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The effects of self-talk strategies on divided attention following physical exhaustion

by

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The author of this thesis had a great amount of help from Prof. Antonis Hatzigeorgiadis

Abstract

This study examined the effects of self-talk strategies on divided attention following physical exhaustion. Participants were 60 undergraduate students with a mean age of 20.23 years (SD =). The study was conducted at the facilities of the University of Thessaly, at the lab of exercise and quality of life. The participants were randomly assigned into experimental and control groups, they followed a baseline assessment with the Vienna Test System (VTS) software, in order to check for baseline differences. Then a training period followed for the two groups, with the experimental group using self-talk. The participants then were induced in a state of physical exhaustion and for the final assessment they performed the divided attention test from the Vienna Test System (VTS). The analysis of the control measures showed that the two groups did not differ statistically significantly at the reaction time and percentage of correct responses of the baseline assessment, also there were non-significant differences between the two groups at their running time, running speed and running heart rate and their perceived muscle and physical fatigue. The analysis of the final assessment showed that the two groups differ significantly at their reaction time and percentage of correct responses. The results of this study suggest that self-talk strategies can help countering the negative consequences of physical fatigue by preserving or renewing attentional resources, thus benefiting the function of divided attention. This study provides further support for the attentional effects of self-talk as a plausible mechanism explaining the facilitative effects of self-talk on sport task performance.

Keywords: self-talk intervention, self-talk mechanisms, Vienna Test System, physical fatigue

Table of contents

Introduction

Self-talk and performance

Athletic performance nowadays is much more than it used to be. Top performers and elite clubs especially, recruit all kind of experts from various scientific fields who collaborate and contribute for one sole purpose: the best performance, to reach maximum potential. Even the slightest improvements in athletic performance can result in significant outcome differences in the context of competitive sport. So it comes as no surprise the increasing research efforts and attention that is invested in the positive effects that mental strategies and self-talk, in particular, bring in sport.

Self-talk in sport is a fast-moving, promising field because of its direct applied value and its feasibility in all sports contexts. Although, there are many ongoing lines of research that have yet to be explored, so that a comprehensive self-talk theory can emerge, contemporary findings, such as that from a recent meta-analysis from Hatzigeorgiadis, Zourbanos, Galanis, & Theodorakis (2011), provide robust evidence for the effectiveness of self-talk strategies in sport. Although it is useful to note that as Hardy, Oliver, & Tod (2009) argue the self-talk's beneficial influence is not only identified in performance.

Hardy, (2006) describes self-talk as (a) verbalisations 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 for the athlete. Hatzigeorgiadis, Zourbanos, Latinjak, & Theodorakis, (2013) later described self-talk as "what people say to themselves either silently or aloud, inherently or strategically, to stimulate, direct, react and evaluate events and actions. It is this strategic generation of self-talk, through self-talk interventions that Hatzigeorgiadis et al., (2011) mentions that involves the use of self-talk cues that serve the purpose of facilitating learning and enhancing performance through the

stimulation of appropriate responses. Yiannis Theodorakis, et al. (2012) classified those self-talk interventions into four levels (a) interventions testing the effectiveness of self-talk on fundamental motor tasks in lab or field settings (b) interventions on the effectiveness of self-talk on performance components of different sports, (c) interventions testing self-talk strategies on sport performance in non-competitive context and (d) interventions investigating the effectiveness of self-talk strategies on competitive sport performance. It is evident that between those four distinct levels there is a trade-off between ecological and internal validity. However, there was identified a more widespread lack of studies that enhance the ecological validity, through the examination of the effectiveness of self-talk interventions on competitive sport performance (Yiannis Theodorakis, Antonis Hatzigeorgiadis, 2012).

Further progress in the self-talk research has been initiated after the introduction of the matching hypothesis by Theodorakis, Y. Weinberg, R. Natsis, P., Douma, I., & Kazakas (2000), which suggested that instructional self-talk outperforms motivational for fine tasks and motivational self-talk outperforms instructional for gross tasks. This hypothesis was based on the principle that the different content of self –talk serves different purposes and facilitates performance through different functions. So, it was predicted that instructional self-talk facilitates concentration and attention to technical aspects of a task or movements required and that motivational self-talk affects confidence, persistence, mood etc. beneficially.

The aforementioned meta-analysis of the self-talk literature by Hatzigeorgiadis et al. (2011), provided more insight and useful material for applied practice, generation of new hypotheses and future research. Apart from the moderate definite effect size (ES=.48) of self-talk interventions on task performance in sport, moderators of the self-talk and performance relationship were identified. In particular, interventions that involved novel, fine tasks and self-talk training were more effective than those that involved well-learned, gross tasks and no self-talk training respectively. Also, partial support

was provided for the task by type matching hypothesis, as instructional self-talk was statistically significantly more effective for fine tasks than was motivational self-talk. Although motivational self-talk had a more significant effect than instructional self-talk, for gross tasks, the effect was not statistically significant. However, given the fact of the limited quantity of studies employing motivational self-talk, the future inclusion of such new studies may lead to full support for the task by type matching hypotheses.

Self-talk mechanisms

In order to facilitate applied practice, customized to the individual needs of the athletes and maximize the effectiveness of self-talk strategies for enhancing sport performance it was advocated by Hardy et al. (2009) that researchers should shift their focus from “first generation questions”, that is, examination of self-talk effects on performance to “second generation questions” that is, investigation of moderators and mediators underlying the relationship. A common theme throughout all the studies that are involved with the investigations of self-talk mechanisms is that there exists an abundance of possible functions through which self-talk strategies facilitate performance. Also, depending on the type of self-talk that is used we can expect to have different or similar performance outcomes.

Some representative studies in this line of research were conducted by Hatzigeorgiadis, Theodorakis, & Zourbanos (2004), where they tested the task by type matching hypotheses by applying instructional and motivational self-talk interventions in a precision and power tasks. They also measured the interfering thoughts of the participants, and the findings revealed that both self-talk groups reported less interfering thoughts after the self-talk intervention, whereas the control group’s interfering thoughts remained unchanged. So, a possible function of self-talk, based on the results of the study, was suggested to be the enhancement of concentration that can lead to performance increases.

Another study by Hatzigeorgiadis, Zourbanos, Mpoumpaki, & Theodorakis (2009) explored the effects of motivational self-talk on self-confidence, anxiety and task performance. The findings suggested that self-talk had a positive effect on task performance, increased self-confidence, reduced cognitive anxiety and that changes in task performance were related to changes in self-confidence. Thus, it is suggested that self-talk facilitates performance through increases in self-confidence.

This line of research is extending and progressing because exploring the mechanisms through which self-talk operates facilitating performance, is fundamental for the development of effective, individualised to the needs of the athlete self-talk interventions. It also contributes decisively to the formation of a comprehensive self-talk theory, which is the pillar into which future research will support. In this direction, guiding the research of self-talk mechanisms, the existence of models of self-talk has been proven very useful.

Models of self-talk

One of the first attempts to track down and organize the functions of self-talk was initiated by Theodorakis, Y., Hatzigeorgiadis, A., & Chroni (2008). Based on athletes' reports and empirical evidence from the literature they developed a multidimensional model and instrument. According to this model, namely FSTQ (Functions of Self-Talk Questionnaire), self-talk strategies facilitate sports performance through the enhancement of attentional focus, increasing confidence, regulating effort, controlling cognitive and emotional reactions and by triggering automatic execution.

Similar to the multidimensional FSTQ model Hardy et al. (2009), proposed a conceptual model consisting of four clusters of potential underpinning mechanisms. First, a cognitive cluster was proposed to reflect processes such as attention control, concentration, information processing, attentional style maintenance and alteration of attentional focus. Then a motivational cluster of mechanisms was added

that included self-efficacy and persistence. Self-efficacy as a mechanism of self-talk derives from Bandura's theory, that recognizes verbal persuasion as an antecedent of self-efficacy (Bandura, 1997). It was proposed by Hardy (2006), that self-delivered verbal persuasion acts ultimately as self-talk that influences self-efficacy and subsequently effort, persistence and performance. He also supports the utilization of the self-efficacy theory for future research.

Furthermore, Hardy (2006) at his model includes a cluster of behavioural mechanisms that revolve around technique improvement and movement patterns and an affective dimension of mechanisms that refers to the affective states, in particular, anxiety.

Also, some possible moderators are suggested, that can determine the effectiveness and compatibility of self-talk strategies in applied contexts. First is the preference of the athlete for verbal or non-verbal cognitive processing techniques and also the belief in self-talk's effectiveness. It is suggested that if the athlete demonstrates a preference towards non-verbal techniques or lack of faith in the applicability of self-talk strategies, alternative intervention options should be pursued.

A prospective model of self-talk mechanisms was developed by Galanis, V., Hatzigeorgiadis, A., Zourbanos, N., & Theodorakis (2016). This model includes two broad clusters of mechanisms, attentional processes related mechanisms and motivational processes related mechanisms. Regarding the attentional perspectives, this model uses the framework of the dimensions of attention refined by Sturm (2005), namely intensity, selectivity and the spatial dimension of attention.

A series of experiments conducted by Galanis, Hatzigeorgiadis, Zourbanos, Papaioannou, Theodorakis (2016), attested to both self-talk models, Hardy's et al., cognitive cluster of mechanisms and Galanis et al., attentional cluster respectively. The experiments mentioned above provided strong evidence of the effectiveness of self-talk strategies on task performance through the enhancement of attentional functions. In particular, the effects of self-talk strategies were examined on all three different

dimensions of attention by using the Test Battery for Perception and Attention Functions test, an objective behavioural measure. In 16 out of 17 tests that were performed, the experimental groups had faster reaction times than the control groups. A meta-analytic synthesis of the results showed a large effect size (d=0.91), thus providing strong support that self-talk strategies can be used as cues triggering or directing attention and subsequently enhancing task performance.

Galanis et al. (2016) model, also comprises attentional constructs and theoretical perspectives of attention that facilitate our understanding of how self-talk strategies affect attention and provide new insight for future research. In particular, the theory of attentional styles is included (Nideffer, 1976), which identifies two dimensions of attention: direction and width. The direction is divided into external or internal and width ranges from narrow to broad. This distinction creates four different combinations of attentional style, internal-narrow, internal-broad, external-narrow and external broad. The model suggests that self-talk strategies can lead athletes to stick on more optimal attentional styles depending on the context and help them with a smoother transition between attentional styles based on the requirements of the task, thus improving performance.

Moreover, a recent study examined the effectiveness of self-talk strategies on task performance under conditions of external distraction in laboratory and field environments (Galanis E., Hatzigeorgiadis A., Comoutos N., Charachousi F., 2017). The results suggested that self-talk can counter the effects of distraction on performance. In conjunction with more preliminary data, it is proposed that self-talk impede the debilitating effects of both external and internal distractions that interfere with attention and focus.

A final construct at Galanis et al. (2016), model is that of mental effort. Through initial experiments (Galanis E., Hatzigeorgiadis A., Sarampalis A.) with the use of pupilometry (eye tracker), the self-talk group outperformed the control group, and its pupil dilation was smaller. It was suggested that this was

an indication of superior attentional performance with a less mental effort for the self-talk group. It may be that self-talk in a sense leads to a more effortless attention effect, further investigation though is warranted.

The model concludes with the motivational perspectives that include self-efficacy's plausible mediating role in the self-talk performance relationship that has received considerable research support. It is stated that emotion regulation, as a possible mediator in the self-talk performance relationship, has still weak research support. Considerable support from contemporary research has been provided to the perception of effort and persistence that as a possible mediator of self-talk strategies leads to greater endurance performance.

Self-talk and ego depletion

A contemporary line of research has focused on the beneficial effects self-talk can provide on performance under aversive conditions such as that of reduced self- control. Self-control strength is proposed to be a limited resource that gets temporarily depleted when self-control demanding tasks drain its strength (Baumeister, R.F., Vohs, K.D., & Tice, 2007). The diminished state of self-control was operationalised as ego depletion. Being on that state comes with limited self-control strength that influences negatively the performance of subsequent actions that require self-control (Baumeister, R.F., Bratslavsky, E. Muraven, M. & Tice, 1998). This conclusion has been supported by several studies that have shown that a state of ego depletion can be detrimental to performance because it can negatively influence attentional processes that require self-control (Gregersen, Hatzigeorgiadis, Galanis, Comoutos, & Papaioannou, 2017).

As a consequence, the need to develop strategies countering those aversive effects has emerged. Research on self-talk strategies, as it is aforementioned, provides strong evidence regarding performance

improvement, through the enhancement of attention and focus. The beneficial attentional effects of self-talk were tested in the domain of countering the detrimental effects of ego depletion (Gregersen et al., 2017). In this study, after the baseline assessment, an experimental and a control group undertook a selective attention test, that was consisted by a visual and auditory part, while being in a state of ego depletion, due to a preceding depleting transcription task. The experimental group which employed self-talk strategies had a lower reaction time in both the visual and the audio test and a better score of correct responses in the visual test. These facilitating effects were discussed concerning the preserving or renewing of attention resources thus reducing the impact of ego depletion for the self-talk group. Also, some alternative hypotheses were proposed such as the distraction-related hypotheses that imply enhancement in attention by reducing distractions. Moreover, the process model of ego depletion was mentioned, that relates declines in performance with declines in motivation. Finally, the subjective perceptions of exertion are mentioned, that self-talk strategies may help ease. Overall, the above speculations offer multiple explanations for the facilitating effects of self-talk in performance in a state of ego depletion, that may operate in tandem (Gregersen et al., 2017).

In this line of research, further support for the effectiveness of self-talk strategies is provided by two recent studies Nurkse, (2018) examined the effects of a self-talk intervention on a golf putting task, while the participants were in a state of ego depletion. The results revealed that the self-talk group significantly increased their golf putting performance from baseline to final measurement, whereas the performance for the control group remained stable. Similarly, Kooijman, (2018) examined the effects of a self-talk intervention on a divided attention golf task under a state of ego depletion. Similar results were found, the experimental group significantly increased their performance on the final measurement compared to the baseline measurement while the control group did not increase their performance.

Physical fatigue and performance

It is well established that cognitive processing plays a crucial role and interferes with decision making in the context of sport performance. Sport performance commonly induces physical fatigue, sometimes to the point of physical exhaustion. However, previous research in the self-talk literature has not yet taken into consideration the variable of exhaustion.

Great research interest was allocated to the examination of the influence of physical fatigue on cognitive processes. The results extracted can be characterized ambiguous, since some evidence suggests that physical fatigue significantly lengthens central processing (e.g. reaction time) (Sparrow, W.A., & Wright, 1993), whereas some other evidence suggests that the volitional exhaustion did not affect central processing (Tomporowski, P.D., Ellis, N.R., & Stephens, 1987). Generally, there is no agreement on how physical exhaustion interferes with information processing in general and attentional performance in particular. A meta-analysis (Chang Y.K., Labban J.D., Gapin J.I., 2012), that examined the literature on acute exercise and cognitive performance found a small positive, overall effect (g=0.097, n=1034) and a handful of significant moderators that included exercise duration, exercise intensity, type of cognitive performance assessed and participant's fitness. Of course, the studies that were included had multiple variations of induced physical fatigue and cognitive performance operationalisation. This ambiguousness has been proposed to be the reason why inconsistent results are found (Fery Y.A., Ferry, A., Vom Hofe A., 1997). Thus for the present study, a preceding experiment was conducted (Karathanasi A., Papagiannis E., Filippou N., Nurkse L., 2018), in order to examine the effects of a specific physical exhaustion task on a divided attention task. The results suggested that fatigue had a debilitating effect on attentional performance. The same procedure, for the operationalisation of physical fatigue and attention performance was followed at the methodology of the present study. The results of the preceding experiment served the purpose of an extra manipulation

check ensuring that the participants performed a physical exhaustion task with debilitating effects being manifested upon their attentional performance.

The literature so far provides accumulated suggestions for the importance of attention for sport performance, the debilitating effect of fatigue on attentional performance and also with encouraging evidence of self-talk's facilitating effects on performance through the enhancement of attentional processes. Taking into account all the above conclusions, the current study examined whether self-talk can counter the detrimental effect of physical exhaustion on divided attention. In particular, we examined in a laboratory setting, the effects of self-talk strategies on a computer-based, divided attention test, while the participants were induced in a state of ego depletion. We expected that following the self-talk intervention, the self-talk group would have superior attentional performance than that of the control group.

Method

Sample and apparatus

Sixty sport science students (29 female, 31 male, mean age = 20.23) were randomly assigned into two equal groups. Participants provided written informed consent before the onset of the study and received course credit for their participation.

Divided Attention Assessment

The Test Battery for Perception and Attention Functions (Sturm, 2006) of Vienna Test System (VTS) was used to assess attentional performance. The VTS comprises six tests assessing attention functions corresponding to the dimensions described by the conceptualisation of (Sturm, 2005). In the present study, the unimodal visual test from S1 was used for the final measurement of the divided attention.

Stimuli were presented on a 20-in LCD widescreen computer monitor with screen dimensions of 1280×720 pixels. Participants were entering their responses on a designated panel (Universal response panel, Schuhfried). Physical fatigue was measured using the Borg Scale Of Perceived Exertion (Borg, 1982). Afterwards, the participants were asked to run on an indoor treadmill track (Impulse RT700), both groups followed the same protocol.

Procedure

The institution's ethics committee provided permission to conduct the study. The experiment included four phases that were completed in one session: baseline assessment, training intervention, inducing physical fatigue through running and a final assessment. For this study, a between-subjects experimental design was adopted.

Phase 1 Baseline assessment

First, participants were randomly divided into two groups, control and self-talk intervention group. They received information regarding the requirements of the study and signed a consent form. They also provided information regarding their health medical history and demographic information. Next, they wore a polar device that tracked down their heart rate throughout the session. They were instructed to lie down for ten minutes, in a mattress that was placed in the lab, and try to relax. In a different room of the lab, we measured their lowest heart rate. Based on their lowest heart rate value we estimated participants 75%, 80% and 85% max heart rate. Then the participants completed a nine-item ego depletion manipulation check questionnaire, that was delivered to measure how depleted the participants felt at the moment. Responses were given on a 10 point Likert type scale ranging from 1 (not at all) to 10 (very much). Afterwards, the baseline assessment took place. The inclusion of a baseline measurement was

deemed necessary in order to control for differences between the control and the experimental group. The visual pre-test WAFW S3 was administered to the participants for the baseline measurement. The participants followed the same instruction given to them orally and standard computerized instructions that were presented on the monitor for both groups. Participants were also informed that their reaction time and the correctness of their responses would be recorded. The baseline measurement lasted four minutes.

Phase 2 Training program

Following the completion of the baseline assessment, the participants were administered WAFW S2 pre-test. On this occasion, they completed the test twice, so the overall time for the completion of the tests was eight minutes. The participants followed, once again, instructions that were given to them orally and standard computerized instructions that were presented on the monitor for both groups. Participants were also informed that their reaction time and the correctness of their responses would be recorded. The participants of the experimental group received in addition, information about the use of self-talk strategies and how to implement it. In particular, they received general information about self-talk as a performance-enhancing strategy and instructions about which self-talk cues they are going to use, when they will use them and for what purpose. The participants were also given the option to use the self-talk cues either covertly or overtly. Generally, the training phase was considered a necessary part of the experimental design because of the positive impact it has demonstrated as a moderator on the effectiveness of self-talk interventions (Hatzigeorgiadis et al., 2011). Also, a different attentional task than that of the final assessment was opted for the training of self-talk, so that any learning effects could be eliminated.

Phase 3 Physical fatigue induction

Next, the participants were guided to the treadmill in order for the physical fatigue induced ego depletion to take place. They received some information regarding safety precautions, and they were shown the Borg Scale of Perceived Exertion (Borg, 1982). It was explained to them that when they start running, they will be asked, every minute, to provide a number that corresponds to their perceived exertion. Afterwards, they were informed about the details of the running protocol; namely, they started with a warm-up in low intensity for three minutes, then they continued without stopping at nine k/h, and the inclination of the treadmill was elevated at 2%, in order to induce greater muscle fatigue. From this point and on, they were asked every minute to provide a number between 6 and 20 and every three minutes the speed of the treadmill was elevated one k/m per hour. A research assistant was standing beside the participants their speed, track down their responses on the Borg scale and their heart rates. When the participant indicated 18 or above at the Borg scale, and their heart rate was above 75% of their max heart rate, then the speed was lowered at 6km/hr for one minute, and the treadmill was shut off.

Session 4 Final assessment

Following the induction of ego depletion through physical fatigue, the participants were guided right away at the computer room where they completed the ego depletion manipulation check, the same that was administered to them at phase 1. The time interval between finishing the depletion task and the initiation of the final assessment was approximately three minutes. The divided attention test (unimodal (WAFG unimodal visual test from S1), from the Test Battery for Perception and Attention Functions of the Vienna Test System served as the task for the final assessment. Participants followed instructions given to them orally and standard computerized instructions that were presented on the monitor for both groups. Participants were also informed that their reaction time and the correctness of their responses

would be recorded. Also, the participants of the experimental group have reminded the information about the use of self-talk strategies and how to implement self-talk in this specific attention task. In particular, they were informed which self-talk cues to use in each case, namely “square”, “circle”, “both” or “cancel”. When correctly to use them and for what purpose. They were also given the option to use the self-talk cues either overtly r covertly. The divided attention final assessment test lasted for about fifteen minutes. Upon the completion of the divided attention test, the participants of both groups were asked to complete a standard self-talk manipulation check. Those in the control group were asked to indicate whether they deliberately and systematically implemented any form of self-talk while undertaking the divided attention task and if they did, to provide the extent to which they implemented this cognitive strategy on a 10 point scale (1= not at all, 10=all the time).

Results

Control measures

A number of analyses involving control measures were conducted to ensure the integrity of the experimental validity. In particular, analyses of variance were calculated to test for differences between the two groups on (a) reaction time and number of mistakes for the baseline attention test, (b) running time, highest speed during the running task, heart rate on completion of the running task, and (c) levels of physical fatigue and muscle fatigue before the final attention test. Descriptive statistics for all measures are presented in Table 1.

Baseline attention test

The analysis for the baseline attention test showed a non-significant multivariate effect, $F(2, 57)= 0.92$, $p= .41$. Examination of the univariate effects showed non-significant differences between groups on reaction time, $F(1, 58)= 1.18$, $p= .28$, and number of mistakes, $F(1, 58)= 0.03$, $p= .86$.

Running task

The analysis for the variables of the running task showed a non-significant multivariate effect, $F(3,56)= 1.14$, $p=.34$. Examination of the univariate effects showed non-significant differences between groups on running time, $F(1,58)= 0.76$, $p=.39$, running speed, $F(1,58)= 0.22$, $p=.64$ and running heart rate, $F(1,58)= 0.91$, $p=.34$.

Physical and muscle fatigue

The analysis for the variables of fatigue showed a non-significant multivariate effect, $F(2,57)= .08$, $p=.92$. Examination of the univariate effects showed a non-significant differences between groups on physical fatigue, $F(1,58)= .01$, $p= 1$, muscle fatigue, $F(1,58)= .10$, $p=.76$.

Table 1.

	Control	Experimental
Baseline reaction time (ms)	0.66±0.12	0.63±0.11
Baseline correct responses (%)	92.27±6.6	92.5±4.4
Running Time (min)	10.6±4.8	9.7±3.0
Running speed (km/h)	11.40±1.9	11.20±1.3
Running heart rate	184.8±9.8	186.9±7.4
Physical fatigue	5.08±2.11	5.08±2.58
Muscle fatigue	5.57±2.11	5.38±2.58

Final Assessment

The analysis for the final attention test showed a significant multivariate effect, $F(2,57)= 4.23$, $p<.05$. Examination of the univariate effects showed significant differences between groups on reaction time, $F(1,58)= 4,21$, $p<.05$ and total mistakes, $F(1,58)= 5.81$, $p<.05$.

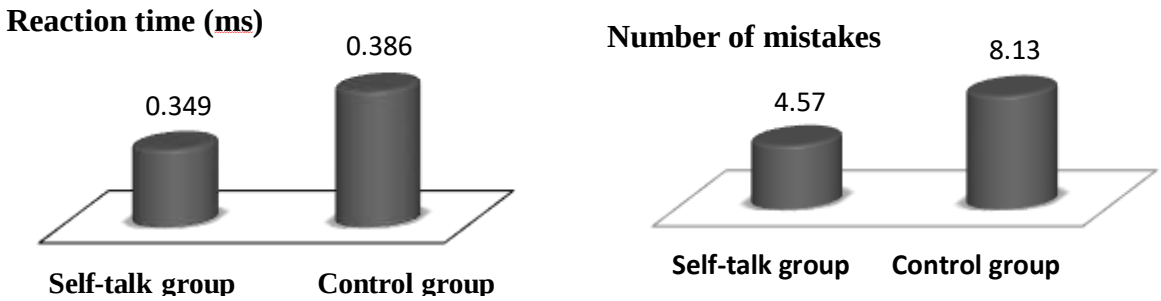

Figure 1.

Discussion

The purpose of the study was to examine whether self-talk can help attentional performance, specifically the function of divided attention, following the adverse condition of physical fatigue. We expected that self-talk would counter the detrimental effect of physical exhaustion on a divided attention lab test.

Integrity of experimental manipulations

The experimental design included several experimental manipulation checks in order to secure and ensure the integrity of the experimental procedure. First, the independent samples t-test for reaction time and total mistakes made revealed that the two groups did not differ significantly at the baseline assessment. So, this means that the two groups performed equally at the selective attention baseline test and an equivalent result was to be expected at the divided attention test if there wasn't a self-talk intervention in between. Second, several aspects of the physical fatigue induction phase were recorded for later analysis. Specifically, the experimental and the control group did not differ significantly at their

total run time, running speed and their running heart rate. So besides the fact that the two groups did not differ in pre and post manipulation check scores of physical fatigue and muscle fatigue, those aforementioned objective measures ensure that both groups withstood the same amount of physiological and perceived physical fatigue.

In conclusion, the lack of differences between the two groups in these variables secure the integrity of the experimental conditions, thus enhancing our confidence for the findings.

Effectiveness of self-talk intervention

The experimental procedure of the present study is interrelated with the preceding experiment that examined the effects of physical exhaustion on a divided attention test. As it is aforementioned the exact same operationalization of physical exhaustion was followed in the present study. The results of the pre-experiment showed that fatigue had a debilitating effect on attentional performance.

In the present study it was examined whether a mental strategy such as self-talk may help countering the effects of fatigue on attention functions. The results showed that the self-talk group displayed faster reaction times and less mistakes on a divided attention lab test, indicating that self-talk can help preserving or renewing attentional resources, thus benefiting the function of divided attention.

These findings are in accordance with previous findings examining the effectiveness of self-talk strategies under adverse conditions. First, Galanis et al, (2017) explored the effectiveness of self-talk strategies on task performance, under conditions of external distractions in laboratory and field experiments. In both experiments participants of the self-talk group performed better than the participants of the control group, suggesting that self-talk can counter the effects of distraction on performance. Furthermore, Gregersen et al. (2017) examined the effects of a self-talk intervention on selective attention while the participants were in a state of ego-depletion. The results of this study,

suggested that the use of self-talk can benefit selective attention for participants in states of ego depletion.

The effectiveness of the self-talk intervention in the present study is interpreted through the approach that regards attention as a limited capacity resource. Moreover fatigue seems to reduce available attentional resources and constrain the processing of available cues. So, the self-talk intervention effectiveness exists in the countering of the negative consequences of physical fatigue by preserving or renewing attentional resources.

Limitations

The present study combines two contemporary lines of research, the one that investigates the mechanisms through which self-talk strategies facilitate performance and the one that examines the effects of self-talk interventions on task performance under adverse conditions. It also forwards research as it is, to our knowledge, the first study that examines the effects of a self-talk intervention on divided attention following physical exhaustion. Nevertheless, the study was conducted in a lab setting and subsequently there is limited generalizability of the findings.

Directions for future research

Future research is encouraged to test the hypotheses in field settings, using sport tasks and realistic, for the sport, physical fatigue manipulations. This will support the external validity of the findings on the self-talk literature. Moreover, the future implementation of more extensive self-talk intervention training periods will strengthen and improve the methodological part of the self-talk literature.

Furthermore, future research could study the effects of self-talk strategies under different adverse conditions and on different attention dimensions, both in a lab and a field setting. Also, future research could focus on participants that are athletes of a specific sport or at different level of athletes.

Conclusions

The present study for the first time takes into consideration the effect of fatigue on divided attention. The meticulous methodological design included a preceding experiment that established the debilitating effect of physical fatigue on attentional performance. The findings provide further support for the attentional effects of self-talk as a plausible mechanism explaining the facilitative effects of self-talk on sport task performance. The present study can guide future research, inform practice and contributes its small part to the creation of a unified self-talk theory.

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