Mind over Body:
Investigating Cognitive Control of Cycling Performance with Dual-Task Interference

Johanne Nedergaard (nedergaard@cc.au.dk)
&
Mikkel Wallentin (mikkel@cc.au.dk)

School of Communication and Culture, Jens Chr. Skous Vej 2
Aarhus University, Denmark

Abstract

In cognitive psychology, dual-task investigations have indicated that internal language plays a role in a variety of cognitive functions. This preregistered study investigated whether physical endurance as exemplified by cycling performance depends on internal language and internal visual experience. A sample of 50 physically active participants performed 12 cycling trials, each lasting one minute where they were required to cycle as fast as possible while remembering either a sequence of letters and numbers (verbal interference) or locations on a grid (nonverbal interference). We found that participants cycled a shorter distance in the verbal interference condition compared with the no-interference ($p < .001$) and the visuospatial inference conditions (nonsignificant: $p = .10$). Further, participants who reported that self-talk usually helps their sports performance were more negatively affected by verbal interference. Our study comprises a first attempt at using the dual-task method to investigate the causal role of self-talk in physical performance.

Keywords: dual-task interference; cognitive control; self-regulation; endurance sport

Introduction

Language and motor control are usually conceived of as separate cognitive systems with little influence on each other. However, if we think of (prolonged, sustained) motor control as requiring executive functions, the connection becomes clearer, as language and executive functions have long been linked in various theories and experimental paradigms (see e.g. Alderson-Day & Fernyhough, 2015). We plausibly need inhibition control to prevent ourselves from quitting when feeling exhausted, and we need cognitive flexibility to allocate resources for fine motor control (see parts IV 'Motivation and Emotion' and V 'Cognition' on pp. 313-449 in Handbook of Sports Psychology, 2016). In the present study, we attempt to combine findings from sport psychology showing that self-talk interventions improve performance in a range of sports with experimental paradigms from cognitive science that investigate the role of verbal rehearsal in various cognitive processes using dual-task interference. Specifically, we tested non-expert participants' cycling performance on an exercise bike under two different interference conditions (verbal and visuospatial) and a no-interference control condition.

Verbal Rehearsal and Cognitive Control

Two specific theoretical frameworks have been influential on research on the function of inner speech, the first one related to the development of verbal mediation of behavior and cognition (Vygotsky, 1962; Vygotsky & Luria, 1994), the second related to rehearsal and working memory (Baddeley Chincotta, & Adams, 2001; Baddeley, 2012). According to the former, Vygotskian perspective, inner speech is the endpoint of a trajectory moving from instructions from others (parents, caregivers) over overt self-instruction (private speech) to covert self-instruction in development. The function of inner speech in this context is enhanced planning and self-control with children gradually taking over more strategic responsibility for their own cognition and behavior. According to the working memory account of inner speech associated with Baddeley's work (e.g. Baddeley & Hitch, 1974), on the other hand, internal verbalizations belong to a component of working memory often termed the "phonological loop" or "verbal working memory". Studies in this literature often use "articulatory suppression" to investigate dual-task interference and thereby the functions of the phonological loop. Here, we combine these perspectives to investigate the role of internal language in behavior control – as exemplified by physical exertion – using a dual-task paradigm.

The core executive functions are inhibition and interference control, working memory, and cognitive flexibility (Diamond, 2013). Of the executive functions that research has shown that internal language is involved in, we specifically expect cycling performance to be related to inhibitory control. Inhibition (or response inhibition) refers to the ability to resist temptations and to resist acting impulsively. In the case of endurance cycling, the impulse to be inhibited is the impulse to stop when the physical exertion becomes uncomfortable. One study that specifically investigated inhibitory control under dual-task conditions was conducted by Tullett and Inzlicht (2010). This study tested a go/no go task under verbal (repeating the word ‘computer’ at 2 Hz) and spatial (drawing circles) interference conditions and found that verbal interference increased impulsive responding (faster responses, more commission errors, fewer omission errors). There is also some indication in the parts of the literature that do not specifically investigate inhibition that verbal interference makes participants less able to inhibit prepotent responses (see e.g. Dunbar & Sussman, 1995; Baldo et al., 2005).

Self-Talk in Sport Psychology

In sport psychology, the role of inner speech – most often called ‘self-talk’ in this literature – has also been investigated with a range of methods including questionnaire studies, intervention studies, and observational studies. A systematic review (Tod, Hardy, & Oliver, 2011) and a meta-analysis (Hatzigeorgiadis et al., 2011) both found that self-talk interventions generally have positive effects on performance across a range of sports. Only a few studies to date have directly investigated self-talk in endurance sport. This type of sport is particularly interesting from a cognitive perspective because it involves a real-world example of many challenges traditionally thought to require a high degree of cognitive control. Long-distance runners, cyclists, swimmers, rowers, etc. have to continuously inhibit the prepotent response (quitting) in order to fulfill a longer-term goal. These athletes presumably also offer a rich source of self-talk content as they are often alone with their thoughts for prolonged stretches of time during both training and competition.

As for previous literature, most relevant in the present context are especially two questionnaire studies on marathon runners (Nedergaard, Christensen, & Wallentin, 2021; Van Raalte et al. 2015) and seven intervention studies (Blanchfield, Hardy, de Morree, Staiano, & Marcora, 2014; Wallace et al., 2017; Hatzigeorgiadis et al., 2018; Hamilton et al., 2007; Schüler & Langens, 2007; McCormick, Meijen, & Marcora, 2018; Barwood et al., 2015). With the exception of one (McCormick, Meijen, & Marcora, 2018), the intervention studies found that instructional and motivational self-talk training helped endurance performance, even under conditions of uncomfortable heat. Because of the design of most of these intervention studies, it has not been possible to conclude that the self-talk interventions directly caused performance improvement – it could also simply be the case that undergoing any intervention helped, regardless of the content. Van Raalte et al. (2015) in one of the studies with the highest number of participants to date (N = 483) simply asked marathon runners to list their thoughts in an open-ended way and later coded the answers into categories. The authors found that 88 % of marathon runners reported engaging in self-talk while running, and that this self-talk took a variety of both motivational and instructional forms. Nedergaard et al. (2021), on the other hand, found evidence indicating that self-talk quality was correlated with running skill.

The Present Study

We chose two comparable memory tasks for the present study because a) it was straightforward to assess performance on them by conducting a memory test after each cycling interval, and b) participants could devote all physical resources to cycling while simultaneously needing to devote mental resources to rehearsing and maintaining the memory load. Our preregistered hypotheses (full preregistration available at https://osf.io/2ah7s) were as follows:

i. Cycling performance will decrease in both the verbal and non-verbal interference conditions compared to the control condition.
ii. If inner speech is required to maximize performance, we expect cycling performance to decrease significantly more in the verbal compared to the non-verbal interference condition.
iii. If there is no detectable dual-task effect on cycling performance, we expect to see a trade-off where there is instead a detrimental effect on the verbal or non-verbal simultaneous task.
iv. Participants who indicate high self-talk frequency and efficacy in the questionnaire will be more negatively affected by the verbal distraction task than other participants.

Method

As no studies had previously combined verbal interference and endurance sport such as cycling, we could not use previous studies to determine the optimal sample size. We chose to aim for approximately 50 participants as this seemed reasonable given the small to moderate effect sizes found in verbal interference literature.

Participants

The project received ethical approval from both the Institutional Review Board at Aarhus University and the Human Subjects Committee at the Cognition and Behavior Lab at Aarhus University. We recruited 51 participants from the participant pool attached to Cognition and Behavior Lab. Participants all normally exercised at least twice a week, and had no known heart conditions (*mean age* = 26.95, *SD* = 10.2; 29 men and 20 women). They received 90 DKK as compensation for their time. One participant was unable to complete the full experiment and was thus excluded from the following analyses, as was one participant who did not meet the exercise frequency requirement. Nine participants had not measured their resting heart rate prior to the experiment so it was estimated based on their age and exercise frequency (Reimers, Knapp, & Reimers, 2018).

Materials

Cycling. We ran the experiment using custom-written software in PsychoPy version 3.2.4 (Peirce et al., 2019). The exercise bike was a Titan Fitness model SB550 Prestige adjusted to Level 14 resistance (piloting had shown that this level of resistance suited the widest range of participants). We used a CatEye Velo 7 cycling computer attached to the exercise bike to measure meters cycled per trial.

Heart Rate. We used a Charge 2 FitBit wristband to measure heart rate during the experiment. While wrist-worn heart rate monitors are not as accurate as chest-worn monitors, we opted for the wrist-worn monitor for convenience - we did not need high-fidelity accuracy but simply to have a way of making sure that participants were putting in effort. Benedetto et al. (2018) tested the accuracy of the FitBit Charge 2 wristband and found that it had a modest bias in measuring heart rate at -5.9 bpm (95%CI: -6.1 to -5.6 bpm). We were unable to retrieve heart rate data from eight participants so their heart rate data were excluded from subsequent analyses. All participants were instructed to reach 70 % of their heart rate reserve on each cycling trial. We calculated 70 % of the individual participant's heart rate reserve with the following formula (adapted from Tanaka, Monahan, & Seals, 2001):

$$HR_{target} = (208 - 0.7 * age - HR_{rest}) * 0.7 + HR_{rest}$$

Questionnaire. Participants completed the Automatic Self-talk Use Questionnaire for Sports (ASTQS; Zourbanos et al., 2009) prior to the cycling section of the experiment. The ASTQS is a questionnaire made to measure the quantity and quality of self-talk used by athletes of varying levels of activity and fitness. The questionnaire measures four positive and four negative self-talk dimensions. Positive self-talk consists of psych-up (e.g. 'come on'), confidence (e.g. 'I'm very well prepared'), anxiety-control (e.g. 'don't get upset'), and instruction (e.g. 'concentrate on what you have to do right now' while negative self-talk consists of worry (e.g. 'I'm going to lose'), disengagement (e.g. 'I can't keep going'), somatic fatigue (e.g. 'I'm tired'), and irrelevant thoughts (e.g. 'what am I doing later today?').

Procedure

Participants began the experiment by filling out the ASTQS and then proceeded to the cycling section of the experiment. After a brief warm-up and an introduction to the experiment set-up, participants completed 24 1-minute trials (12 rest and 12 cycling, interleaved). During each 1-minute trial, participants were asked to rehearse and remember either the locations of six letters and numbers on a 6x6 grid or the letters and numbers themselves. A third of the trials were control trials where participants did not have to remember anything. The stimuli were presented in the same way regardless of the verbal or visuospatial nature of the memory task: Six letters and numbers were randomly selected by the computer and appeared sequentially for one second each. After the stimuli were presented, the program counted down from three and started the 1-minute countdown. When the countdown had finished, participants had as much time as they wanted to click on either the locations they remembered (visuospatial trial) or the letters and numbers they remembered (verbal trial). Order was not considered. The visuospatial, verbal, and control conditions were randomized for each participant within four blocks of three cycling trials. See Figure 1 for an illustration of the procedure.

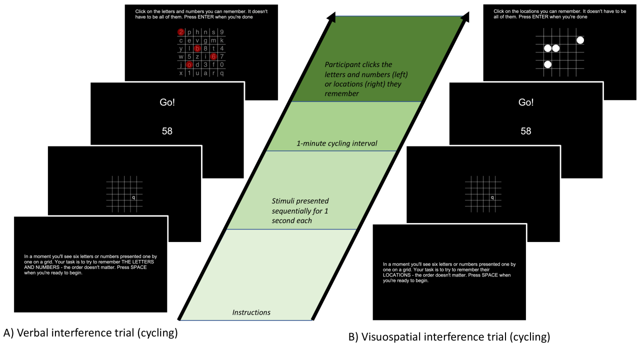

Figure 1: *The progression of a verbal interference trial (A) and a visuospatial interference trial (B).*

Results

Descriptive statistics

Questionnaire. Only three of our 50 participants answered that they never talk to themselves while exercising. Of the remaining 47, seven answered that they 'rarely' talk to themselves while exercising, 24 said that they 'sometimes' talk to themselves while exercising, 12 said that they 'often' do so, and four said that they 'very often' do so. In terms of self-talk efficacy, 19 participants reported that self-talk usually has a positive effect on their performance, 21 said that the effect is sometimes positive and sometimes negative, and seven said that self-talk does not affect their performance. See Figure 2 for a visualization of self-talk frequency and efficacy.

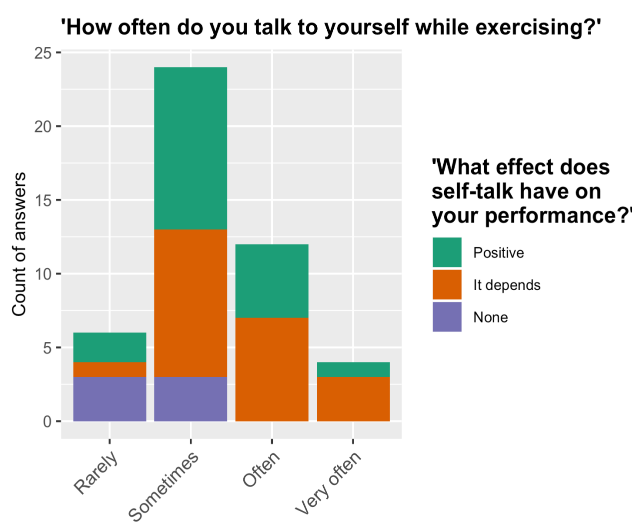

Figure 2: *Visualization of participants' answers to the self-talk efficacy and self-talk frequency questionnaire items.*

For exercise frequency, 15 participants reported exercising a few times a week, 21 participants reported exercising most days every week, 12 participants reported exercising every day or almost every day, and one participant reported exercising several times almost every day.

Heart Rate. Out of a total of 591 cycling trials, we were unable to determine the peak heart rate from 106, including trials performed by the eight participants whose heart rate data we could not monitor at all. Across the remaining 485 trials where we could identify a peak, participants reached the target of 70 % maximal heart rate on 270 trials and did not reach the target on 215 trials. Two independent samples t-tests indicated no difference between trials where the target was reached and where the target was not reached either for meters cycled (p = 0.38) or for memory performance (p = 0.90). A linear mixed model of interference condition predicting peak heart rate (scaled according to individual participant) indicated that there was no difference between interference conditions (all $p > .785$). Therefore, we decided to retain all trials and include them in subsequent analyses.

Interference Tasks. Participants performed better on the verbal interference task than on the visuospatial interference task (See Table 1 for an overview of participants' performance on the memory tasks during cycling intervals and rest intervals). To test whether participants' performance was above chance, we simulated 1,000,000 trials of six 'clicks' and used the distribution of the number of correct values to find the threshold at which participants would be performing above chance. Through this procedure, we estimated that the probability of getting at least three correct by chance is 0.04. Thus, any trial on which a participant got three or more correct would be highly unlikely to be a chance-level trial. There were 86 cycling trials potentially at chance-level, 15 of which were verbal and 71 of which were visuospatial.

Table 1: *Performance on the interference tasks during cycling and rest.*

Interference condition	Cycling condition	Mean success	SD of success
verbal	REST	0.86	0.22
verbal	CYCLING	0.84	0.22
visual	REST	0.54	0.28
visual	CYCLING	0.53	0.27

Cycling Performance. We scaled the meters cycled according to the individual participant's mean distance cycled. See Table 2 for an overview of participants' cycling performance under the different distracting conditions (unscaled) and Figure 4 for a visualization of the same (scaled). The scaled meters are used in subsequent analyses and models, primarily because they met normality assumptions and the untransformed meters cycled did not (judged by tests of skewness and kurtosis and by visual inspection of quantile-quantile plots). We also calculated individual susceptibility to verbal interference by subtracting within-person average performance on verbal interference trials from within-person average performance on control trials. This was used to compare to participants' own experience of the effects of inner speech on performance.

Table 2: *Cycling performance during the different interference conditions.*

Interference condition	Mean meters cycled	SD of meters
control	214.76	35.88
verbal	212.26	34.86
visual	213.67	35.98

Trade-Off Between Interference Task and Cycling Performance

To ascertain whether there was a trade-off between the memory tasks and cycling performance, we conducted a Pearson's correlation coefficient test on meters cycled (scaled according to each individual participant) with success on the interference tasks (again scaled according to each individual participant and separately for verbal and visuospatial interference). We expected that if participants had to choose between performing well on the cycling task and performing well on the memory task, scores on the two should be negatively correlated. The statistical test found no evidence of a correlation in either direction (p = 0.81). See Figure 3 below.

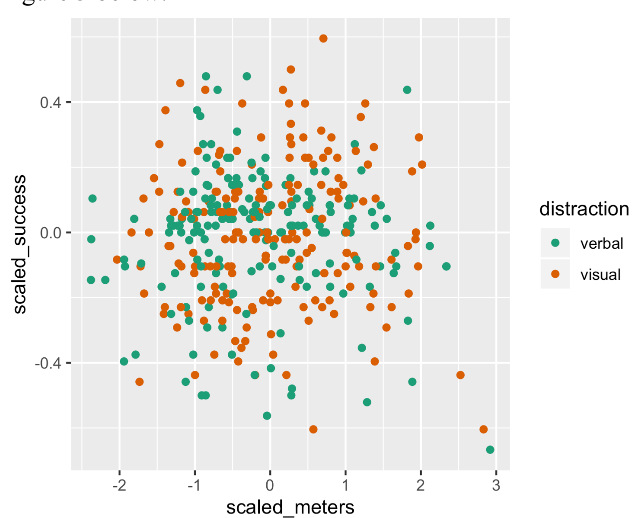

Figure 3: *Plot showing the correlation between scaled success on the interference tasks (green = verbal, orange = visual) and scaled meters cycled.*

Statistical Models

Dual-Task Condition Predicting Cycling Performance. Our model including random intercepts for participants and random slopes for trial suggested that the participants in the control condition cycled significantly faster than in the verbal interference condition ($\beta = 0.27$; $SE = 0.10$; $t(432.51) = 2.85$;

$p < .001$; see also Figure 4). There was no significant difference between either the visuospatial interference condition and the verbal interference condition ($p = .10$) or the control condition ($p = .227$). Cohen's d for the difference between verbal interference and control trials was 0.29 while Cohen's d for the difference between verbal and visual interference trials was 0.22.

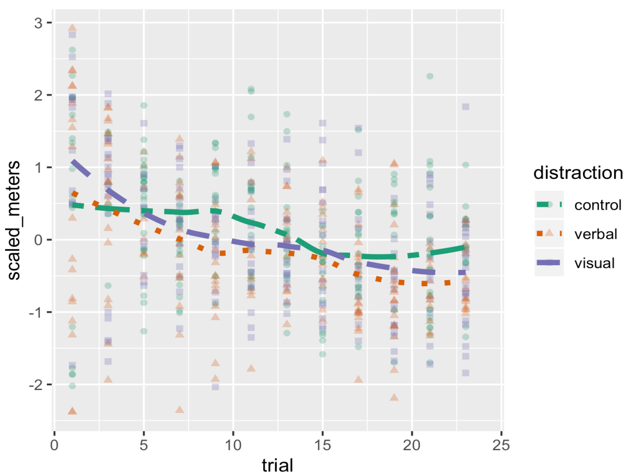

Figure 4: *Plot showing participants' cycling performance across the entire experiment, scaled by their individual mean meters cycled. The three lines represent performance during verbal interference, visuospatial interference, and a no-interference control condition. Points indicate individual performance on a given trial.*

Self-Talk Frequency and Self-Talk Efficacy Predicting Verbal Interference. For the model of self-talk frequency, we excluded the two extreme points on the self-report scale ('Never' and 'Very often') as too few participants had chosen them (three and four, respectively). This model found no evidence of reported self-talk frequency predicting verbal interference ($p = .1$). For the model of self-talk efficacy, we only tested the difference between "Self-talk usually has a positive effect on my performance" and "Self-talk sometimes has a negative and sometimes a positive effect on my performance", again because too few participants had chosen the other two options (seven had said that self-talk does not affect their performance, and zero had said that self-talk negatively affects their performance). This model indicated that participants who report that they are sometimes negatively and sometimes positively affected by self-talk are significantly less affected by verbal interference than participants who report that self-talk usually has a positive effect on their performance ($\beta = -2.91$; $SE = 0.60$; $t = -4.83$; $p < .001$). Cohen's d for the difference between these two groups was 0.46. See also Figure 5.

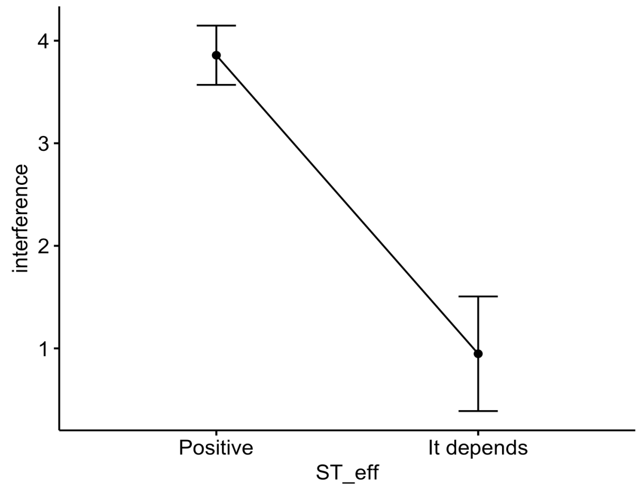

Figure 5. *Line plot showing the difference between susceptibility to verbal interference for participants who reported that self-talk usually has a positive effect on their performance (n = 19) and participants who reported self-talk sometimes having a positive and sometimes a negative effect on performance (n = 21).*

Discussion

This study tested the influence of two different interference tasks – a visuospatial memory task and a verbal memory task – on cycling performance. We found that both interference tasks were associated with slower cycling performance and importantly that only cycling performance during the verbal interference task was significantly worse than in the control condition. This result was in line with our main hypothesis although it is important to note that the verbal and visuospatial interference tasks did not have significantly different effects (contrary to our predictions). Further, participants who said self-talk usually benefits their performance were on average more negatively affected by the verbal distraction task.

Dual-Task Interference and Cognitive Control

As discussed in the Introduction, the reason we would expect internal language to be involved in cycling performance is that endurance sport demands inhibitive control. The prepotent response to muscle pains and being out of breath is to stop the physical exertion – in this experiment, participants had to exert control to keep going, and we hypothesized that this control would to some extent depend on the ability to use inner speech. Participants could use many different inner speech strategies and indeed claimed to do so in the questionnaire – regardless of which one, disrupting self-talk should disrupt control of the physical performance. The vast majority of our participants reported talking to themselves during exercise. The results from our study fit well with the idea that inner speech is needed for inhibition control – under verbal interference, participants were less able to use their inner voice to control their cycling performance. This is also in line with previous dual-task literature suggesting that participants respond more impulsively (i.e. faster and with more errors) under verbal distraction conditions (Tullett & Inzlicht, 2010; Dunbar & Sussman, 1995).

Limitations and Future Directions

The most important limitation of the present study is of course that one of the preregistered hypotheses was not confirmed, namely that verbal interference would be significantly more detrimental to performance than visuospatial interference. However, cycling performance under verbal interference was significantly different from performance under the control condition and numerically different from the visuospatial condition. The effect size of the difference between verbal and visuospatial interference in the present study was small (Cohen's *d*: 0.22). Future studies need to further explore whether this difference was spurious or due to a lack of power in the experiment, and whether the small effect could be due to the fact that participants did not always reach a sufficiently high rate of exertion (70% of max. heart rate). The verbal and visuospatial memory tasks used here are further limited by the fact that participants could potentially commit the sequences to long-term memory and not rehearse them until they needed to respond after the one-minute trial. It would be more optimal to use interference tasks that place more continuous demands on working memory, for example having participants judge N-back similarity with word or picture stimuli. More traditional articulatory suppression (e.g. using verbal shadowing) is not possible under such physically strenuous conditions. If the effect of verbal interference found in this study is real, then a more continuous interference task should cause a larger effect on physical endurance.

As we have seen in the section on interference task performance above, there was a strong ceiling effect for the verbal interference task compared to the visuospatial interference task (85.36 % in the verbal interference condition versus 53.26 % in the visuospatial interference condition). We prioritized having interference tasks that were as similar as possible except the verbal/visual memory component over for example increasing the items on the verbal memory version. It could have been the case that participants simply abandoned the visual memory task because it was too hard. The data, however, do not support this. First, performance on the visual memory task was generally well above chance level, and second, there was no evidence for a speed/accuracy trade-off between cycling and memory.

Conclusion

The present study tested cycling performance during 1-minute intervals under verbal and visuospatial interference conditions and found that the verbal interference condition affected cycling performance significantly compared with a control condition, and numerically, albeit non-significantly, with visuospatial interference. Participants who reported that self-talk usually has a positive effect on their performance were significantly more affected by the verbal interference than participants who reported that self-talk sometimes has a positive and sometimes a negative effect on their performance. Future studies should explore the connection between the content of self-talk and performance within a dual-task interference paradigm and should attempt to replicate the effects found in the current study using other, more continuous types of interference tasks.

References

Alderson-Day, B., & Fernyhough, C. (2015). Inner speech: development, cognitive functions, phenomenology, and neurobiology. *Psychological bulletin, 141*(5), 931.

Baddeley, A. (2012). Working memory: theories, models, and controversies. *Annual review of psychology, 63*, 1-29.

Baddeley, A., Chincotta, D., & Adlam, A. (2001). Working memory and the control of action: Evidence from task switching. *Journal of experimental psychology: General, 130*(4), 641.

Baddeley, A. D., & Hitch, G. (1974). Working memory. In *Psychology of learning and motivation* (Vol. 8, pp. 47-89). Academic press.

Baldo, J. V., Dronkers, N. F., Wilkins, D., Ludy, C., Raskin, P., & Kim, J. (2005). Is problem-solving dependent on language? *Brain and Language, 92*, 240–250. http://dx.doi.org/10.1016/j.bandl.2004.06.103

Barwood, M.J., Corbett, J., Wagstaff, C.R.D., McVeigh, D., & Thelwell, R.C. 487 (2015). Improvement of 10-km time-trial cycling with motivational self talk compared with neutral self-talk. *International Journal of Sports Physiology and Performance, 10*, 166-171. DOI: 10.1123/ijspp.2014-4900059.

Benedetto, S., Caldato, C., Bazzan, E., Greenwood, D. C., Pensabene, V., & Actis, P. (2018). Assessment of the Fitbit Charge 2 for monitoring heart rate. *PloS one, 13*(2), e0192691.

Blanchfield, A. W., Hardy, J., de Morree, H. M., Staiano, W., & Marcora, S. M. (2014). Talking yourself out of exhaustion: The effects of self-talk on endurance performance. Medicine and Science in Sport and Exercise, 46, 998-1007. doi: 10.1249/MSS.0000000000000184

Diamond, A. (2013). Executive functions. *Annual review of psychology, 64*, 135-168.

Dunbar, K. & Sussman, D. (1995). Toward a Cognitive account of frontal lobe function: Simulating frontal lobe deficits in normal subjects. *Annals of the New York Academy of Sciences. 769*, 289-304.

Hamilton, R. A., Scott, D., & MacDougall, M. (2007). Assessing the effectiveness of self-talk interventions on endurance performance. *Journal of Applied Sport Psychology, 19*, 226–239.

Hatzigeorgiadis, A., Zourbanos, N., Galanis, E., & Theodorakis, Y. (2011). Self-talk and sports performance: A meta-analysis. *Perspectives on Psychological Science, 6*, 348–356.

Hatzigeorgiadis, A., Bartura, K., Argiropoulos, C., Comoutos, N., Galanis, E., & D. Flouris, A. (2018). Beat the heat: effects of a motivational self-talk intervention on

endurance performance. *Journal of Applied Sport Psychology, 30*(4), 388-401.
McCormick, A., Meijen, C., & Marcora, S. (2018). Effects of a motivational self-talk intervention for endurance athletes completing an ultramarathon. *The Sport Psychologist, 32*(1), 42-50.
Nedergaard, J., Christensen, M. S., & Wallentin, M. (2021, February 1). Valence, form, and content of self-talk predict sport type and level of performance. https://doi.org/10.31234/osf.io/bm945
Peirce, J., Gray, J. R., Simpson, S., MacAskill, M., Höchenberger, R., Sogo, H., ... & Lindeløv, J. K. (2019). PsychoPy2: Experiments in behavior made easy. *Behavior research methods*, *51*(1), 195-203.
Reimers, A. K., Knapp, G., & Reimers, C. D. (2018). Effects of exercise on the resting heart rate: a systematic review and meta-analysis of interventional studies. *Journal of clinical medicine, 7*(12), 503.
Schinke, R., McGannon, K., & Smith, B. (Eds.) (2016). *Routledge International Handbook of Sport Psychology*. London: Routledge, https://doi.org/10.4324/9781315777054
Schüler, J., & Langens, T. A. (2007). Psychological crisis in a marathon and the buffering effects of self-verbalizations. Journal of Applied Social Psychology, 37, 2319–2344.
Tanaka, H., Monahan, K. D., & Seals, D. R. (2001). Age-predicted maximal heart rate revisited. *Journal of the american college of cardiology, 37*(1), 153-156.
Tod, D., Hardy, J., & Oliver, E. (2011). Effects of self-talk: A systematic review. *Journal of Sport and Exercise Psychology, 33*(5), 666-687.
Tullett, A. M., & Inzlicht, M. (2010). The voice of self-control: Blocking the inner voice increases impulsive responding. *Acta Psychologica, 135*, 252–256. http://dx.doi.org/10.1016/j.actpsy.2010.07.008
Van Raalte, J. L., Morrey, R. B., Cornelius, A. E., & Brewer, B. W. (2015). Self-talk of marathon runners. *The Sport Psychologist, 29*(3), 258-260.
Vygotsky, L. (1962). *Thought and Language* (E. Hanfmann & G. Vakar, Trans.). Cambridge, MA: MIT Press.
Vygotsky, L., & Luria, A. R. (1994). Tool and symbol in child development. In R. van der Veer & J. Valsiner (Eds.), *The Vygotsky Reader*. Oxford, UK: Blackwell.
Wallace, P. J., McKinlay, B. J., Coletta, N. A., Vlaar, J. I., Taber, M. J., Wilson, P. M., & Cheung, S. S. (2017). Effects of motivational self-talk on endurance and cognitive performance in the heat. *Medicine & Science in Sports & Exercise, 49*, 191–199.
Zourbanos, N., Hatzigeorgiadis, A., Chroni, S., Theodorakis, Y., & Papaioannou, A. (2009). Automatic Self-Talk Questionnaire for Sports (ASTQS): Development and preliminary validation of a measure identifying the structure of athletes' self-talk. *The Sport Psychologist, 23*(2), 233-251.