TARGETING PERFORMANCE PACE IN LONG DISTANCE RUNNERS THROUGH ACCEPTANCE AND COMMITMENT TRAINING

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ABSTRACT

TARGETING PERFORMANCE PACE IN LONG DISTANCE RUNNERS THROUGH ACCEPTANCE AND COMMITMENT TRAINING

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Long-distance runners often encounter private events while running that may negatively impact their performance, such as staying on pace throughout the duration of a run. Recent research has attempted to target the private events of athletes through a variety of mindfulness-based approaches with varied results. Despite the popularity of mindfulness approaches, there is limited research evaluating the effectiveness of Acceptance and Commitment Therapy (ACT), a behavior analytic approach that combines mindfulness strategies with behavior change strategies to target psychological flexibility (PF), on the performance of athletes. The current study used a multiple baseline across participants design to evaluate the effects of a brief ACT intervention on three female high school cross country runner's ability to meet goal pace times. In addition, the study evaluated whether the intervention impacted participant's self-reports of PF after a run. Results of the study indicate the ACT intervention did not impact participant's goal pace times but was effective at increasing participants' self-reports of PF. Implications of the study and future research are discussed.

Keywords: Long-distance runners, acceptance and commitment therapy, mindfulness, psychological flexibility

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Introduction

Runners face challenges both physically and mentally when running. Many runners experience negative thoughts or feelings while running and may try to escape or avoid the unpleasant feelings or may become fixated on those negative thoughts, which can impact their performance. For example, a runner may try to suppress the sensation that their legs feel heavy during their run by bringing their attention elsewhere. Conversely, a runner may become fixated only on how heavy their legs feel during their run. Both circumstances may make the run more difficult to get through. An athlete's responses to these negative private events (i.e., thoughts, feelings, and sensations that occur in one's own skin) can play a pivotal role in both immediate and long-term outcomes (Shortway et. al., 2018). However, Hanin (1980) argues there is no one ideal performance state and athletes can perform as desired regardless of any affective, cognitive, or physiological state. As a result, recent sports related research has emphasized acceptance and mindfulness-based practices to train athletes on how to effectively deal with negative private events rather than trying to control and avoid events as they arise (Worthen & Luiselli, 2016). Given the mental challenges runners face when performing, it may be helpful to further examine the effects mindfulness-based practices can have on runners.

Individuals experience some negative verbal behaviors because it is human instinct to produce these behaviors as a self-defense mechanism to aid in surviving (Harris, 2019). However, not all the private verbal behavior that occurs is the result of an actual dangerous situation, rather a situation that is just uncomfortable, much like the discomfort runners experience while competing. Runners often experience a continuous cycle of avoiding or escaping an uncomfortable thought by overtly responding to them (e.g., slowing down or

stopping their workout). These behaviors can consist of private verbal accounts of fatigue, boredom, pain, performance anxiety, and any other negative thoughts (Corbally et al., 2020). Hayes and colleagues, (1999) suggests that attempting to suppress negative or unwanted thoughts can actually have a paradoxical effect. During the process of suppression, an individual is actively monitoring for any unwanted thought or feeling, interfering with present moment attention on the task or targeted performance (Garner & Moore, 2004). Focusing on getting rid of negative thoughts or suppressing them may cause an increase in unwanted private events (Wegner et al., 1994). A variety of mindfulness-based approaches have been used to address the negative thoughts and feelings athletes experience with varying degrees of success.

A cognitive behavioral technique called psychological skills training has been used to target the enhancement of athlete's performances by targeting private events (Whelan, Mahoney, & Meyers, 1991). Psychological skills training procedures encourage the reduction of negative emotions and bodily states with a concurrent increase in positive emotions and confidence levels within athletes to attempt to achieve optimal athletic performance (Hardy et al., 1996). However, this approach has not been widely supported due to inconsistent performance results across studies (Corbally et al., 2020). In addition, a meta-analysis by Craft and colleagues (2003) found a weak relationship between competitive anxiety, self-confidence, and athletic performance. One technique from psychological skills training that has been successfully implemented in sports is the practice of mindfulness.

Gardner and Moore (2004) implemented a mindfulness-acceptance-commitment based approach on a 22-year-old male intercollegiate swimmer due to the inconsistency of his performances. Much like runners' experience, the swimmer engaged in self-evaluation and

judgment during competitive performances. The mindfulness-acceptance-commitment intervention focused on achieving the swimmer's goals, defusing private events that impacted behavioral choices, and refocusing the athlete's attention on task relevant cues and contingencies within the external world to enhance engagement, competitive performance, and enjoyment in the athlete. After the intervention, the athlete self-reported that he worried less, enjoyed the sport more, and athletic behaviors were more consistent with his personal values and goals he had set for himself for his athletic improvement. One limitation was that although the swimmer's standardized scores and self-reports of fused behavior had decreased, his competitive performances demonstrated minimal improvement. However, after four post-intervention sessions that focused on integrating mindfulness-acceptance-commitment skills into competitive performances instead of just practices, the athlete had his best competitive season to date.

A similar study targeted the effects of a Mindful Sport Performance Enhancement intervention on 25 recreational long-distance male and female runners ranging from 18 to 55 years of age (De Petrillo et al., 2009). The intervention consisted of 4 weekly sessions that ranged from 2 ½-3 hours long. During each session, there was a discussion of meditation and mindfulness followed by exercises to practice mindfulness, such as mindful breathing, yoga, and walking meditation. Participants were then told to rehearse the mindfulness aspects of the exercises during running performances. As a result, post-test scores demonstrated there was a significant decrease in self-reported sports-related anxiety, personal standards of perfectionism, and parental criticism, as well as major increases in awareness. However, after conducting a dependent *t* test on runners' best mile times, there were no significant performance changes noted within the runners. This could be because the workshop focused on mindfulness in daily life rather than specific performance related mindfulness issues an athlete may experience.

A one-year follow up study by Thompson and colleagues (2011) assessed the long-term impacts of the Mindful Sport Performance Enhancement intervention conducted by De Petrillo and colleagues (2009) on the 25 long-distance runners. Within 2 weeks of the end of the intervention, participants were sent the same questionnaires from De Petrillo and colleagues (2009). When analyzing results of the questionnaires from the long-distance runners included in the follow up was the primary focus for the present study. During the initial workshop conducted by De Petrillo and colleagues (2009), the best mile time reported was 7:36, which then decreased to 7:28 during the post-test. At the 12-month follow-up workshop, the best time reported was 6:54, demonstrating a 30s decrease for best mile from post-intervention to follow up. There were also significant increases in participants' overall mindfulness and ability to act with awareness as well as decreases in task related worries, task-irrelevant thoughts, and overall sport anxiety from post-workshop to follow up. One limitation is that researchers in both studies relied on self-reports of performance data. However, the follow up demonstrated that continued practice with mindfulness can have positive long-term effects on long-distance runners.

Corbally and colleagues (2020) conducted a literature review of randomized controlled trials of mindfulness interventions evaluating performance and performance-based factors on long-distance runners. Researchers found seven studies that met the inclusion criteria and concluded that much of the research that has been done is of low quality due to methodological weaknesses. However, the review provides tentative support for the use of mindfulness-based interventions as studies demonstrated improvements in mindfulness, reductions in performance anxiety, and small to moderate improvements in running performance. It is important to note that very few studies examined the enhancement of performances after mindfulness training, meaning they did not study the effects of generalization and maintenance of skills to running

performances. Given the limited success of previous mindfulness approaches, one treatment to address the negative private events of long-distance runners may be acceptance and commitment therapy (ACT).

ACT is a behavior analytic intervention that combines acceptance and mindfulness strategies with behavior change strategies to increase psychological flexibility (PF). PF is an individual's ability to attend to present moment experiences and behave in a value-guided manner (Stoddard & Afari, 2014). In other words, PF is the ability to reframe private events to support an individual's long-term goals and values. Doing so removes the rigid rule-governed behavior (e.g., psychological inflexibility) an individual may experience if something does not go as planned and may allow for more flexible solutions to problems. ACT encourages individuals to take value-guided actions, based upon one's personal values, to help an individual achieve a long-term goal (Harris, 2019). ACT teaches individuals PF through the six core components of ACT: present moment attention, defusion, acceptance, self-as-context, values, and committed action (Harris, 2009). ACT aims not to help individuals reduce or get rid of uncomfortable thoughts, but to teach individuals how to accept and become comfortable with the uncomfortable.

ACT is based on relational frame theory (RFT), a contextual theory of human cognition and language (Bach, et al., 2008). RFT suggests that there is a correlation between derived stimulus relations (i.e., a relation between two or more stimuli that is not not directly trained and not based on physical properties of the stimuli) and one's verbal behavior (Fletcher & Hayes, 2005). When enough experiences are reinforced across enough scenarios, individuals can derive relations across scenarios and stimuli because individuals have the tendency to associate one

stimulus event with the current stimulus event. This association, whether it is a negative thought or a predicted outcome, serves as reinforcement for the present private verbal behavior. Reinforcing the association creates the derived stimulus relation regardless of whether there is an actual relation or not. For example, during a workout a runner may have felt they could not keep their goal pace for the duration of the run, so they slowed down. Because the runner slowed down during one run when this sensation occurred, they are more likely to do it in a different workout when the feeling arises. RFT implies that an individual can create inaccurate associations through negative private verbal behavior.

Although there are several studies on mindfulness-based approaches for athletes, very few studies explicitly examine ACT in sports training. Lundgren and colleagues (2020) however, implemented a controlled group feasibility study with 21 elite male ice hockey players in their twenties to test the effectiveness of ACT on PF. Participants received four 30-40min ACT training sessions across 4 weeks to enhance hockey related PF. Training targeted enhancing acceptance, mindfulness, and values within the context of ice hockey through a presentation of skills, experiential exercises, and homework assignments in between sessions. To evaluate PF in the context of hockey, researchers created and administered the Values, Acceptance, and Mindfulness Scale (VAMS), an 11-question survey on a 7-point Likert scale (Lundgren et al., 2018). Previous research on the VAMS has shown that higher levels of PF regarding ice hockey related private events are associated with increased performance, such as number of goals and assists (Lundgren et al., 2018). This VAMS was administered pre- and post-intervention and results demonstrated significant improvement in scores for the ACT group and little to no change in scores for the control group. Additionally, all participants within the control group reported positive effects from receiving ACT and would recommend it to other hockey players. However,

a limitation of the study is that the impact of the ACT intervention on hockey performances was not measured. Future research should evaluate the direct impact ACT has on objective performance measures in addition to the indirect PF measures.

Mindfulness and acceptance-based behavioral interventions are becoming more popular within sports psychology (Shortway et al., 2018). To our knowledge, no ACT based interventions have been developed specifically to enhance the performance of runners. Therefore, the purpose of the current study was to evaluate the effects of an ACT intervention on long-distance runners' running performances and if the intervention had effects on their PF. More specifically, the current study addressed the following research questions: 1) What effect does an ACT intervention have on female high school cross country runner's pace times? and 2) What effect does an ACT intervention have on female high school cross country runner's self-reported PF scores?

Methods

Participants and Settings

To identify potential participants for the study, 13 white female high school cross country athletes who attended and competed at a Division 3, Class C level at a Midwestern high school completed consent forms prior to data collection. Athletes were selected for participation in the study if they met the following inclusion criteria: 1) inconsistently meeting or failing to meet pace times assigned by the coach; 2) low self-reported PF scores on the Acceptance and Action Questionnaire (AAQ; Bond et al., 2011) and 3) uploading baseline data on a weekly basis. All athletes who did not meet the inclusion criteria were excluded from the study. A total of three participants met the inclusion criteria and participated in the study. The three participants were varsity level cross country runners who spoke English as their primary language. Mary was a 10^{th} grader who had 10 years of running experience (i.e., participation in 5k races or part of an organized running team) prior to participating in the study. Ally was an 11^{th} grader who had 5 years of running experience and Olive was a 12^{th} grader with 6 years of running experience.

The setting for data collection varied, but always took place during participants' practices and high school cross country meets. Variations in the workout setting included running on the sidewalk or roads within the town, cross country racecourses, and the high school track. The setting was determined by the style of running the coaching staff decided for that day (i.e., tempo-run, interval- repeats, and distance runs) and if there was a cross country meet.

The three individual training sessions occurred one on one with the lead researcher and participant during times that did not interfere with practice, school, and extra-curricular activities. The first two ACT training sessions took place in a high school classroom with no one else present. The researcher and participant sat side by side at a large desk, looking at the same computer screen, which displayed the presentation for the training. For convenience, the last ACT training for each participant took place via Zoom, with both the participant and the researcher sitting at a desk in their own rooms.

Materials

A variety of materials were used to collect data. Participants were required to have a smartphone to access the Under Armour MapMyRun app, which was used to record run data during tempo runs, interval runs, and long-distance runs. Meet times were recorded using the official time clock used during the race. Mile splits for races were recorded by the coach of the participants using a stopwatch. Participants were also required to have a computer with internet access, a webcam, and access to Zoom to attend the one online training and upload data to a secure Microsoft OneDrive folder. A Qualtrics survey was used for participants to complete the AAQ at the conclusion of each run.

A variety of materials were used during ACT trainings including printed worksheets, pen/pencil, a soccer ball to practice defusion techniques, the Personal Value Card Sort created by Miller and colleagues (2011), and *The Big Book of ACT Metaphors: A Practitioner's Guide to Experiential Exercises and Metaphors in Acceptance and Commitment Therapy* (Stoddard & Afari, 2014). The lead researcher's computer was used to present each in person training using Microsoft PowerPoint™.

Design

A multiple baseline across participants design was used in the present study (Ledford & Gast, 2018). All participants started in baseline at the same time and the ACT intervention was implemented separately across participants. Once at least five data points were established during baseline for the first participant, she then received the intervention while the other participants remained in baseline. Following training for the first participant, participant 1 entered the post-intervention phase, participant 2 received the ACT intervention, and participant 3 remained in baseline. This pattern continued until all participants received the intervention and participated in post-intervention.

Dependent Variables and Data Collection

There were two dependent variables in this study: meeting goal pace times and the participant's self-reported PF after each run. Meeting goal pace times was defined as the number of splits during a given workout a participant was 5s above or below their assigned goal time. For the last split of a run, participants had to perform below the goal pace time or within 5 s of the pace goal time to encourage participants to decrease their overall race time. The expected pace goal times were assigned in advance by the coach and varied for each participant and each split depending on the type of run and each athlete's skill level. Skill level was determined by 1) times of splits during previous meets and runs; 2) conflicting injuries and illnesses; and 3) environmental conditions, such as the difficulty of the type of run, course conditions, and weather conditions. Splits varied in distance depending on the type of run. Splits for interval repeats were either a ¼ or ½ mi and all other runs Data for meeting goal pace times was collected across four different types of runs. The four types of runs included tempo-runs, interval repeats, long-distance runs, and 5k races. A tempo run was defined as a run that had a distance ranging from 3 to 4 mi with a pace that most related to a performance pace. Interval repeats were defined as runs with a pace faster than performance pace for shorter distances with breaks of 5 min or less in between each interval. Distance runs were defined as runs with distances ranging from 4 to 6 mi with a pace slower than performance pace. A 5k race was defined as any scheduled competition of 3.1 mi in the participants' season schedule. Scoring for meeting goal pace times occurred on a per opportunity basis where the number of goal times that were successfully met per split was divided by the total of splits for a given run and multiplying the sum by 100. For example, if a runner had a goal time of 7:00 min per mi on a 4 mi run, there were 4 total split times that could be successfully made. If the runner demonstrated a time of

6:57 for the first mi, 7:20 for the second mi, 6:30 for the third mi, and 6:45 the fourth mi, the participant successfully made two of the four splits (the first and the last split), demonstrating 50% success in meeting goal pace times.

The second dependent variable measured was the percentage of PF participants reported on the days meeting goal pace times data were collected. The AAQ was used to measure the PF of participants reported during performances and consisted of 7 questions on a 7-point rating scale. The questions on the AAQ were slightly revised, as in the PF in Sports Scale (Johles et. al., 2020) and the VAMS (Lundgren et al., 2018), to focus on participant's willingness to experience negative private events while running. The questions were revised as follows 1) My painful experiences and memories while running make it difficult for me to compete at a level that I value; 2) I'm afraid of the feelings I may experience during runs; 3) I worry about not being able to control my worries and feelings during runs; 4) Painful memories from runs get in the way of me having a fulfilling athletic experience; 5) Emotions regarding running cause problems in my performance; 6) It seems like other teammates are handling the sport and their performances better than I am; and 7) Thoughts I experience during runs, get in the way of my success. With a possible 49 points, higher scores indicated more psychological inflexibility within participants. This score was converted to the percentage of PF to monitor progress throughout the study on an increasing trend. To calculate PF, the sum of the AAQ was subtracted from the possible 49 points and divided by 49 to get a percent. For example, if a participant scored 42 on the AAQ, PF was found by subtracting 42 from 49, and then dividing that number, 7, by 49 to get the percentage of PF demonstrated, 14%.

Interobserver Agreement of Calculated Scores

Interobserver agreement (IOA) for calculated scores of meeting goal pace times and PF were assessed. A master's level graduate student was trained to calculate scores for meeting goal pace times by the lead researcher by reviewing the definition and criteria for meeting goal pace times. IOA was assessed for at least 30% of reported scores across participants and conditions. IOA for calculated scores of meeting goal pace times was calculated on a trial by trial basis for each split. IOA was calculated by adding the number of agreements divided by the number of total number of opportunities multiplied by 100 (Ledford & Gast, 2018). Results demonstrate 100% IOA of calculated scores for meeting pace times across all participants. IOA was also assessed for PF scores to ensure calculations of the interobserver matched the researcher's calculations. Results demonstrated IOA of calculated scores for PF across all participants were 100%

Procedures

Baseline

Prior to baseline, thirteen female athletes on the cross-country team completed assent and consent forms to be considered as potential participants in the study. Before data collection began, all athletes attended a training via Zoom where the researcher introduced Map My Run, an app by Under Armour used to track pace times. This training was 30 min in length and the researcher explained how to set up the app, begin a workout, and upload workout summaries to Microsoft OneDrive each week.

All athletes were given goal pace times that were assigned by the head coach prior to beginning each run. After each run, the athletes were instructed to fill out the AAQ based on that day's run. At the end of each week, the athletes were expected to upload screenshots of their

performance data to Microsoft OneDrive. Text reminders were sent periodically to athletes during baseline as a prompt to complete the AAQ and submit data in a timely manner. No other instructions or details regarding the purpose of the study were provided.

Intervention

All training sessions followed the same general format and lasted approximately 1 hr 30 min (see Table 1). First, a brief overview of the training concepts for the current session was provided. Then, the researcher reviewed all available data on the participant's running performances and PF scores with the participant. To review data with the participant, the researcher oriented the participant to the graph, explained what each graph measured, and explained how to interpret data on both graphs. The researcher then allowed an opportunity for the participant to ask questions before beginning the content for each training. The content for each training session varied based on the concepts being covered, but included an overview of each skill, definition, discussed benefit of skills in the context of running, and at least one activity (e.g., a video, worksheet, or exercise) to practice the skill. Participants were encouraged to ask questions throughout each training. The trainer also reminded the participant not to discuss any content in the training with teammates for the purpose of the study.

Table 1. ACT Training Procedure

Session	**Concepts**	**Definition**	**Exercises**
Induction	-Overview of ACT -Fusion -Psychological flexibility	Overview of ACT: to accept what one cannot control and commit to taking values-guided actions that enrich one's life.	- Review of 6 core components -Reflection of negative experiences while running

Table 1 (cont'd)

		Fusion: reacting to thoughts as if they are the absolute truth or as if they must receive an individual's sole attention.	-Pre-race habits exercise -RFT video (Garder, 2019)
		Inflexible thoughts: excessive expectations, control efforts, and experiential avoidance. Flexible thoughts: seeing thoughts for only thoughts, adapting to a situation as it comes, and accepting thoughts rather than making control efforts.	-Compare differences between flexible and inflexible thoughts - Being with all your experiences video (About Kids Health, 2019)
Hex The Mind	-Acceptance -Values -Defusion	Acceptance: Allowing negative thoughts to exist without trying to change them or get rid of them.	-Reflection on what common private events lead to control effort - The Struggle Switch video (Harris, 2015)
		Values: desired qualities of ongoing action and the importance of qualities.	-Values vs. Goals video (Harris, 2015) -Adjusted Bull's eye Worksheet (Harris, 2009)
		Defusion: removing how literal thoughts are perceived by separating thoughts from the physical self.	- How to Defeat Negative Thinking: An Animation (Carpenter, 2017) - Functions of fused thoughts activity - Kicking Soccer Balls defusion exercise (Stoddard & Afari, 2014) -Controlling Thoughts and Feelings video (Harris, 2008)

Table 1 (cont'd)

Flex What You Know (Remote Training)	-Present Moment -Observing Self -Committed Action	Present Moment: being psychologically present, continuously paying attention to here and now rather than attending to private events.	-Examples of moment-to-moment stimuli -The Power of Now: Psychological Time vs. Clock Time (Lavendaire, 2016) -Going along with the process (Stoddard & Afari, 2014)
		Observing Self: the elements of one's mind that are aware of whatever they are thinking, feeling, sensing, or doing at any moment.	-Accept vs Control scenario activity -Determine example and non-examples of problematic private events that need immediate attention vs acceptance. -5 min body scan meditation (Peloton)
		Committed action: achieving a meaningful experience by doing what it takes to live by personal core values.	-Race day routine -Goal setting worksheet (Harris, 2009) -Willingness and action plan worksheet (Harris, 2009)

Post-Intervention

Once the intervention was complete, weekly post-intervention sessions occurred via Zoom. These sessions were approximately 30 min and began with a general check where the researcher asked how the participant was doing practicing skills learned in training, if they had experienced any negative private events, and how that impacted them during performances. Then, the researcher reviewed performance data with the participant. Last, the researcher and

participant discussed the participants' goals and willingness and action plan, which was completed during the final ACT training. As a part of the willingness and action plan, participants identified observable goals related to running, potential negative private events they were willing to experience when trying to reach the goal, and ACT strategies they could utilize when negative private events arose. When discussing the action plan, the researcher reviewed the goals with the participant, worked with participants to adjust the goals if needed, and offered potential strategies to help accept and/or defuse negative private events.

Procedural Fidelity

Procedural fidelity measures were taken to ensure the intervention was implemented as described. Fidelity was assessed for 33% of ACT trainings. A task analysis with 17 steps was created to assess the extent to which each aspect of the intervention was implemented as described (Table 2). Procedural fidelity was calculated by dividing the number of observed behaviors by the number of planned behaviors and multiplied by 100 (Ledford & Gast, 2018). Results demonstrated 100% fidelity across all trainings.

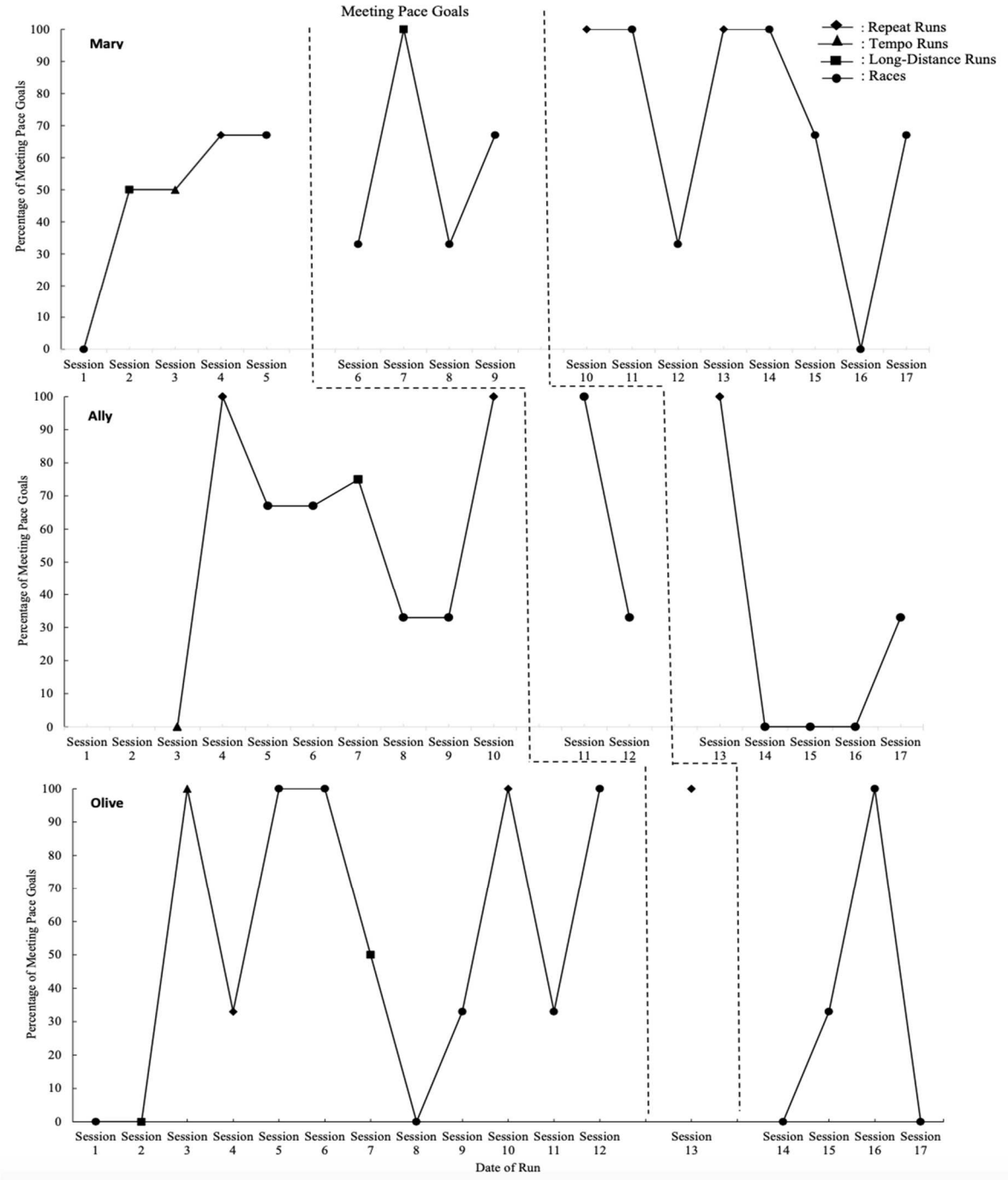
Table 2. Procedural Fidelity Datasheet

Steps	Task	Yes (Y) / No (N)/ Not Applicable (NA)
1.	Greeting	Y / N / NA
2.	Go over Data and discuss participant progress depicted in graph	Y / N / NA
3.	Address what components will be covered	Y / N / NA
4.	Introduce component(s) with definition (I.e., main components- psychological flexibility, values, acceptance, defusion, present moment attention, observing self, and committed action)	Y / N / NA
5.	Simplifies component definition for participant	Y / N / NA
6.	Provides example through a video, visual, metaphor and/or activity following component definition	Y / N / NA
7.	Trainer offers participant opportunity to ask questions	Y / N / NA
8.	Trainer encourages the participant to provide input/asks questions to individualize training component	Y / N / NA
9.	Repeat steps 3-7 through all components within training	Y / N / NA
10.	Participant completes activity trainer presents	Y / N / NA
11.	Trainer goes over completed activity with participant and provides participant opportunity to record activity content to refer to	Y / N / NA
12.	Trainer provides time options to schedule next training	Y / N / NA
13.	Trainer and Participant agree on time for next training	Y / N / NA
14.	Trainer reminds participant not to discuss training content with teammates still in baseline	Y / N / NA
15.	Trainer gives participant items to focus on until next training	Y / N / NA
16.	Trainer provides participant opportunity to ask questions before conclusion of training	Y / N / NA
17.	Trainer concludes training, asking participant how they feel and thanking them for being there	Y / N / NA
Total		**/17**

Results

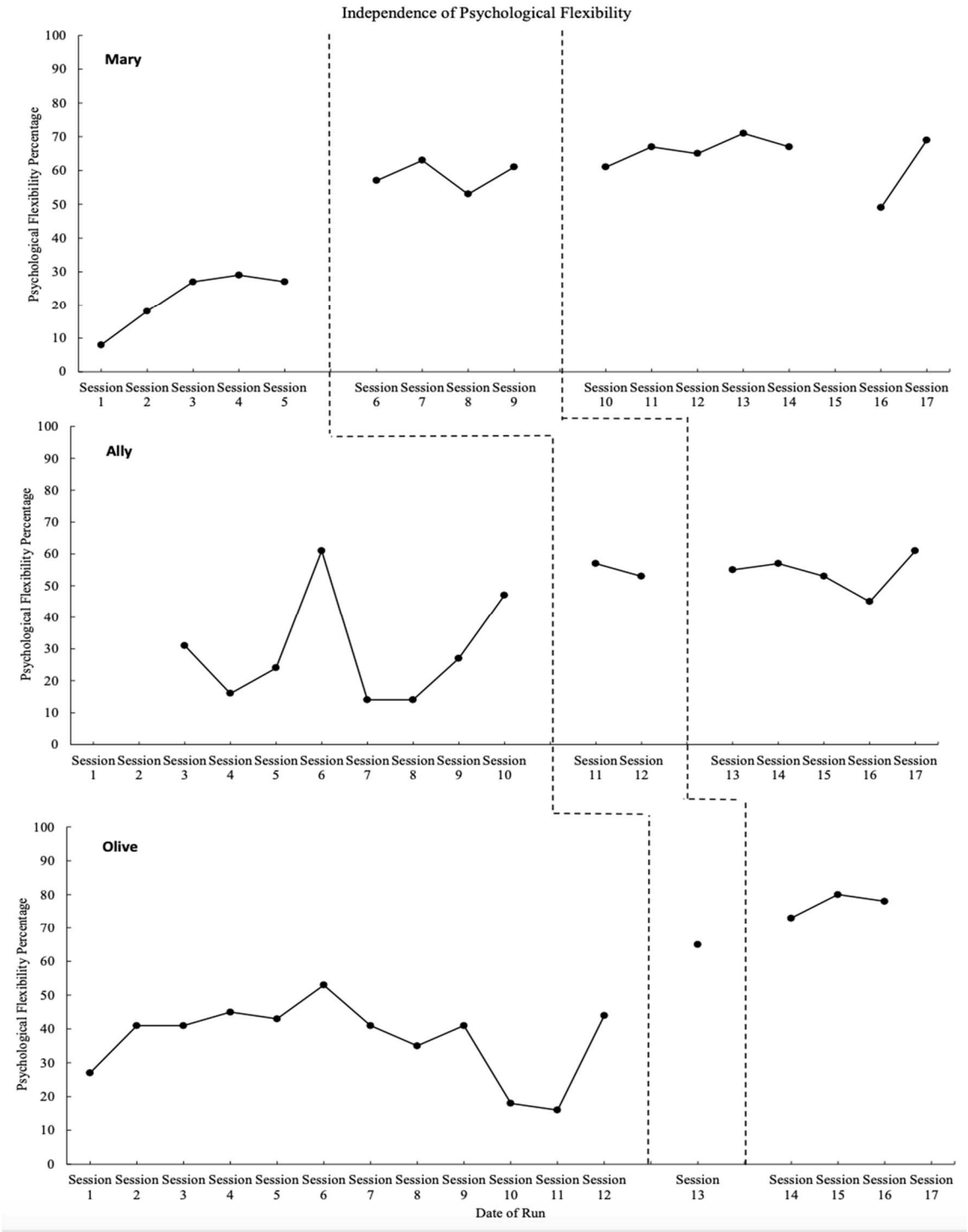
Results suggest there is not a functional relation between the ACT intervention and meeting goal pace times. Mary's mean for meeting goal pace times during baseline was 47% (range, 0 to 67%) and 71% (range, 0 to 100%) post-intervention. During intervention, Mary's mean for meeting goal pace times across four performances was 58% (range, 33 to 100%). Mary demonstrated a 24% mean increase in meeting goal pace times from baseline to post-intervention. Ally's mean for meeting goal pace times during baseline was 59% (range, 0 to 100%) and 27% (range, 0 to 100%) following the intervention. During the intervention, there were two 5k race performances, demonstrating a mean of 50% (range, 0 to 100%) meeting goal pace times. Ally demonstrated a 32% decrease in meeting goal pace times from baseline to post-intervention. Olive demonstrated a mean of 54% (range, 0 to 100%) for meeting goal pace times during baseline. Post-intervention, Olive's average for meeting goal pace times across four performances was 34% (range, 0 to 100%). Olive had one performance session during intervention where she demonstrated 100% meeting goal pace times. There was a 20% decrease in Olive's mean meeting goal pace times from baseline to post-intervention (Figure 1).

Figure 1. Dependent Variable Results: Meeting Goal Pace Times



Results for the second dependent variable indicate a functional relation between the ACT intervention and PF. Mary's mean PF during baseline was 22% (range, 8 to 29%), 59% during intervention, and 63% (range, 49 to 71%) in post-intervention, demonstrating a 41% percent increase from baseline to post-intervention. Ally's mean PF during baseline was 29% (range, 14 to 61%), 55% during intervention, and 54% (range, 45 to 61%) following intervention, demonstrating a 25% increase from baseline to post-intervention. Olive's mean PF during baseline was 37% (range, 16 to 53%), 100% in intervention, and 77% (range, 73 to 80%) following intervention, demonstrating a 40% increase from baseline to post-intervention (Figure 2).

Figure 2. Dependent Variable Results: Psychological Flexibility



Social Validity

Concluding completion of the intervention and the participants' cross-country season, all participants completed an anonymous social validity questionnaire using a 5-point Likert scale (Table 3). The head coach of the participants completed the same social validity questionnaire, which was adapted slightly so the coach could evaluate the student participants. All participants, including the coach, responded they agreed or strongly agreed to all seven questions within the questionnaire. There were three supplemental questions where participants could provide additional information regarding the enjoyment and benefit of the intervention, barriers, and suggestions for improvement. The primary barrier identified across all participants and the coach was the interest in additional intervention training and an extended duration between trainings to practice components discussed during intervention. The primary benefit noted was participants' opportunity to obtain specific skills to increase PF (e.g., defusion techniques, core values, and content within each training broadly). Furthermore, participants reported that training taught them how to interact with negative private events effectively, influencing overall well-being across contexts outside of cross-country.

Table 3. Social Validity Questions and Mean Scores for all Participants

Question	Mean Score
I enjoyed participating in this study	4.75
I was interested in the content and tools used in the study	4.75
I will continue using the mindfulness tools I learned to navigate difficult thoughts/feelings	4.75
I have increased my overall mindfulness and psychological flexibility from this study	4.75
Strategies from trainings played a role in bettering how I PREPARED for my performances	4.75

Table 3 (cont'd)

Strategies from trainings played a role in bettering how I PERFORMED for my performance	4.5
Strategies from trainings played a role in getting through difficult thoughts or feelings that arise during performances	4.5
I would recommend this study to others	5

Discussion

Results of the study demonstrate that the ACT intervention was effective at increasing participants' self-reported PF during running performances but was not effective for improving their ability to meet goal pace times. Across all participants, the mean increase of PF was 35% (range, 25% to 41%) from baseline to post-intervention, which suggests participants made progress toward their willingness to experience negative private events. The intervention did not appear to have an impact on participants' running performance, or more specifically, their ability to meet pace times assigned by the coach throughout their runs. Although there was no noticeable impact on their running performances, ACT based interventions may offer other overarching benefits that may contribute to sports enjoyment and lower stress and anxiety (Corbally et. al., 2020). The results of the present study are consistent with previous research evaluating PF in long distance runners. More specifically, previous research on mindfulness-based interventions for runners has shown improvements in self-reported measures of mindfulness, but limited improvements in running performance (Corbally et al., 2020). There are several potential reasons why the ACT intervention did not demonstrate an impact participants' ability to meet goal pace times.

Data were collected on four types of runs: tempo, distance, and interval repeats, all which occurred during practices, as well as cross country meets, which were races against other high school athletes. Across all participants and phases, there was the most variability in meeting goal pace times during races, meaning they frequently missed goal pace times assigned by the coach during meets. Participants may have had difficulty meeting pace times during races for several reasons. First, during practices, participants were encouraged to routinely check the running application to identify their current pace more frequently. However, during races they were

discouraged to routinely check their pace and instead, attend to the competitive environment. Second, a race environment consists of additional impeding variables outside of a runner's performance behavior, such as course environment, presences of competitors and observers, perceived importance of the performance, or "pressure" to perform by coaches, peers, or family members. With a multitude of variables to attend to and a history of not evaluating pace times during races, implementing mindfulness strategies recently learned while also attending to performance pace requires a higher response-effort from participants. Therefore, attending to current pace effectively in a race environment may have been challenging given the competing stimuli. Last, the primary type of run where data was collected during post-intervention happened to be race performances due to the increased frequency of races towards the end of the regular cross-country season. Therefore, there may have been limited opportunities for participants to practice learned mindfulness strategies in an environment with a lower competitive demand.

During races, participants may have engaged in experiential avoidance (i.e., slowing down pace in attempt to avoid or escape negative private events that arise while maintaining pace goals) to contact short-term reinforcement in the form of relief from the physical sensations of running. Although Tarbox (2020), stated that identifying core values during ACT can serve as rules that function as motivating operations, values alone are not strong enough to produce effective change on their own. This is because reinforcement (i.e., performing consistently with values) is too delayed and often results in access to negative short-term reinforcement (i.e., slowing down pace). For example, Ally demonstrated higher meeting goal pace times during races when her meeting goal pace times in the prior practice was high. These successful prior practices may have provided behavioral momentum that further reinforced the core values she

identified during intervention. Future research should consider identifying more immediate reinforcers to shape the magnitude and strength values may serve during race performances.

Another potential explanation for the limited impact of the intervention on running performances may have been due to time constraints. The intervention may have been more beneficial if time constraints allowed for training sessions to be implemented further apart, which could increase the opportunities to practice mindfulness skills learned in previous sessions. Jha et al., (2017) suggests an athlete's ability to engage in PF skills is correlated with the ability to maintain performance within high-demand environments. Participants are more likely to demonstrate lasting effects of PF when they have more opportunities to practice the skills for a longer duration of time before addressing performance goals and improvements in an arbitrary environment outside of ACT trainings (Lundgren et al., 2020). Future research may consider implementing the intervention during pre-season to increase the amount of time for participants to practice strategies and build skills in an environment that is less intrusive. Another potential solution to address time constraints would be to examine the potential benefits of group ACT training so more participants could access the training at once and participants could discuss their experiences together as a team.

A final explanation for performance goals not being consistently met could be due to the dependent variable used in the current study. Participants' performance pace goals were not consistently met throughout the study, suggesting the need for a more refined measurement system. Given that ACT considers individual values when setting goals, setting performance goals with participants that align with their identified values might be more socially valid and have a greater impact on performance. Behavior analysts are ethically required to take necessary steps to prioritize consumer benefits by involving individuals when selecting treatment goals

(Board, B. A. C., 2020). Furthermore, identifying individualized performance goals aims to maximize benefits specific to each participant. Rather than targeting overall improved performance, researchers may consider targeting other aspects of performance, such as participants' running technique and form across runs (e.g., length of stride, body posture, and facial expressions). Despite the limited effectiveness of the ACT intervention on participants' running performances, the present study contributes to the literature by measuring long distance runner's objective performances in addition to evaluating PF to further evaluate the effects negative private events may have on runner's overt performances.

Results of the study extend the literature on ACT based approaches for athletic performance, more specifically, high school female cross-country runners. The current study adjusted the AAQ-II questions to relate to running in order to evaluate the PF in the context of performances. The AAQ-II was used and adapted in this study because it is one of the most used measurements for PF. Other researchers have adapted and tested sports specific measures of PF, such as the VMAS (Lundgren et. al., 2018) for ice hockey or the PFSS (Johles et. al., 2020) for sports more generally. However, more research is needed to further evaluate whether sports specific flexibility measures are necessary and if so, how often they can be administered.

Individual differences in problematic private events may have contributed to the effectiveness of the ACT intervention on participants' self-reported PF scores. In addition individual differences related to various core components of the ACT model were noted across participants. For example, Mary described inflexibility defusing her negative verbal behavior to effectively attend to the present moment during her performances. During her third training, Mary reported she experienced an increase in negative private events (e.g., worrisome thoughts when performing faster or slower than the goal pace) when she attends to her current pace during

a performance and struggled to effectively defuse the thoughts and attend to her performance. Ally described a deficit in committed action as she reported her primary focus is on dance and academics. Throughout the intervention, Ally reported she enjoys cross country for the supportive relationships she has built with her team and stated she felt she serves the team best within a supportive role. Ally may have engaged in behavior incongruent with her pace goals at the onset of negative private events because the goals did not align with her identified core values. Intervention further focused on re-framing Ally's negative private events to better align with her values might be helpful (e.g., committing to her values of purpose and compassion to remain on pace for the greater good of the team). In addition, this highlights the importance of setting performance goals that are socially valid to the participant. Olive presented a deficit in component areas of accepting negative private events, present moment attending, and observing self. At the beginning of the intervention, Olive reported her attention was primarily on the success of her teammates and she often compared their success to her poor performances. Following intervention, Olive reported she was able to decrease comparison thoughts and other worries by increasing her present moment attention skills (e.g., body and environmental scans). It is suggested that when athletes learn how to identify and defuse private events to intentionally reframe their focus to attention and awareness context it may demonstrate improvements in performances previously negatively affected by avoidant performance behavior (Lundgren et al., 2018).

The present study provides further evidence towards the social validity of implementing ACT interventions with high school athletes. Research on social validity has previously been limited regarding the exposure of high school athletes to mindfulness interventions (Baltzel et. al., 2014); however, all participants in the present study reported overall benefits to learning

mindfulness strategies. Data from the social validity survey completed by participants after the study revealed that ACT helped their personal running goals appear more attainable. In addition, it was reported that the strategies they learned were also helpful with negative private events experienced in everyday life (e.g., school, band, relationships). One participant, who disclosed she struggled with anxiety, wrote ACT was "extremely helpful" in allowing her to understand how to properly understand and approach negative private events she experiences. All participants reported that ACT sessions were beneficial and suggested spending more time practicing strategies before introducing additional components. Research continues to demonstrate that when athletes learn mindfulness skills in sports contexts, it can be helpful in coping with negative private events across environments (Lundgren et. al., 2020).

There are several limitations to the current study. The main limitation was a lack of inter-observer agreement (IOA) data collection between researchers for the dependent variables. This means there is no available data to support whether the data collection methods for meeting goal pace times were reliable. Researchers did not collect IOA for reported performance paces due to several reasons. First, participants tracked performances using Under Armour's Map My Run app or the official meet clocks. Given the general reliability and accuracy of GPS based applications, the researchers decided the app would be efficient and effective for the study since it would also be difficult for the coach to record all split times, which could also impact reliability of data. Since participants were not able to carry their phone during official cross country meets, the official time clock was used to track performances during races out of convivence. Future research should consider using multiple observers and using more reliable and accurate forms of data collection.

Another limitation was the approach used to setting goal pace times for participants throughout the course of the study. The head coach was responsible for setting goal pace times for participants because she was most familiar with the participants. However, the coach did not regularly adjust and individualize goal pace times, meaning the goal times may not have aligned with the pace participants could perform on a given day. In the future, researchers should use clear guidelines or criteria for setting and adjusting goal pace times. Another limitation related to goal setting was that the coach and researcher initially used different definitions for meeting goal pace times during baseline. During baseline, researchers used the definition of meeting the pace time at or up to 3 s faster than the goal for meeting goal pace times as a more conservative measure. However, the researcher became aware during intervention that the coach had been using her own definition of above or below 5 s of the goal time. Although this limitation did not impact implementation of the intervention, it did impact initial trend lines for participants during baseline and impacted the order in which participants received the intervention. These limitations further highlight the need for a more clear, complete, concise, and objective dependent variable for measurement.

In conclusion, the present study suggests the implementation of an ACT intervention for long-distance high school runners is a socially valid approach to helping participants navigate negative private events. The ACT Intervention was not effective for improving the performance of participants but was effective in improving self-reported PF scores across participants. It is also suggested that individualizing performance variables specific to participant deficit areas could demonstrate a greater impact of the ACT intervention on sports performances.

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