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Dyadic Aerobic Exercise as Treatment for Social Anxiety: A Randomized Control Trial

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Abstract

This study examines the effects of aerobic exercise, especially dyadic aerobic exercise, on levels of social anxiety. Investigated, also, is the extent to which dimensional moderators of social anxiety play an intermediary role in levels of social anxiety. The present study follows a between subjects, repeated measures, randomized control trial design. All experimental data was derived from self-report measures conducted prior to, during, and at the conclusion of a two-week aerobic exercise regimen. Data analysis was conducted via means comparisons, within subjects and between groups, on various metrics. Our results suggest a greater efficacy of dyadic aerobic exercise over both solitary aerobic exercise and a control condition for reducing levels of social anxiety. However, our study finds no significant data regarding dimensional moderators. Limitations and future implications of the study are further discussed.

Keywords: Dyadic aerobic exercise, aerobic exercise, social anxiety disorder, social anxiety, dimensional moderators, psychometric-measurement

Dyadic Aerobic Exercise as Treatment for Social Anxiety: A Randomized Control Trial

There is a strong scientific and social movement in developed countries emphasizing the importance of exercise to maintain physical health. The Centers for Disease Control and Prevention (CDC, 2020) and World Health Organization (WHO, 2020) recommend 150 minutes of aerobic exercise each week for adults and it has become common knowledge that a sedentary lifestyle is linked with poorer health and a shorter lifespan (Katzmarzyk & Lee, 2012; Patel et al., 2010). Such research, and several social movements, have stimulated the formation of a prominent exercise and health community in every developed country, replete with cultural norms, services, and industries. Recent lines of psychological research, however, have suggested the benefits of exercise, particularly aerobic exercise, are not limited to just physical health improvements. A study performed by Moses and colleagues (1989) found anxiety and coping deficits decreased when exercise was performed. The researchers also found reductions in the aforementioned psychological malefactors only emerged when an aerobic component was present and is therefore not attributable to participation in a structured program of progress toward physical achievement. Altogether, this suggests there are neurological mental health benefits associated with exercise on anxiety and anxiety disorders.

At present, the psychological literature on aerobic exercise and general mental health is clear; aerobic activity is highly beneficial to the mental life of human beings (Tyson et al., 2010). The effect of aerobic exercise on specific mental disorders, in regard to treatment efficacy, has received little research attention. Furthermore, even fewer attempts have been made in the relevant literature at iterating and improving upon aerobic exercise treatments, with respect to positive mental health gains, by modifying its implementation as a therapy. The current study

attempts to further our scientific and psychological understandings on both of these understudied topics. Specifically, this study seeks to measure the positive mental health gains of aerobic exercise on levels of social anxiety and its moderators, under the conditions of both solitary and dyadic aerobic exercise. In order to engage properly with the subject matter of this study, we will first review the dimensional literature on social anxiety with reference to aerobic exercise.

State of Dimensional Literature on Social Anxiety

Previous research has indicated that exercise influences social anxiety. In one review, Panic Disorder, Social Anxiety Disorder, Generalized Anxiety Disorder, Post-Traumatic Stress Disorder, and Obsessive-Compulsive Disorder were each found to have their negative symptoms reduced by various forms of exercise (Asmundson et al., 2013). With regard to Social Anxiety Disorder (SAD), aerobic exercise in efficacy studies was found to be just as successful at significantly reducing scores ($n^2_p = 0.25$) on the Social Interaction Anxiety Straightforward Scale (SIAS-S) as mindfulness-based treatments (Jazaieri et al., 2012). This research supporting the efficacy of aerobic exercise for reducing social anxiety is a useful starting point. However, further attention must be paid to the dimensional mechanisms and factors relevant to constructing a scientifically sound experiment to investigate aerobic exercises efficacy concerning SAD.

Several anxiety disorders, including SAD, have been found to be underlaid by specific behavioral trait combinations (Naragon-Gainey & Watson, 2011; Stein & Stein, 2008). These findings include combinations of low extroversion, high neuroticism, and an internalizing-neuroticism factor as particularly relevant to increasing likelihood of developing SAD (Hettema et al., 2006; Stein & Stein, 2008). This line of research suggests important moderating variables relevant to the current study. If neuroticism is decreased and extroversion is increased post-

intervention, positive mental health growth with respect to SAD and other anxiety disorders may have been made. Though personality traits have conventionally been considered highly stable over time (American Psychiatric Association, 2013), more recent research has challenged this assumption, at least for trait neuroticism (Clark, 2009; Eaton, Krueger & Oltmanns, 2011; Roberts & Mroczek, 2008; Roberts, Walton, & Viechtbauer, 2006). Therefore, pre- and post-intervention levels of extraversion and neuroticism appear to have a significant effect on reducing social anxiety through exercise.

Similar to personality trait measurements, are measures of emotionality and affectivity. Negative emotionality has been found to be correlated with SAD, whereas positive emotionality has been found to be negatively correlated with SAD (Naragon-Gainey & Watson, 2011). This provides another metric to approach measuring the possible positive effects of aerobic exercise on levels of social anxiety. While these aspects of dispositional bases are considered highly inflexible over time, aerobic exercise studies and reviews have been shown to reduce anxiety (Acarturk et al., 2009; Smits et al., 2008). This gives plausible credibility that increased aerobic exercise may lead to long term improvements in positive-affectivity and reductions in negative-affectivity, thus decreasing negative SAD symptoms.

A final consideration derived from the literature concerns the connection of anxiety sensitivity to SAD. Anxiety sensitivity measures have been found to provide incremental validity in the psychogenesis of SAD beyond measures of the Big Five and measures of negative or positive-affectivity; though these gains may not be specific to SAD, as they are general across all anxiety disorders (Naragon-Gainey & Watson, 2011). Nevertheless, the effects of aerobic exercise on anxiety sensitivity are perhaps the most pronounced measures discussed thus far

(Broman-Fulks & Storey, 2008; Smits et al., 2008) and also deliver an extremely "sensitive" metric to judge the relative efficacy of the opposing conditions tested in this study.

Aerobic Exercise

Before describing the current study, it is necessary to describe the specific advantages of aerobic exercise as a treatment of anxiety disorders. While aerobic exercise is found to be an efficacious treatment, Cognitive Behavioral Therapy (CBT) and mindfulness-based therapies have also been proven to be beneficial. The question that arises is what does aerobic exercise offer that these alternative treatments do not? Aerobic exercise is a free and accessible treatment, practicable by everyone. Exercise also does not carry the stigmas of medication or talk therapy, and is instead a celebrated and common aspect of our culture. Aerobic exercise serves as an easily circulatable treatment as well, not requiring specialized training or expert implementation to conduct (Smits, 2007). There are associated physical health benefits included in the practice of aerobic exercise too, as discussed at the beginning of this article. In sum, aerobic exercise presents itself as an attractive manner to treat anxiety disorders.

The Current Study

The iterative innovation tested in the present study (which serves as the basis of our unique manipulation) is one that has not yet been specifically examined in psychological literature. Our aim is to study the varying levels of efficacy that may be produced by aerobic exercise treatment on reducing social anxiety and its dimensional moderators, relative to two conditions: solitary aerobic exercise and dyadic aerobic exercise (aerobic exercise conducted with a partner). Dyadic aerobic exercise, in effect, pairs a relatively understudied therapeutic treatment (aerobic exercise) with an extremely well-studied therapeutic treatment (exposure therapy) that is specific to the symptoms of SAD, as social interaction is itself a trigger of

maladaptive symptoms for those with SAD. The hope is that a significant improvement in aerobic exercises efficacy for SAD symptoms will be found under the dyadic condition to aid the general public with more effective mental health strategies. Also, provide clinicians who prescribe aerobic exercise to their patients with a useful modification to such prescriptions, while increasing client's gains at little additional cost or effort for the client and clinician.

Hypotheses

Six hypotheses have been formulated for the present study, consistent with the literature and theory discussed previously. *First*, if three groups of participants are gathered, with one group receiving a dyadic aerobic exercise treatment, one group receiving a solitary aerobic exercise treatment, and one group receiving a control condition; the group receiving the dyadic aerobic exercise treatment will experience the greatest relative decrease in neuroticism, followed directionally in the same manner to a lesser extent by the solitary aerobic exercise group, then followed by no change in the control condition group. *Second*, the dyadic aerobic exercise group will experience the greatest relative increase in extroversion, followed directionally in the same manner to a lesser extent by the solitary exercise group, and followed by no change in the control condition group. *Third*, the dyadic aerobic exercise group will experience the greatest relative decrease in negative-affectivity, followed directionally in the same manner to a lesser extent by the solitary exercise group, and followed by no change in the control condition group. *Fourth*, the dyadic aerobic exercise group will experience the greatest relative increase in positive-affectivity, followed directionally in the same manner to a lesser extent by the solitary exercise group, and followed by no change in the control condition group. *Fifth*, the dyadic aerobic exercise group will experience the greatest relative decrease in social anxiety, followed directionally in the same manner to a lesser extent by the solitary exercise group, and followed

by no change in the control condition group. *Sixth*, the dyadic aerobic exercise group will experience the greatest relative decrease in anxiety sensitivity, followed directionally in the same manner to a lesser extent by the solitary exercise group, and followed by no change in the control condition group. Further moderating variables that will be measured, but with no hypotheses made, are pre-existent levels of physical activity; whether any form of therapy for anxiety has been sought in the past, gender, age, race, and socioeconomic status.

Method

Participants

The study consisted of 22 undergraduates at Hillsdale College in Hillsdale, Michigan. Participant age ranged between 17-21 years old (M = 19.00, SD = 1.23), with 63.6% identifying as female and 36.4% identifying as male. All participants were Caucasian, and predominantly middle class. An overwhelming majority of participants exercised regularly prior to their involvement in this study, and seven of the 22 participants had received some form of therapy for anxiety, however none had ever been diagnosed with social anxiety. Seven participants were assigned to the control condition, seven participants were assigned to the solitary aerobic exercise condition, and eight participants were assigned to the dyadic aerobic exercise condition. No participants withdrew from the study.

Measures

Short-scale Eysenck Personality Questionnaire – Revised (EPQ-R) (Only Extroversion and Neuroticism items)

The items posed in the Short-scale EPQ-R, as used in this study, measure the personality-level traits of extroversion and neuroticism (Eysenck & Eysenck, 1993). Twelve items for extroversion, and twelve items for neuroticism are included, making for a total of twenty-four

items in this scale. An example of an item for extroversion is “Are you a talkative person,” and an example of an item for neuroticism is “Do you often feel ‘fed up’.” All items in this scale are answered on a yes or no basis. Researchers have found this scale to be both reliable and valid (Alexopoulos & Kalaitzidis, 2004).

Positive and Negative Affectivity Schedule – Short Form (PANAS-SF)

The items in the PANAS-SF measure positive and negative-affectivity as experienced over the past week (Watson et al., 1988). Ten items for positive-affectivity and ten items for negative-affectivity are included, making for a total of twenty items in this scale. An example of an item for positive-affectivity is “Indicate the extent you have felt this way over the past week: excited,” and an example of an item for negative-affectivity is “Indicate the extent you have felt this way over the past week: distressed.” All items in this scale are measured by a 1 to 5 Likert scale, from “very slightly or not at all” to “extremely.” Researchers have found this scale both reliable and valid (Watson et al., 1988).

Liebowitz Social Anxiety Scale (LSAS)

The items in the LSAS measure the two primary components of social anxiety: fear, and avoidance (Liebowitz Social Anxiety Scale). Twenty-four items are included in this scale. All items in this scale are measured by two 0 to 3 Likert scales (one for fear and one for avoidance), from (fear) “none” or (avoidance) “never,” to (fear) “severe” or (avoidance) “usually.” Examples from this scale one may fear or avoid are “using a telephone in public” and “meeting strangers.” Researchers have found this scale both reliable and valid (Heimberg et al., 1999).

Anxiety Sensitivity Index-3 (ASI-3)

The items in the ASI-3 measure dispositional levels of anxiety sensitivity (Taylor et al., 2007). Eighteen items are included in this scale. Two examples from this scale of high anxiety

sensitivity are “It is important for me not to appear nervous,” and “It scares me when my heart beats rapidly.” All items are measured by a 0 to 4 Likert scale, from “very little” to “very much.” Researchers have found this scale both reliable and valid (Rifkin et al., 2015).

Procedure

The present study follows a between subjects, repeated measures, randomized control trial design. Participants signed informed consent documents, and then took the pre-test battery of self-report measures. Prior to leaving their respective meetings, but after having taken the pre-test measures, each participant was then randomly and evenly assigned to either the control condition, solitary aerobic exercise condition, or dyadic aerobic exercise condition. The aerobic exercise treatment, was operationalized as a thirty- minute session in which participants were directed to walk outdoors casually for ten minutes, speed walk or lightly jog for ten minutes, and then walk casually again for ten minutes. Over the course of the week after this meeting, the control group received no aerobic exercise treatment as a part of the study, whereas the solitary and dyadic conditions received three aerobic exercise sessions, evenly dispersed across the week. The solitary group completed these sessions alone, whereas the dyadic group completed them with a partner also assigned to the dyadic aerobic exercise condition. Precisely one week after the initial meeting, participants reconvened and were again tested on the same battery of measures. Another week of treatment, in the exact format as described for the first week, ensued, followed by a final day post-test of the same measures. After the post-test, participants were debriefed from the study and their participation in the study was at this point complete. However, all participants agreed to stay a few minutes after to discuss their subjective feelings about the aerobic exercise treatment and their participation in the research study.

Results

Of the six hypotheses posed in this study, two were partially confirmed, two were inconclusive, and two were rejected. The *first* hypothesis, that neuroticism would be decreased most in the dyadic condition, followed by the solitary condition, and no change in the control condition, was partially confirmed. In the dyadic condition, scores of neuroticism fell by .485 of a standard deviation from the pre-test to the post-test, at a within-subjects significance of $F(1,7) = 10.17$, $p = .003$. In the solitary condition, scores of neuroticism fell by .81 of a standard deviation at a within-subjects significance of $F(1,6) = 6.29$, $p = .02$. In the control condition, scores of neuroticism increased by .07 of a standard deviation at a within-subjects significance of $F(1,6) = .14$, $p = .74$. No significant between-groups effect was observed in any condition. See Table 1 for statistics on neuroticism, and Figure 1 for a visual on changes in neuroticism.

The *second* hypothesis, that extroversion would be increased most in the dyadic condition, followed by the solitary condition, and no change in the control condition, was inconclusive. In the dyadic condition, scores of extroversion increased by .04 of a standard deviation from the pre-test to the post-test, at a within-subjects significance of $F(1,7) = 2.07$, $p = .17$. In the solitary condition, scores of extroversion fell by .08 of a standard deviation at a within-subjects significance of $F(1,6) = .79$, $p = .45$. In the control condition, scores of extroversion fell by .24 of a standard deviation at a within-subjects significance of $F(1,6) = 3.43$, $p = .06$. While the dyadic condition was the only condition in which extroversion had increased from the pre-test to the post-test, no significant within-subjects or between-groups effects were found in any condition. See Table 2 for statistics on extroversion.

The *third* hypothesis, that negative-affectivity would be decreased the most in the dyadic condition, followed by the solitary condition, and no change in the control condition, was also inconclusive. In the dyadic condition, scores of negative-affectivity fell by .36 of a standard

deviation from the pre-test to the post-test, at a within-subjects significance of $F(1,7) = 2.42$, $p = .13$. In the solitary condition, scores of negative-affectivity fell by .07 of a standard deviation at a within-subjects significance of $F(1,6) = .08$, $p = .88$. In the control condition, scores of negative-affectivity fell by .09 of a standard deviation at a within-subjects significance of $F(1,6) = .19$, $p = .69$. While all conditions had a decrease in negative-affectivity from pre-test to post-test, and the dyadic conditions' decrease was the largest, no significant within-subjects or between-groups effects were found in any condition. See Table 3 for statistics on negative-affectivity.

The *fourth* hypothesis, that positive-affectivity would be increased the most in the dyadic condition, followed by the solitary condition, and no change in the control condition, was rejected. In the dyadic condition, scores of positive-affectivity increased by .17 of a standard deviation from the pre-test to the post-test, at a within-subjects significance of $F(1,7) = .55$, $p = .55$. In the solitary condition, scores of positive-affectivity increased by .50 of a standard deviation at a within-subjects significance of $F(1,6) = 3.68$, $p = .07$. In the control condition, scores of positive-affectivity increased by .75 of a standard deviation at a within-subjects significance of $F(1,6) = 1.08$, $p = .36$. While no significant within-subjects or between-groups effects were found in any condition, the increase in positive-affectivity from pre-test to post-test was greater in both the solitary and control conditions than in the dyadic condition. See Table 4 for statistics on positive-affectivity.

The *fifth* hypothesis, that social anxiety would be decreased the most in the dyadic condition, followed by the solitary condition, and no change in the control condition, was partially confirmed. In the dyadic condition, scores of social anxiety fell by 1.40 standard deviations from pre-test to post-test at a within-subjects significance of $F(1,7) = 15.93$, $p = .00$. In the solitary condition, scores of social anxiety fell by .35 of a standard deviation at a within-

subjects significance of $F(1,6) = 1.43$, $p = .28$. In the control condition, scores of social anxiety fell by .29 of a standard deviation at a within-subjects significance of $F(1,6) = .13$, $p = .30$. No significant between-groups effect was observed in any condition. See Table 5 for statistics on social anxiety and Figure 2 for a visual on changes in social anxiety.

Finally, the *sixth* hypothesis, that anxiety sensitivity would be decreased most in the dyadic condition, followed by the solitary condition, and no change in the control condition, was rejected. In the dyadic condition, scores of anxiety sensitivity fell by .39 of a standard deviation from the pre-test to the post-test, at a within-subjects significance of $F(1,7) = 2.61$, $p = .15$. In the solitary condition, scores of anxiety sensitivity fell by .77 of a standard deviation at a within-subjects significance of $F(1,6) = 7.13$, $p = .02$. In the control condition, scores of anxiety sensitivity fell by .45 of a standard deviation at a within-subjects significance of $F(1,6) = 6.99$, $p = .02$. While anxiety sensitivity decreased in the dyadic condition as well, no significant change in anxiety sensitivity scores was found. No significant between-groups effect was observed in any condition. See Table 6 for statistics on anxiety sensitivity.

Discussion

The most significant finding of this study was the partial confirmation of hypothesis five. The hypothesis that social anxiety would be decreased most by the dyadic condition, followed by the solitary condition, and no change in the control condition was partially confirmed because the directional data for all conditions (change in standard deviation from pre to post-test) and within-subjects significance tests confirmed the hypothesis, but no significant between-groups effect was observed. Hypothesis five was the most crucial hypothesis because it concerns SAD directly, which we hoped to prove the efficacy of dyadic aerobic exercise as a treatment for. With hypothesis five partially confirmed, we have a strong indication that dyadic aerobic

exercise does provide a substantial, non-insignificant gain in anxiolytic (anxiety-reducing) effects over solitary aerobic exercise. Shown in Table 5 and Figure 2.

Another key finding of this study was the partial confirmation of hypothesis one. The hypothesis that neuroticism would be decreased most by the dyadic condition, followed by the solitary condition, and no change in the control condition was partially confirmed because the directional data for the control condition (change in standard deviation from pre to post-test) and within-subjects significance confirmed the hypothesis, but the percentage change in the solitary condition was greater than in the dyadic condition, and no significant between-groups effect was observed. Though neuroticism is considered a highly stable, higher-order factor, the malleability and susceptibility to change of neuroticism scores in response to our aerobic exercise interventions supports the psychological literature advancing the theory that neuroticism is a trait much more pliable than it has been thought to be, traditionally (see: Clark, 2009; Eaton, Krueger & Oltmanns, 2011; Roberts & Mroczek, 2008; Roberts, Walton, & Viechtbauer, 2006). Our partial confirmation of hypothesis one, which necessarily found neuroticism malleable to our interventions, aligns with previous research conducted by Barlow and others (2017), which theorizes several emotional disorders (including SAD) are governed and explained (at least in part) by trait neuroticism. Our data fits Barlow's theory, as it is consistent with our data that neuroticism, which decreased along with social anxiety in both of our aerobic exercise conditions, may have been a primary driver of the observed decreases in social anxiety. Shown in Table 1 and Figure 1.

The findings that hypotheses two and three were inconclusive, and four and six were rejected, are crucial as well. Hypothesis two, the hypothesis on extroversion for which data was inconclusive, suggests trait extroversion is not malleable to aerobic exercise interventions, and/or

not a core driver of social anxiety. Hypothesis three, the hypothesis on negative-affectivity for which data was inconclusive, suggests negative-affectivity is not highly influenced by aerobic exercise interventions, and/or is not a core driver of social anxiety. Hypothesis four, the hypothesis on positive-affectivity which the data rejected, suggests positive-affectivity was simply not malleable to aerobic-exercise interventions, and/or perhaps not a core driver of social anxiety. Finally, hypothesis six, the hypothesis on anxiety sensitivity which the data rejected, suggests anxiety sensitivity was perhaps a driver of social anxiety, but not one which is influenced by dyadic aerobic exercise with enough certainty.

Social anxiety was the only metric along which the dyadic condition produced both the directionally strongest effect among the three conditions *and* a significant within-subjects effect. However, the dyadic condition was the only condition, that trended, directionally, in the hypothesized manner, across all six studied metrics (neuroticism, extroversion, negative-affectivity, positive-affectivity, social anxiety, and anxiety sensitivity). This indicates dyadic aerobic exercise was the most well-rounded and beneficial intervention tested compared to solitary aerobic exercise. This is a particularly significant discovery when the limitations of this study are considered.

Limitations

The main limitations of this study were the sample size and demographic availability. Given the nature of Hillsdale College's small undergraduate student body, lack of monetary incentives available to participants, and strenuous and time-consuming nature of this study, participant recruitment was troublesome. The largest impact of the small sample size came in regard to between-groups analysis; no significant between-groups effect was found for any of the studied metrics, most likely as a product of the small sample size. Hillsdale's student body is

predominantly White and middle class, which was reflected in the participant sample. Furthermore, making it the sample's characteristics difficult to generalize to a broader population.

Another drawback of this study was the lack of a clinical population. While this is not inherently a limitation, the goal of this study was to determine the effectiveness of dyadic aerobic exercise over and above the effectiveness of solitary aerobic exercise as a treatment for those with SAD. Having a sample where no one was clinically diagnosed with SAD likely resulted in a sample with less to gain from the aerobic exercise interventions. Perhaps, smaller observed directional shifts occurred from pre- to post-intervention than it would have with a clinical sample.

In addition, there were scope and time constraints that presented limitations to the study. Participants were college students; therefore, the aerobic intervention was not as time consuming or strenuous as it might have seemed to attract them to the study. As for time constraints, all participants were run through an experimental runtime of only two weeks. Many comparable studies use interventions occurring across several months (e.g., Broman-Fulks & Storey, 2008; Jazaieri et al., 2012). This study was designed to fulfill a course credit requirement for the principal investigator in Fall of 2021, imposing time constraints that pigeonholed the experimental phase into a smaller timeframe.

A final noteworthy limitation may be found in participant perceptions of aerobic exercise and the experiment itself. Two participant groups were run through this study, and their participation did not overlap. Whereas the first group (comprising nine participants) expressed a generally *positive* view of their time spent participating in the study and engaging in the aerobic exercise interventions (during a discussion post-debriefing), the second group (comprising

thirteen participants) expressed a generally *negative* view of their time spent participating in the study and engaging in the aerobic exercise interventions (during a discussion post-debriefing). Given the possibility for individual variation in how aerobic exercise is viewed as either positive or negative, and participation in a research study is viewed as either positive or negative, these feelings may have some effect on the efficacy of the aerobic exercise conditions as a treatment for social anxiety. However, the nature of this possible effect on the current study is unclear.

Conclusion and Future Directions

This study sought to uncover the unique effects of dyadic aerobic exercise, as opposed to solitary aerobic exercise, for the treatment of SAD. Despite a bevy of limitations, including a small, non-clinical sample, highly restricted resources, and a short timeframe, significant effects were found which both directly partially-confirmed two hypotheses, and indicated the saliency of two others. Although two hypotheses were rejected, beneficial information was gleaned from these rejections about the genesis of social anxiety from dimensional factors and the effectiveness of aerobic exercise at shifting dimensional metrics. Findings from this study show that social anxiety, as measured directly, is most effectively and significantly reduced by a dyadic aerobic exercise intervention, when compared to solitary aerobic exercise or a control condition. Further research with a larger, clinical sample, more resources, and a longer timeframe would be beneficial to future discoveries on the efficacy of dyadic aerobic exercise as a treatment for social anxiety. Our research suggests there are clinically significant anxiolytic effects to be found for those with social anxiety that are prescribed aerobic exercise with a partner, over and above the already clinically studied anxiolytic effects associated with solitary aerobic exercise.

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Compliance with Ethical Standards

The author reports no potential conflicts of interest in the conduction of this research.

The author reports that this research involved human participants, and that appropriate IRB procedures were followed and permissions obtained.

The author reports that all participants received and signed an informed consent prior to participation.

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Table 1

Change in Levels of Measured Neuroticism Pre to Post-Trial in Each Condition

Neuroticism	Dyadic	Solitary	Control	Pre-test	Post-test
ΔSD pre to post	-.485	-.811	.069		
within-subjects *p*	.003	.018	.742		
within-subjects *F*	10.173	6.293	.143		
between-groups *p*				.766	.294
between-groups *F*				.271	.306

Table 2

Change in Levels of Measured Extroversion Pre to Post-Trial in Each Condition

Extroversion	Dyadic	Solitary	Control	Pre-test	Post-test
ΔSD pre to post	.035	-.084	-.237		
within-subjects *p*	.171	.450	.062		
within-subjects *F*	2.067	.794	3.426		
between-groups *p*				.984	.821
between-groups *F*				.016	.199

Table 3

Change in Levels of Measured Negative-Affectivity Pre to Post-Trial in Each Condition

Negative-Affectivity	Dyadic	Solitary	Control	Pre-test	Post-test
ΔSD pre to post	-.358	-.067	-.088		
within-subjects *p*	.130	.884	.693		
within-subjects *F*	2.427	.077	.187		
between-groups *p*				.603	.953
between-groups *F*				.520	.048

Table 4

Change in Levels of Measured Positive-Affectivity Pre to Post-Trial in Each Condition

Table 4: Positive-Affectivity	Dyadic	Solitary	Control	Pre-test	Post-test
ΔSD pre to post	.172	.498	.751		
within-subjects *p*	.550	.071	.356		
within-subjects *F*	.553	3.675	1.080		
between-groups *p*				.897	.794
between-groups *F*				.109	.234

Table 5

Change in Levels of Measured Social Anxiety Pre to Post-Trial in Each Condition

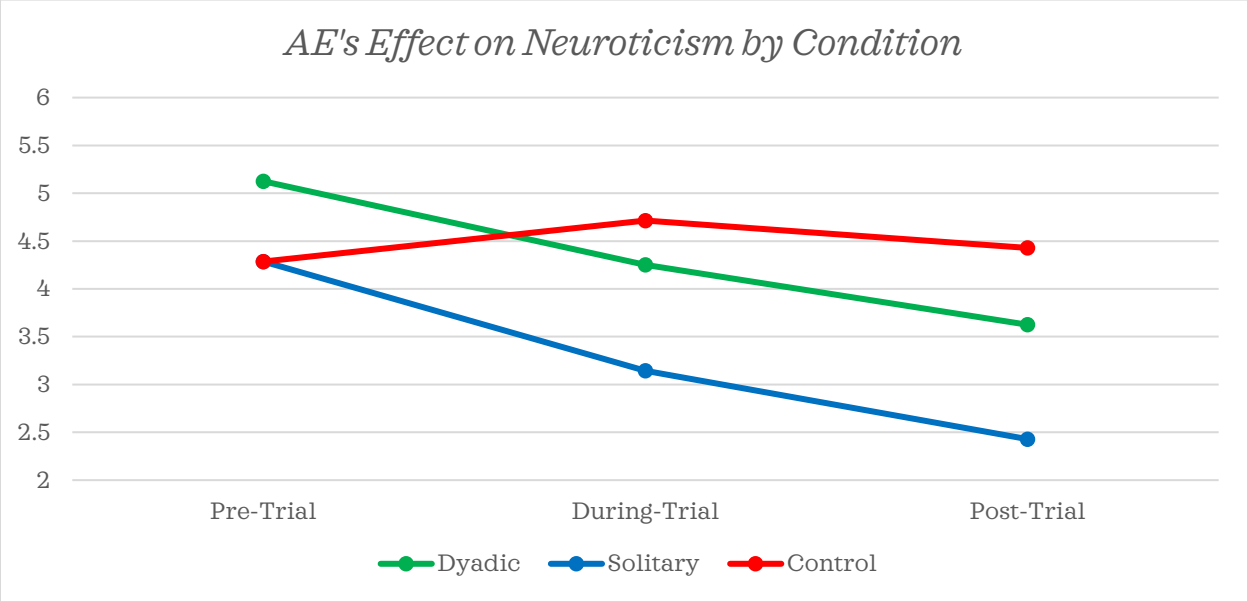
Social Anxiety	Dyadic	Solitary	Control	Pre-test	Post-test
ΔSD pre to post	-1.401	-.345	-.285		
within-subjects *p*	.002	.279	.302		
within-subjects *F*	15.928	1.431	1.307		
between-groups *p*				.772	.439
between-groups *F*				.263	.860

Table 6

Change in Levels of Measured Anxiety Sensitivity Pre to Post-Trial in Each Condition

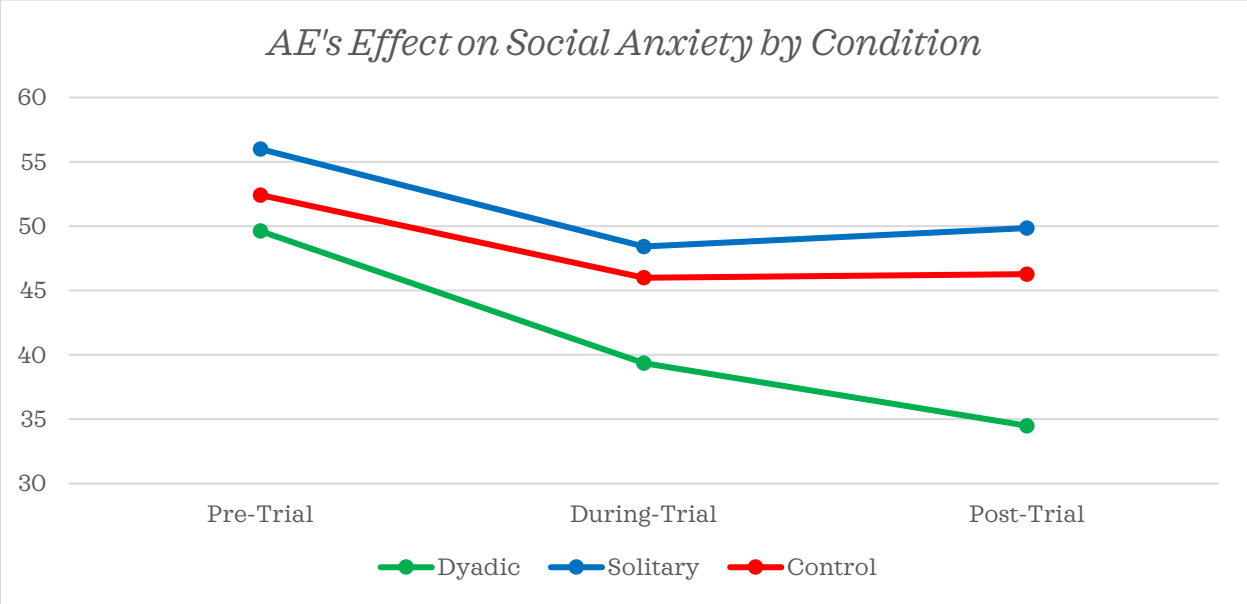
Anxiety Sensitivity	Dyadic	Solitary	Control	Pre-test	Post-test
ΔSD pre to post	-.393	-.769	-.448		
within-subjects *p*	.149	.017	.015		
within-subjects *F*	2.614	7.129	6.992		
between-groups *p*				.669	.732
between-groups *F*				.411	.317

Figure 1



Note. Aerobic exercise's effect on social anxiety by condition, specifically changes in neuroticism.

Figure 2



Note. Aerobic exercise's effect on social anxiety by condition, specifically changes in social anxiety.