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Fast talkers? Investigating the influence of self-talk on mental toughness and finish times in 800-meter runners

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ABSTRACT

The purpose of this study was to explore whether a personalized self-talk intervention influenced mental toughness, rating of perceived exertion, sense of the urge to slow down, perceived performance and finish times in a series of 800-meter run time trials. While mental toughness has been associated with improved endurance performance, the effect of changing an individual's momentary self-talk on mental toughness and finish time has not yet been examined. This single-subject, multiple baseline design case study incorporated three participants who each ran a series of 11 – 13 maximum effort 800-meter time trials on the track, separated by a minimum of two days, across ten weeks. Following an initial series of four to six baseline sessions, they were each then provided a personalized self-talk intervention before running the seven additional sessions. Visual analysis (including review of non-overlapping data points between baseline, intervention, and follow-up sessions) demonstrated the personalized self-talk intervention positively influenced mental toughness and finish times across all three participants but did not consistently affect the rating of perceived exertion, urge to slow down or perceived performance. Additional insights were identified through the integration of social validation interviews informally after each run session and then formally after the intervention. These insights included identifying a new baseline of effort accompanied by different levels of mental toughness and an intrigue on the part of participants about the notable improvement in outcomes in spite of previously perceived "all-out" effort.

Lay Summary: Mental toughness variability and 800 meter finish times were both positively influenced by a personalized self-talk intervention in runners. In addition, as mental toughness increased, 800 meter finish times improved.

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There has been significant interest in developing cognitive and behavioral strategies to improve athletic performance, given the relatively small physical and skill-based differences in athletes at the elite level (Tracey & Elcombe, 2016). For example, these same authors note that mental toughness has been "regularly cited within and, importantly, beyond the literature as the key set of attributes for optimizing performance" (p. 1002). Interest in the concept of mental toughness within the scientific community has

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expanded significantly over the past decade. A Web of Science search on July 27, 2019, using "Mental Toughness" as the topic search criteria revealed just 25 total articles in publication on the subject before 2006. From 2006–2015, the number of articles increased to 189 and since 2016, an additional 246 articles have been published. Recent narrative (Cowden, 2017) and systematic (Liew et al., 2019) literature reviews and meta-studies (Anthony et al., 2016) have provided summary insights about the relationship between mental toughness and improved outcomes, but identify limitations based on inconsistent definitions and measurement, and a reliance on cross-sectional research methodologies. The current study sought to address some of these limitations, particularly with respect to the need for longitudinal intervention designs to examine causality rather than correlation.

The construct of mental toughness has been defined as a "psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits" (Gucciardi, 2017, p. 18). In endurance events, athletes experience significant adversities and stressors because of the physiologically demanding nature of the event. When running at intensities approaching one's physical VO_2max in training and competition, athletes benefit from having personal resources allowing them to maintain effort, technique, and motivation in the presence of noxious stimuli (e.g., discomfort, fatigue, perceived effort). Previous research has revealed that mental toughness is associated with such behavioral perseverance (Gucciardi et al., 2014) and endurance performance (Blanchfield et al., 2014) and is adopted long-term by ultra-marathon study participants (McCormick et al., 2017).

However, if interventions are to be developed, it is important that intra-individual variations in mental toughness can be identified. A series of complementary studies (Cooper et al., 2018, 2019a, 2019b) specifically addressed this existing gap in the literature. The authors of these studies initially identified the presence of mental toughness variability and then investigated potential optimizers of that variability. Cooper et al. (2018) revealed that perceived mental toughness varied during a series of high-level endurance events and importantly, that perceived mental toughness could be increased by self-talk. Cooper et al., 2019a revealed that Masters Athletes also used self-talk to optimize their performance and to positively influence their perceived mental toughness (i.e., the belief that they could achieve their goals, control attention, control emotions). Finally, Cooper et al. (2019b) revealed that athletes used self-talk as a method to offset the deleterious effects of experimentally manipulated sleep restriction. Specifically, some of the participants in Cooper et al. (2019b) study reported that when sleep-restricted they would use functional self-talk to redress the emotional disturbances caused by reduced sleep and to motivate themselves during periods of sleep-related motivational loss.

The emergence of self-talk as a potential optimizer of mental toughness from these studies makes it a prime candidate for an explicit intervention strategy. Self-talk has been defined by Hardy (2006) as "(a) verbalizations or statements addressed to the self; (b) multidimensional in nature; (c) having interpretive elements associated with the content of statements employed; (d) being somewhat dynamic; and (e) serving at least two functions; instructional and motivational" (p. 84). Self-talk has been shown to be "malleable to perceptions and interpretations of stimuli from the social environment" (Zourbanos et al., 2010, p. 782) and as such, two types of self-talk; organic and strategic

have been noted (Latinjak, Hatzigeorgiadis, et al., 2019). Extensive research has revealed an association between self-talk and performance, as well as other related variables including cognitive, motivational and behavioral mechanisms (Van Raalte et al., 2016). However, the effect of self-talk on mental toughness is less well understood (Bell et al., 2013; Cooper et al., 2019a).

Our aim was therefore to examine whether a strategic self-talk intervention (via personalized cue words or phrases) could improve mental toughness and running performance. We were also interested in examining whether the intervention influenced related variables such as the urge to stop, perceived exertion, and perceived performance. We opted to use a personalized approach rather than a group-based approach, because the meaning associated with a specific self-talk strategy is idiosyncratic (Hardy, 2006) and prior systematic reviews of strategic self-talk (Hatzigeorgiadis et al., 2011) have called for research designs to be targeted to the end user. In line with the personalized nature of the intervention, we also chose to measure intervention effects using a single subject multiple baselines research methodology. Not only do n-of-1 research designs enable the exploration of individual changes that can sometimes be hidden in group-based designs (Vieira et al., 2017), they have been used previously in the self-talk literature (Latinjak, Hernando-Gimeno, et al., 2019; Latinjak, et al., 2016) with social validation interviews (e.g., Jones et al., 2011) utilized to check the acceptability of and satisfaction of intervention procedures.

We hypothesized that a personalized strategic self-talk strategy would positively influence mental toughness as measured by the Mental Toughness Index (Gucciardi et al., 2015) and performance in an 800 meter run by participants as measured by finish time. Further, we also hypothesized that the strategic self-talk intervention would extend the time it takes for the athlete to feel the urge to slow down and reduce the rate of perceived exertion relative to average speed.

Methods

Research approach

Following ethical approval from the authors' institutional research ethics committee, participants were recruited through convenience sampling. This study adopted a multiple baseline single subject sample design with three experienced female Masters athletes. We chose to sample female Masters athletes because they are an under-researched population in the literature (Costello, Bieuzen, & Bleakley, 2014). The n-of-1 study allows hypotheses to be tested within individuals across repeated measurements to examine the influence of the variable over a specific timeframe (McDonald et al., 2017). This design ideally incorporates a baseline phase long enough to demonstrate a clear pattern of outcome values in order to clarify the differences between baseline and intervention (Hedges et al., 2012). It is a type of research for which a sample size of between one (Horner et al., 2005; Hrycaiko & Martin, 1996) and five (Jones et al., 2011) participants is standard. In the seminal text on the topic, Barlow and Hersen (1984) compared and contrasted the benefits of single-case replications to alternative research designs; "In terms of validity or generality of findings, a series of single-case designs in similar clients in which the experiment is directly replicated three or four times can far surpass the experimental group/no treatment control group design" (p. 57).

Participants

Three female athletes volunteered for the study. All three met the screening criteria of current run training of three or more days per week; absence of any injury that limited running for over one week in the past three months; and being over the age of 18 years. Furthermore, each participant was asked to consider whether she had availability and willingness to meet the lead researcher at a specific running track 11–13 times over a specific ten-week period. The three participants were P1 – a 43-year-old experienced Ironman triathlete, P2 – a 35-year-old All-American triathlete and P3 – a 40-year-old experienced high school track coach and trail runner.

Measures

Mental toughness was assessed following each session using the Mental Toughness Index (MTI: Gucciardi et al., 2015), an eight-item, uni-dimensional measure. This assessment uses the sum of items from a 7-point Likert scale ranging from 1 (*False, 100% of the time*) to 7 (*True, 100% of the time*). We adjusted the wording of the original eight items to fit the context of this setting without affecting the outcome of the assessment. As an example, question one of the MTI reads, "I believe in my ability to achieve my goals." This item was adjusted to read, "I believe in my ability to achieve my goals throughout the 800 meters." This adjustment was pre-reviewed with the developer of the study and was consistent with adjustments made in Study IV of Gucciardi, et al, 2015. Previous studies examining the internal reliability of the MTI demonstrated both a high Cronbach's α (0.90) and composite reliability (0.90) levels (Jones & Parker, 2018).

Perceived effort levels were collected using the 6–20 point Borg Rating of Perceived Exertion scale (Borg, 1982) following individual training of each participant in the use of the tool. Perceived quality of the performance was documented by participants following similar training by marking on a 100 mm visual analog scale (VAS) ranging from "*Worst Imaginable Performance*" to "*Best Imaginable Performance*." Participants also received training on the use of the Sportcount 200 Lap Counter and Timer (finger click stopwatch), used to aid in the identification of when they first felt the urge to slow down. Finish times and 200-meter lap splits (available in the Supplementary table) were collected for each session using an iPhone digital stopwatch application, with faster times (fewer total seconds, as shown in Figure 5) demonstrating improvement.

Procedure

Participants individually met the lead researcher at a local 400-meter track between 6:30 and 7:30 AM on 11–13 different times over ten weeks, with each session being separated by a minimum of two days. Scheduling was arranged so participants would not overlap with each another, and they were instructed to maintain a consistent morning routine leading into each session (including pre-run fuel, caffeine intake, activity levels, and pre-session warm-up). Participants initially completed four (P1), five (P2) or six (P3) baseline 800-meter runs, for which they were instructed to complete the distance as fast as they could run, prior to completing four intervention and three follow-up

800-meter runs. The multiple baseline design staggered the number of baseline sessions completed by each participant to make it easier to attribute any change identified to the intervention itself, rather than the number of sessions (Rhoda et al., 2011). This method compared positively to previous run intervention studies (Yamamoto et al., 2008) that often include a single session or no baseline performance for comparison.

During each trial, participants pressed the finger click stopwatch to indicate when they first felt the urge to slow down. Following the 800-meter run, the participant would complete the MTI, RPE, and VAS. The first author then walked the track with the participant while she cooled down and discussed the run. Open-ended questions from the researcher focused on patterns of thoughts, feelings, and organic self-talk and other insights on the part of the participant regarding her run performance. These informal qualitative interviews lasted between 5–10 minutes and were included for the purpose of garnering insights from participants as they were experiencing it (Adhabi & Anozie, 2017). They were not audio-recorded but lasted between 5–10 minutes, and any notable highlights were immediately recorded by the first author on the spreadsheet related to that specific day's data, as the participant was leaving the track. These data were then used to prompt questions in the formal social validity interviews and to reveal participants' qualitative experiences of completing the run (and intervention).

Intervention

No instruction or coaching took place during the baseline sessions. Following the completion of the baseline sessions, participants were provided with a personalized strategic self-talk strategy to be utilized during the intervention run sessions. Initially, each athlete was provided with a series of self-talk cue words to utilize during the first intervention session. The wording for the initial intervention session was developed through a combination of an 18-month pilot study conducted by the first author on himself (an elite Masters athlete) and feedback provided by participants during the discussions that followed their baseline sessions. These were then replaced or modified further over the ensuing intervention sessions to create personalized verbal cues, based on participant feedback regarding perceived effectiveness.

The intervention drew on both instructional and motivational cue words (Hardy et al., 2001) and was based on positive reappraisal of negative emotions (Lane et al., 2017), approach for orientation motivation (Elliot & Harackiewicz, 1996) and acceptance of noxious stimuli or pain (Jones & Parker, 2018). The self-talk cue words were then modified differently for each individual participant based on feedback garnered from participants during the brief discussions that followed the intervention 800 meter runs to combat the athletes' competing thoughts. For example, P1 used "Smooth & Fast", "There you are!", "You got this" and (Countdown and) "Launch!" in the initial intervention. Her final intervention involved a similar but adjusted series of cue words and phrases: "Smooth & Fast", "Embrace", You got this!", Counting down and "You're there – launch!" The amended scripts of the specific self-talk cues are provided in Supplementary data.

As with the baseline and intervention sessions, the final three sessions (follow-up) were also performed in the presence of the lead researcher to track the run splits, final

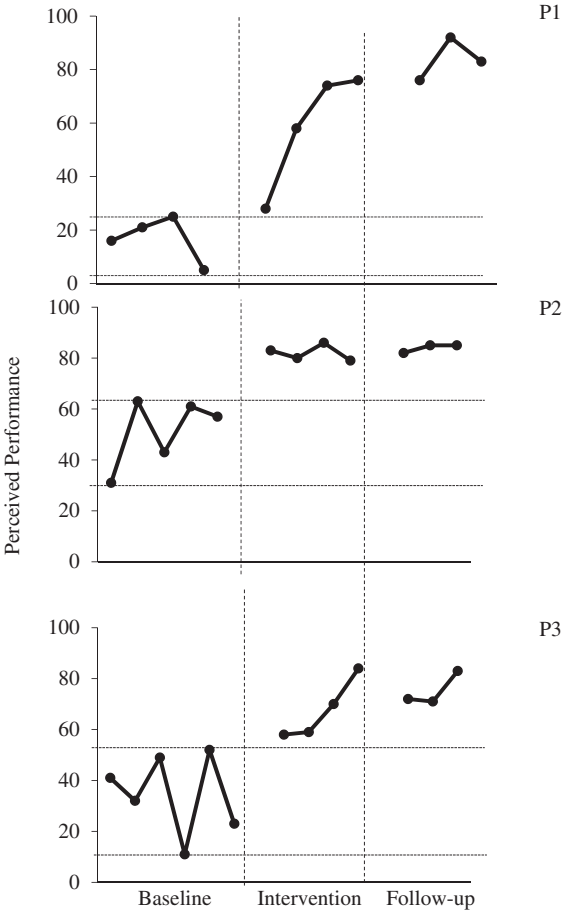

Figure 1. Perceived Performance rating by participants in baseline, intervention, and follow-up sessions. Horizontal lines represent Minimal Meaningful Benefit and Harm, indicating the highest and lowest perceived performance during baseline for each participant.

finish time, and collect the assessments. While the lead researcher worked with each athlete to make personalized adjustments to the specific self-talk strategy leading into each intervention session, the athletes received no additional guidance or instruction prior to or during the follow-up sessions (to replicate the baseline sessions). Athletes were simply instructed to utilize anything they had previously learned as a participant in the study.

Data analysis plan

A visual analysis procedure incorporating a review of level, trend, and variability at baseline and intervention (Horner et al., 2005) was utilized to determine the occurrence of an effect regarding perceived performance, strong urge to slow, rating of perceived exertion, mental toughness and finish times (Figures 1–5). Also, we identified criteria for a meaningful minimal benefit (MMB) and harm (MMH; Stoové & Andersen, 2003) by identifying the absolute highest and lowest outcome variable during the individual

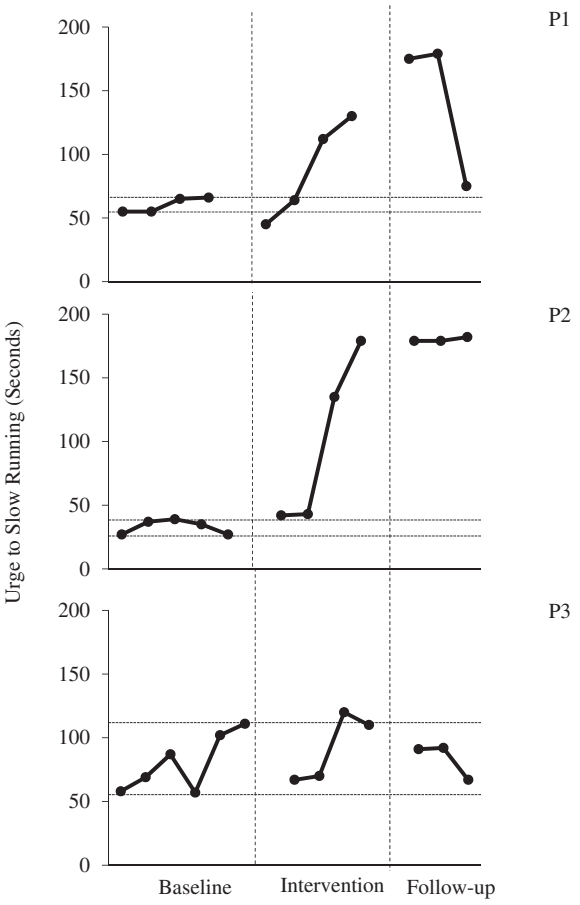

Figure 2. Recognition of initial onset of the urge to slow down in baseline, intervention, and follow-up sessions. Horizontal lines represent Minimal Meaningful Benefit and Harm, indicating the earliest and latest onset of urge during baseline for each participant.

athlete's baseline sessions. The determination of this MMB and MMH is beneficial in interpreting the data and helping ensure the intervention is unlikely to cause harm and more likely to provide a meaningful benefit to the individual (Stoové & Andersen, 2003). We also calculated a Standard Mean Difference (SMD) for each of the measured items, which has been recommended as a method for detecting the effect of interventions (Olive & Smith, 2005). SMD is calculated by subtracting the mean baseline from the mean intervention and then dividing by the standard deviation of the baseline. An SMD of 0.1 would represent a small effect size, while an SMD of 0.51 or higher would represent a large intervention effect.

Social validity interviews

Based on the recommendations of Wolf (1978), we conducted formal social validity interviews within three weeks of the last follow-up 800-meter run session to garner additional insights from participants. Social validation interviews are recognized as an effective way

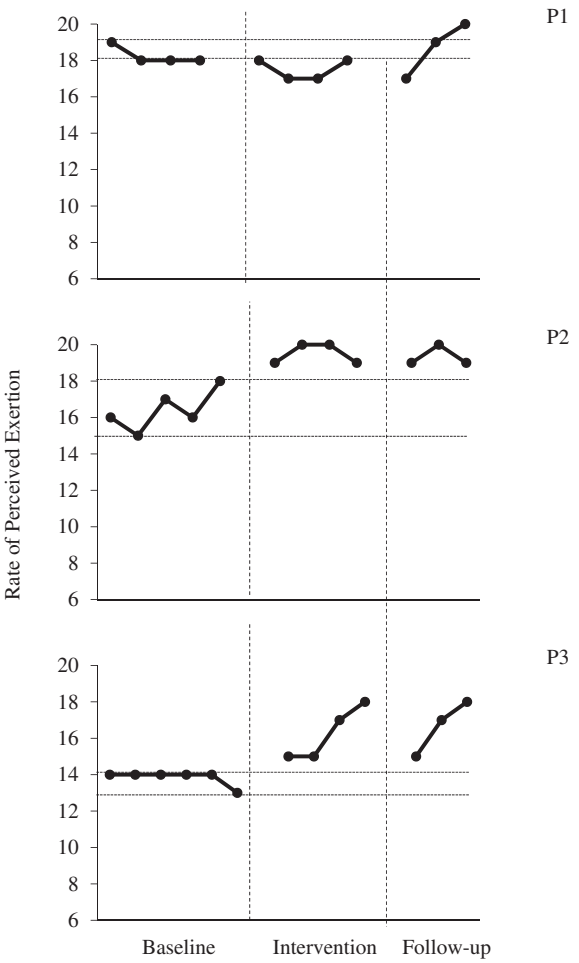

Figure 3. Rating of Perceived Exertion (RPE) by participants during baseline, intervention, and follow-up sessions. Horizontal lines represent Minimal Meaningful Benefit and Harm, indicating the highest and lowest RPE during baseline for each participant.

to further substantiate behavioral research outcomes (Wolf, 1978), and have been used to provide valuable feedback about the practical application and experience of a psychological intervention (e.g., Jones et al., 2011). These interviews lasted an average of 55 minutes in length with a range of 47–65 minutes and were recorded, transcribed, and analyzed. The interviews were also supplemented with written (by the first author) brief individual post-session feedback notes. Wolf offered a three-part framework for validating the social importance of interventions that comprised goals, procedures, and effects. To address the dimensions of social validity questions included a combination of prepared items (e.g., "How did self-talk influence your mental toughness?" or "What did you learn about yourself as a participant in this study?") and free-flowing questions related to various participant responses to previous questions (interview transcription provided as Supplemental file). We analyzed the social validation data using a thematic analysis (Braun & Clarke, 2006) of each participant's experience. Therefore, the results are not presented as group level themes or patterns, but rather the themes that reflected how

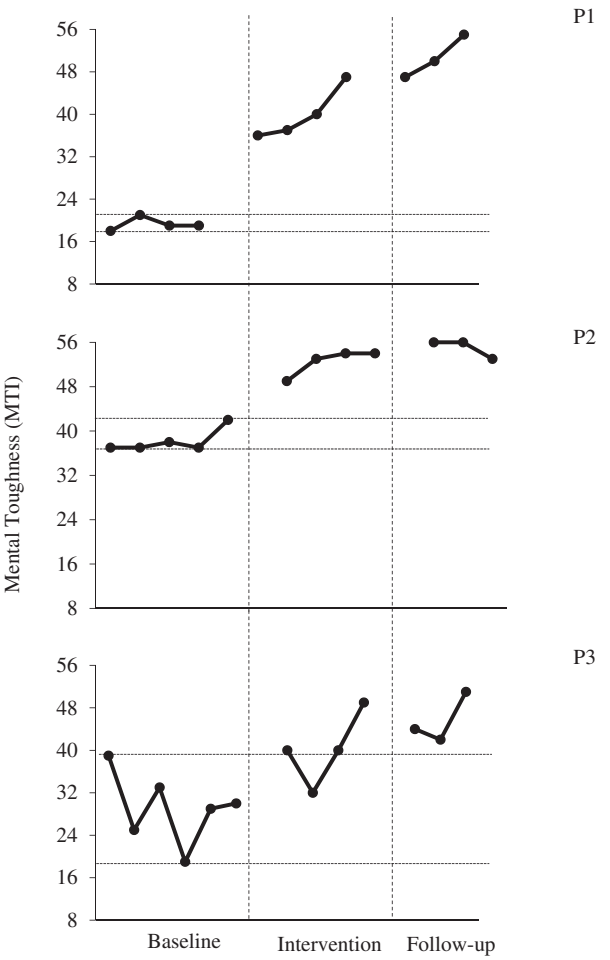

Figure 4. Mental Toughness Index (MTI) scores provided by participants during baseline, intervention, and follow-up sessions. Horizontal lines represent Minimal Meaningful Benefit and Harm, indicating the highest and lowest RPE during baseline for each participant.

each participant experienced the intervention in terms of the goals, procedures, and effects. The thematic analysis involved the searching across a participant's data to find repeated meaning that helped to illuminate the social validity of the intervention. Transcripts were analyzed for these repeated patterns, and insights related to the data collected for each athlete were highlighted and integrated into the summary of results.

Results

Individual participant results related to finishing time, mental toughness, perceived performance, rating of perceived exertion, and urge to slow are provided visually in Figures 1–5. We have also included the data and SMD analysis in Tables 1 and 2 within the Supplementary Materials. SMD of MTI data were 16.7, 6.6 and 1.6, and finish times were 4.5, 5.8, and 3.7, for P1, P2 and P3 respectively – all well above the 0.51 cutoff for intervention effectiveness.

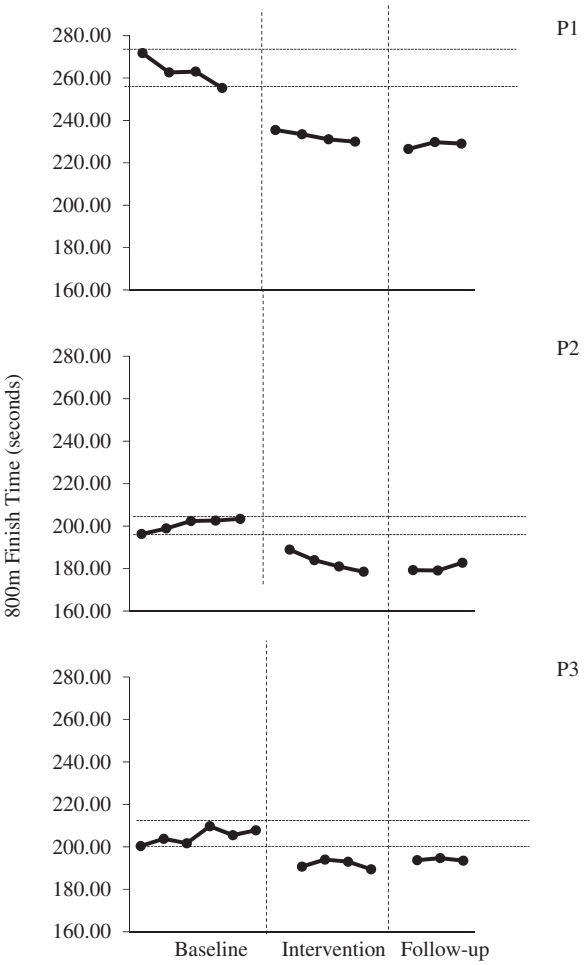

Figure 5. Finish time in seconds (less time indicates improved time) by participants in baseline, intervention, and follow-up sessions. Horizontal lines represent Minimal Meaningful Benefit and Harm, indicating the slowest and fastest finish times during baseline for each participant.

Participant results and insights of note

Participant one (P1)

This participant demonstrated an immediate learning curve improvement from her first baseline run of 9 seconds (3.3%) and then improved an additional 7 seconds (2.6%) over the last three baseline sessions. MTI, RPE, urge to slow, and perceived performance were generally constant throughout the baseline sessions. Upon initiation of the self-talk intervention, her MTI more than doubled from an average of 19 at baseline to 40 during intervention and 51 during follow-up. Her finish times also demonstrated a significant improvement, as she trimmed an additional 25 seconds (9.8%) from her best baseline session and 33 seconds (12.5%) off her baseline average. Perceived performance improved, and the timing of her urge to slow were extended with the intervention.

Interestingly, while she was running significantly faster than her baseline, her RPE remained similar to her baseline during the intervention and follow-up. She shared some of her thoughts on this occurrence as:

> I learned that there are many different levels of mental toughness. There are so many tools that we don't even know exist until they're given to us and the human body is capable of so much more than we think it is.

When comparing her eventual improvement to her baseline times, she expanded her thoughts:

> There's just a lot to take from knowing that you're basically relying on (an assumption that) 'oh well – that's my baseline – I can't go up and above what I've always done. What was it you said (when we discussed self-talk strategies after the conclusion of the study) about breaking the algorithm? That we remember what we've done before and think 'I can't do better than that.' But you can do better than that. Break the algorithm. Just because that's how you've performed in the past doesn't dictate your future. Use these tools that you've been given and look at what you're capable of. Wow – that's amazing!

Perhaps most interesting with this participant was her RPE rating (Figure 3). During her baseline sessions, she rated every session as an 18 or 19 on the 20-point RPE scale. However, when she made significant improvements in her time and mental toughness levels during the intervention and follow-up sessions, her average RPE remained the same (18 average). She shared her thoughts on what was occurring as:

> The first four – as hard as I thought I was pushing myself, looking back obviously they were more on the 'easier' scale. But on each of those specific days, I felt like I was pushing myself as hard as I could. So it really blew my mind that I was then able to go 30 seconds faster throughout those middle three or four (intervention sessions).

In terms of her thoughts about the influence of the self-talk, she noted:

> The mental can overcome the physical… the physical can cause the mental to struggle and vice-versa. Having those different things (self-talk items) to focus on throughout the 800 and to perform based on those cues was very helpful. Otherwise I'm just running. I think (I had more mental toughness) because of the focus that was now enabled. You are giving me something to focus on and that, in turn, pushed that scale higher and higher because when you have tools in your toolbox to reach those goals, they feel more attainable.

Participant two (P2)

The second participant completed five baseline all-out 800-meter time trial runs before moving into the intervention sessions. P2 was the fastest of our three participants, eventually running 2:58.5 during the intervention portion. However, despite her experience and emphasis on short course racing, she showed a significant improvement in both mental toughness and finish time with the self-talk intervention. Her average MTI increased by 14 (37%) from average baseline to average intervention while her run times dropped a notable 18 seconds (9.2%) from her best baseline to her best intervention. RPE did increase with the intervention, and her urge to slow was extended with the intervention. In reference to why she thought her mental toughness improved (and the urge to stop was pushed back) with the self-talk, she noted:

> Having more focus on that self-talk helped quiet down the little voices that the body might have had with the little aches and pains. Your head can wander in the wrong direction, but with mental toughness, you regain control, you steer your head in the right direction.

Before the self-talk intervention, P2 stated she was running all-out but rating her RPE between 15 and 18 (Figure 3). Once the intervention started, her RPE was consistently rated 19–20, and she was running significantly faster. When discussing this, P2 explained:

> I think on the baselines, it's just not realizing how much harder I truly could go. So looking back, yes – I would probably scale those (baseline RPEs) back. At the time that I was doing the baselines I didn't really know that I had more. Clearly, it proved I had more in me. I proved that digging deep – there's room to dig deeper. Reflecting on it, I'm in awe! I'm … wow! Maybe (it's) like a positive feedback loop – knowing that I could, I had more in me or was pushing that boundary. So then, ok – can we do it again? Can we do it a little faster? Can we do a little more?

Participant three (P3)

Our third participant ran her best baseline time during session one (Figure 5). Then, as with the other participants, she demonstrated a dramatic improvement upon initiation of the self-talk intervention, lowering her finish time by over 17 seconds (8%) between her last baseline and first intervention session. Also, while her six baseline sessions had a range of 9 seconds from fastest to slowest, her seven intervention and follow-up sessions were all within 5 seconds of one another. Her average level of mental toughness (Figure 4) correlated closely with this pattern, increasing by 38% from baseline to intervention. Her perceived performance improved, and her urge to slow and RPE increased nominally with the intervention. When reflecting on these various elements, her thoughts about what affected her change in mental toughness included:

> That was huge to show that much improvement because I had really thought I was running at an all-out effort in those six (baseline) 800s. The (self-talk) gave me mental purpose, mental focus. I was no longer just running kind of mindless – I now had focus and purpose. As your mind starts to wander, you start to feel that pain. You just naturally start to slow down and you start that negativity. (This) gets you some focus – some positive focus. It (self-talk) would push them (negative thoughts) aside or kind of dampen them because they were still there – I could still feel them but it just felt like whatever it was in my head (mental toughness) was stronger and taking the focus more than what I was feeling physically. My mental toughness is there [pause] the motivation to use it has to be there in order for it to really work effectively. Otherwise, I was just pulling bits and pieces of mental strength to kind of 'get through' the 800.

She went on to note:

> My intention is always there, but maybe my effort's not. My effort is not always where my intentions are. Realizing that my perception is off on my physical effort that I'm putting into what I'm doing – that I could probably be stronger and be faster than I think I am – maybe I'm holding myself back somehow. The easy choice is to just cruise because you don't have all the extra thoughts or decisions you have to make. It's the comfortable choice – the comfortable path. It (mental toughness) allowed me to push those boundaries just a little bit – to get out of my comfort zone – to get out of my safe zone and allowed me to have some confidence to go outside that comfort zone a little bit and to trust that I would be ok.

She also thought she had several insights about her approach as a high school track coach:

> When I coach, it's 'no crutches' – right? We always talk about no crutches. It is what it is. This is the moment you either take it or you don't. Then in actuality (as she personally experienced it), it's eye opening. It's easier said than done – it's helping me to unpackage those pieces and kind of repackage it in a way that works for them (kids being coached). That mental piece … after having done this study, you realize it's huge – it's huge!

Specific to social validity of self-talk, participants noted dimensions of both goals and procedures from Wolf (1978) three-part framework. P3 noted:

> I liked using the self-talk strategy, mostly on runs when I am not feeling my best. I've used it (as a coach) with the varsity girls' cross-country team this past season. We started it about mid-season – using it on specific, higher intensity training days and then transitioned those moments into how it could be used in the races.

P2 also stated she liked using the self-talk strategies and had continued to utilize it in her athletic pursuits. In addition, she shared also integrating self-talk outside of her athletic pursuits as follows:

> (We) have been remodeling our house and there have been days of labor intense work that self-talk has popped into my head. It changed the outlook of the work from having the feeling of 'ugh, we gotta do this' and dragging our feet to more of a positive 'alright! We can do this, let's get this done.' Granted it was a long project and weren't the same words as when running an 800 but it was a great tool to have for our mental approach to overcome and achieve our monstrous goal.

Discussion

The purpose of this study was to examine whether a personalized strategic self-talk intervention in the form of predetermined cue words could increase the perception of mental toughness and running performance in female Masters athletes. Specifically, we hypothesized that a personalized self-talk strategy using predetermined cue words would positively influence mental toughness as measured by the Mental Toughness Index (Gucciardi et al., 2015) and performance in an 800-meter run by participants as measured by finish time. We also hypothesized that this strategic self-talk intervention would extend the time it takes for the athlete to feel the urge to stop, increase the rating of perceived performance, and reduce the rate of perceived exertion relative to speed.

Self-talk was one of the strategies previously noted (Cooper et al., 2019a) as potentially influencing mental toughness, but further experimental investigation was warranted. As hypothesized, strategic self-talk was associated with changes in both mental toughness levels and run performance. Specifically, the strategic self-talk intervention utilizing predetermined cue words improved self-assessed levels of mental toughness by an average of 62% and improved 800-meter run times by an average of 9% over the baseline average. The 62% figure was skewed by P1, who more than doubled her self-assessed level of mental toughness. However, the range of change in self-assessed MTI noted in P2 and P3 were consistent with the ranges seen previously in that of runners (Cooper, et al., 2019a). The present study is thus unique in showing an association

between a specific optimizer of mental toughness and a concurrent relationship between mental toughness levels and run performance improvement. These results support previous research (Bandura et al., 1987) that indicated training in cognitive control strengthened perceived self-efficacy and ability to withstand pain. The results also provide an additional example of the influence of psychological skills training, including that of self-talk strategies on mental toughness and resultant performance, shown previously among elite military recruits (Fitzwater et al., 2018). Further, while the three participants in our study were not 800-meter specialists, they were all experienced athletes and runners who completed not just a single but also rather a series of baseline time trials before utilization of the self-talk intervention. They all demonstrated a notable increase in self-assessed mental toughness and improvement in 800-meter finish times from baseline.

In reference to self-talk specifically, the intervention is not free of critique. Strategic self-talk cue words may be less effective for more experienced athletes (Hardy et al., 2015). It was for this reason we noted our participants were experienced runners but not 800-meter specialists. Further, it has been noted that while mental control may promote the intended consequence, it has also been found to result in ironic opposite consequences to those intended due to enhanced sensitivity to mental contents (Wegner, 1994).

The results of this study identified a consistent association between a personalized strategic self-talk intervention and mental toughness scores, 800-meter run times, and perceived performance. In reference specifically to RPE, the literature (Marcora & Staiano, 2010; Noakes, 2008) indicates that the perception of effort is one of the primary limiters of exercise performance leading to disengagement from the task. All three of our participants reported they were running "all-out" during baseline. Following the intervention, participants were able to increase their RPE and speed or hold their RPE relatively constant while running significantly faster. This pattern of indicating an 'all-out' effort but then exceeding that effort by a significant margin in future sessions, may provide further insights regarding the use of the RPE scale in future studies in addition to similar findings noted previously (Hardy et al., 2019). While we did not find self-talk reduced RPE as has been demonstrated previously (Blanchfield et al., 2014), it was reduced in comparison to the relative running speed (e.g., faster running at similar RPE). Perhaps the strategic self-talk is also helping the individual discover what the higher levels of exertion feel like for the future or influencing the ability to cope with the higher levels of exertion.

This study also continues to build upon previous research indicating that mental toughness functions more similar to a state (Gucciardi et al., 2014; Harmison, 2011) than a trait. It also provides expanded insights on ways in which that functional state can be optimized (Cooper et al., 2019a) through specific steps taken by the individual either independently or via a coach or other trusted advisor. If self-talk were to be shown to influence mental toughness, it might then feed into the resource caravan (Neal et al., 2017), which is an aggregation of multiple personal resources that interweave to positively influence goal-directed outcomes. For example, the comments shared by P1 about the different levels of mental toughness and the influence on what she then noted she could achieve likely ties into this aggregation.

Limitations

One limitation might be related to the novelty of the specific event for these participants. Experienced 800-meter runners may still benefit, but not likely to the same extent as these non-specialists. Selecting participants who were not 800-meter specialists may reduce the direct application and comparison for track coaches. However, as can be seen in Figure 5, two of the three participants showed evidence of a flat performance at baseline, followed by a notable jump immediately after the initial intervention. The remaining participant (P1) did show some improvement during the baseline sessions and may have benefited from one or two additional baseline sessions, but her improvement post-intervention was non-linear from the baseline trend.

The urge to stop did not appear to be as sensitive to the intervention as our self-report measure of mental toughness or other performance measures (e.g., speed). This may be due to involving an unnatural activity (i.e., considering the point at which they had urge to stop) that may require additional training. We chose to measure perceived mental toughness through self-report. However, we recognize researchers can also measure mentally tough behavior through observation or validated tools (e.g., Bell et al., 2013). It is likely that perceived mental toughness and behavioral mental toughness are distinct variables that are intricately related. Future researchers may wish to build on the current study by integrating the combination of behavioral mental toughness and perceived mental toughness when studying the effect of self-talk interventions.

Completing this study outside the context of a laboratory limited our ability to integrate precise consistency regarding temperature and surface conditions. However, our goal with this study design was to create a real-world setting outside the traditional lab, and we were able to modify the additional variables by scheduling all sessions in the early morning at the same track during generally temperate months of April – June in Colorado. The potential for participant bias is also a limitation of note. Participants knew from the information sheets that the study was examining the influence of self-talk on mental toughness and finish times, and there is potential they wanted to show it "worked." However, it is unlikely that such a Hawthorne effect can fully explain the level of change detected across the three participants.

Future research directions

The insights provided in this study provide a complement to and build upon previous research regarding the optimization of mental toughness (Beattie et al., 2019; Cook, Crust, Littlewood, Nesti, & Allen-Collinson, 2014; Powell & Myers, 2017) but there remain numerous opportunities to build further. The Thrive – Prepare – Activate model (Cooper et al., 2019a) identifies a range of possible mental toughness influencers ranging from fuel and caffeine to relational support and stress facilitation. Investigating one of the influencers outside the specific context of athletics may also provide an intriguing direction of study. For example, does self-talk influence mental toughness related to an individual's chosen activity levels, high caloric food selection, or amount of screen time? Such studies could help bring the mental toughness discussion into that of the general population well-being conversation (Hannan et al., 2015).

Further, the investigation into mediation models to understand why self-talk influences performance and mental toughness is of value. Is it a result of changes in mental toughness via elements such as self-efficacy and perceived control? Alternatively, is mental toughness effectively a collection of cognitive tools and behavioral strategies that improve outcomes across a variety of individual pursuits?

Application for practitioners

There has been increased attention on self-talk in the literature in recent years (Hatzigeorgiadis et al., 2017) and a particular interest in the influence on performance and competitive outcomes (Funatsu, 2018). Based on the apparent impact of strategic self-talk on mental toughness and 800-meter finish times in this study, opportunities for application are likely to be of great interest to coaches, consultants, and athletes. Some of these were directly identified by one or more of our participants in terms of improving their coaching, athletic, professional, and even personal pursuits. In terms of coaching, this study highlighted the value of a consistent approach to mental toughness and its related constructs. Even our highly educated, respected, and up-to-date coach (P3) indicated she would be translating many of her discoveries to how she is coaching her athletes. For example, she noted her perspective of telling her athletes "no crutches" (excuses) would be something she could instead adjust to provide them with specific self-talk strategies to utilize during the difficult periods of a race. All three participants made the connection between what they learned about their mental toughness patterns and processes and both their future athletic and non-athletic pursuits. A typical comment revolved around the discovery through their participation in the study that they were capable of more than they realized, and the additional pursuits for which that discovery might now be a catalyst. Also, the need for a personalized approach to self-talk was clarified as the participants did note overlap between some of the most effective self-talk strategies but also identified others that were specific to their individual history and pursuits. Encouragingly, our findings also indicated that participants were able to maintain the majority of their improved performance during the follow-up sessions without the continued instruction from the outside advisor, providing a long-term value for potential participants.

Conclusion

Performance enhancement in athletics and other aspects of life can take many forms. The data related to the impact of alternatives noted here, such as caffeine or special shoes are of interest as individuals look for ways in which to create that enhanced outcome. Self-talk provides similar outcomes (at least in the current sample), and being volitional and non-intrusive, is not accompanied by any side effects. Our findings related to the influence of strategic self-talk providing results consistently beyond the range of minimal benefit and harm for each of these categories appears to demonstrate a relatedness that can now be expanded upon elsewhere and with other categories seen as mental toughness optimizers.

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