms group, the

CBT/IE yielded a linear reduction in AS over time: linear effect, $F(1,9) = 14.62$, $p = .004$, $\eta^2_p = .619$; no quadratic effect, $F(1,9) = 4.55$, $p = .06$, $\eta^2_p = .336$, conversely, there was no significant effect of the CBT/IE for the low fear of cardiorespiratory symptoms group: no linear effect, $F(91,70) = 4.89$, $p = .063$, $\eta^2_p = .411$; no quadratic effect, $F(91,7) = 1.21$, $p = .308$, $\eta^2_p = .147$. In contrast, the HEC yielded a reduction in AS for both the high fear of cardiorespiratory symptoms group: linear effect, $F(1,9) = 12.02$, $p = .007$, $\eta^2_p = .572$; quadratic effect, $F(1,9) = 5.21$, $p = .048$, $\eta^2_p = .367$ and the low fear of cardiorespiratory symptoms group: linear effect, $F(1,11) = 67.73$, $p = .000$, $\eta^2_p = .860$; no quadratic effect, $F(1,11) = 1.89$, $p = .197$, $\eta^2_p = .146$. The significant quadratic effect in the high fear of cardiorespiratory symptoms group with the HEC intervention indicated a rebound effect for the high cardiorespiratory group at follow-up.

2. In the original test of the brief CBT, Watt et al. (2006) reported a mean change score of 6.7 (approximately 21% reduction in ASI scores) from a comparable high AS starting point of 34. In a telephone-delivered test of the intervention, delivered over an 8-week period, Olthuis et al. (2014) reported a 39% reduction in ASI-3 scores.

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