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Countering the Consequences of Ego Depletion: The Effect of Self-Talk on Selective Attention

by

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Abstract

Aim: The purpose of this study was to test the effect of a self-talk intervention on selective attention in a state of ego-depletion.

Method: Sixty-two undergraduate students (M age 20.02, SD = 1.17 years) participated in the study. The experiment was conducted in four sessions in one week: baseline assessment, 2 training sessions, and final assessment. After the baseline assessment, the participants were randomly assigned into two equal groups (control and experimental group). A 2-session intervention was conducted for the two groups, with the only difference being that the experimental group received self-talk training. In the final assessment the participants first completed a task that induced a state of ego-depletion, followed by two computer-based tasks (auditory and visual) testing selective attention with performance being measured in percentage of correct responses and reaction times.

Results: Analysis of variance for percentage of correct responses revealed a significant effect for the visual test ($p < .05$), with participants of the experimental group achieving higher percentage, and a non-significant effect for the auditory test ($p = .31$). Analysis of variance for reaction time revealed a marginal effect for the visual test ($p = .054$), and a significant effect for the auditory test ($p < .01$) with participants of the experimental group having faster reaction times.

Conclusion: The results of the study showed that the use of self-talk can enhance selective attention for participants being tested in an ego-depletion state. Thus, it can be argued that the negative consequences that ego-depletion can have on attention, can be reduced with the use of self-talk.

Keywords: self-talk mechanisms, concentration, coping with distractions, self-control

Countering the Consequences of Ego Depletion: The Effect of Self-Talk on Selective Attention

The ability to focus the attention on task relevant stimuli, while ignoring task-irrelevant stimuli such as internal distractions (e.g. worrying thoughts) as well as external distractions (e.g. flash-lights from cameras, and sounds and movement from audience) might be essential for athletes in order to experience performing on their highest level. More specifically, attention seems to be one of the most important cognitive abilities to successful sports performance (Moran, 2009). Nevertheless, attention control, which is a self-control act, seems to be dependent on the strength of self-control that is available for the individual in the specific moment (Baumeister, Bratslavsky, Muraven, & Tice, 1998).

One theoretical model explaining the nature of self-control is the strength model of self-control (Baumeister, Vohs & Tice, 2007), which proposes that self-control strength is a limited resource that is being temporarily depleted when acts that require self-control are carried out. When explaining the nature of self-control the comparison to a muscle can be a useful analogy. Both self-control and a muscle require strength and energy to perform an action over a specific amount of time. After an amount of time of action the muscle becomes fatigued. The same can be said about self-control, which reduces in strength after performing a self-control action over an amount of time. The diminished state of self-control strength is referred to as *ego-depletion*, meaning that there is a reduced capacity of self-control available for a certain amount of time, which can lead to impaired performance of subsequent actions that require self-control (Baumeister et al., 1998). The model also posits that self-control strength is not domain specific, meaning that when self-control is used for the performance of an action in one domain (e.g. resisting temptations), actions in other domains requiring self-control (e.g. controlling attention) might be impaired compared to when self-control strength is not depleted (Baumeister et al., 1998). According to Baumeister and colleagues (2007), tasks requiring self-control can be divided into the following domains: a)

controlling attention, b) controlling emotions, c) controlling impulses, d) controlling thoughts, e) cognitive processing, f) choice and volition, and g) social processing.

The cause of ego-depletion has typically been examined using a so-called *dual-task paradigm*, with a subsequent self-control demanding task being performed immediately after the completion of an initial self-control demanding task. This dual-task paradigm has found to lead to a decrease in performance in the subsequent task. According to the strength model of self-control, the reason for the decrease in performance in the subsequent task is a result of a reduced state of self-control because of the initial self-control action, leading to a state of ego-depletion for the individual (Baumeister, 2007).

Several studies have shown that a state of ego-depletion can be detrimental to performance. For instance, domains that have found to be impaired as a cause of ego-depletion are resisting temptations (Muraven & Baumeister, 2000), ability to persist in the face of failure (Schmeichel, Vohs, & Baumeister, 2003), selective attention (Schmeichel & Baumeister, 2010) decision-making (Furley, Bertrams, Englert & Delphia, 2013) and distractibility (Englert, Bertrams, Furley & Oudejans, 2015). Furthermore, a recent meta-analysis on 83 studies revealed a significant effect of ego-depletion on self-control task performance (Hagger, Wood, Stiff, & Chatzisarantis, 2010).

Based on the fact that several studies have found a detrimental effect of a state of ego-depletion on performance because of its reduced strength of self-control required to perform subsequent self-control demanding actions, researchers have attempted to develop relevant strategies to counteract the effects of ego-depletion and subsequently enhance performance. Specifically, research has focused on increasing the self-control capacity through training as well as to replenish the depleted resources through rest and glucose intake.

Regarding training, 7 studies were included in the meta-analysis (Hagger et al., 2010) examining the effects of self-control training on subsequent performances requiring self-control

(Finkel et al., 2009; Gailliot, Plant, Butz, & Baumeister, 2007; Hui et al., 2009; Muraven, Baumeister, & Tice, 1999; Oaten & Cheng, 2006a, 2006b, 2007). The results revealed a large significant effect of training, indicating that trained participants exerted greater performances on subsequent self-control tasks and reported a lower level of ego-depletion compared to untrained counterparts. Regarding rest and recovery, studies have shown that participants who completed a period of rest after an initial self-control task exerted greater performance on a subsequent task, compared to individuals who did not rest (Oaten, Williams, Jones, & Zadro, 2008; Tyler & Burns, 2008). This indicates that self-control strength can increase as a function of time of rest. Regarding glucose intake, studies have shown that depleted individuals receiving glucose as a supplementation, perform significantly better on self-control tasks compared to depleted individuals receiving sweet placebo (DeWall, Baumeister, Gailliot, & Maner, 2008; Gailliot, Baumeister et al., 2007; Gailliot, Peruche, Plant, & Baumeister, 2009; Masicampo & Baumeister, 2008).

These results are positive as athletes might benefit from self-control training, rest and glucose intake between competitions or matches. However, self-control training can only increase the amount of time until an individual reaches a state of ego-depletion. Furthermore, self-control training cannot prevent the fact that a state of ego-depletion will occur after a certain amount of time of self-control actions. Moreover, athletes do not always have time for intake of nutrition or rest. This is for example evident during competitions, matches or shorter period of matches. Therefore, athletes are likely to experience a state of ego-depletion during competitions, which subsequently will have an effect on performance. Specifically one aspect that might be impaired as a cause of ego-depletion is attention (Baumeister et al., 2007).

As previously mentioned, self-control is required in order to exert actions in several domains. However, an individual's ability to exert selective attention has shown to be one of the most important self-control acts, since it influences all the other self-control demanding acts

(Schmeichel & Baumeister, 2010). In order to be able to focus the attention on task relevant stimuli, while ignoring task-irrelevant stimuli, selective attention is needed. (Schmeichel & Baumeister, 2010). A recent study on the effect of ego-depletion on attention found that as athletes get into a state of ego-depletion, their ability to deal with distractions (task-irrelevant stimuli) is impaired (Englert et al., 2015). Based on this it can be argued that developing a strategy that can enhance attention when impaired as a cause of ego-depletion is of high importance.

One strategy that has been argued to enhance attention is self-talk (Theodorakis, Hatzigeorgiadis, & Zourbanos, 2012), although this relationship has not been examined with participants in a state of ego-depletion. A definition of self-talk is that "self-talk refers to what people say to themselves either internally or aloud, inherently or strategically, to simulate, direct, react and evaluate events and actions" (Hatzigeorgiadis, Zourbanos, Latinjak, & Theodorakis, 2014).

There is robust evidence of the effectiveness of self-talk on performance, with a recent meta-analysis on self-talk showing a moderate effect size (d= 48; Hatzigeorgiadis, Zourbanos, Galanis, & Theodorakis, 2011). According to Theodorakis, Hatzigeorgiadis, and Chroni (2008), the potential mechanisms through which self-talk might affect performance are: enhancing attentional focus, increasing confidence, regulating effort, controlling cognitive and emotional reactions, and triggering automatic execution.

Regarding attentional focus, Hatzigeorgiadis et al. (2004) examined the effects of motivational and instructional self-talk on the occurrence of interfering thoughts and performance on a precision task in water polo. The results showed that the self-talk group using instructional self-talk had the greatest improvement on the performance, while both groups experienced a significant decline in interfering thoughts in comparison to the control group. Bell and Hardy (2009) conducted a study with a group of skilled golfers, comparing the effects of three different

focus of attention (internal, proximal external, and distal external). They found that skilled golf performers using a distal external focus of attention perform executed the most accurate performance. These results indicate that there is a link between the way people talk to themselves, their attentional focus and the subsequent behaviour. Recently researchers have started to conduct studies examining the effects of self-talk on different aspects of attentional focus.

Regarding different aspects of attentional focus, a series of studies were conducted examining the effect of a 3-session self-talk training intervention on 6 attentional aspects: alertness, vigilance, selective attention, focused attention, divided attention, and spatial attention (Galanis, Hatzigeorgiadis, Zourbanos, & Theodorakis, 2016). The researchers tested the effectiveness of self-talk use on reaction times and percentage of correctness on the 6 attention tasks. The results showed that the self-talk group had significantly better reaction times compared to the control group on all 6 tasks. However, no differences were found in percentage of correctness between the two groups.

These studies clearly indicate that self-talk can serve as an effective strategy to enhance attention and subsequently performance. Nevertheless, despite the research showing that a state of ego-depletion is leading to impaired attention, and the robust evidence that self-talk can enhance attention, to our knowledge, no studies have examined the effects of self-talk on attention in a state of ego-depletion.

The purpose of the study was to examine the effects of self-talk on selective attention, under condition of ego-depletion. Based on previous findings on the effects of self-talk on attention and more precisely selective attention, we hypothesized that the use of self-talk in an ego-depletion state would lead to enhanced selective attention.

Method

Participants

Sixty-two students (33 male and 29 female) from undergraduate programs in physical education and sport science participated voluntarily in the study. The mean age of the participants was 20.02 (SD = 1.17) years.

Procedure and intervention

The institution's ethics committee provided permission to conduct the study. The experiment included four sessions that were conducted in four consecutive days: baseline assessment (session 1), two training sessions (session 2-3) and final assessment (session 4).

Session 1. Each participant received information on the purpose of the study and their rights to withdraw from the study at any time. Afterwards, each participant signed a consent form. After signing the consent form, the participants received instructions regarding the assessment of session 1. First, participants completed two questionnaires regarding perceived computer typing skills and perceived state of self-control in a paper-and-pencil setting. Afterwards, a non-depleting manipulation task was applied, in which participants transcribed a neutral text from one document to another on a computer screen for 8 minutes. The task was to transcribe as fast as possible with as few mistakes as possible (without receiving any other instructions). Subsequently, participants completed a manipulation-check assessing the difficulty of the transcription task. Finally, the participants completed two preliminary tests, one auditory (S3) and one visual (S6) on the VTS test battery. These pre-tests are specifically developed to measure reaction times and percentage of correct responses to relevant auditory and visual stimuli presented on a computer screen and in a headset. The participants had to react by pressing the appropriate button on response panel.

The purpose of the baseline assessment was to examine the participants' typing skills, state of self-control strength at the beginning of the session, perceived difficulty of the manipulation task,

and to assess the perceptual ability needed to perform on the final assessment (WAF test in final assessment), but also to control for baseline differences. Each participant was tested individually in a quiet and controlled laboratory environment.

Session 2-3. In session 2-3, the participants from the experimental group received self-talk training in addition to training for dart throwing, while the participants from the control group only received training for dart throwing. The dart throwing training lasted approximately 20 minutes, and included 3 sets of 20 dart throws (a total of 60 throws) from a distance of 2.37 m from the dartboard that was placed 1.73 m above floor level. The instructor recorded the score from 0 (hitting outside the dartboard) to 10 (hitting the centre of the dartboard) for every attempt.

Experimental group: The participants from the experimental group started the training session receiving information regarding basic technical aspects of dart throwing (e.g. positioning of the shoulder and movement of the arm). Subsequently, participants were instructed in the use of a self-talk strategy. The instructions distinguished between the purpose of motivational and instructional "cue words" and the effects of self-talk on different aspects of performance (e.g. attention and effort). Before every set of 20 darts, a self-talk cue was assigned and should be applied before the execution of every throw. Also, each participant was informed when and why the specific cue should be applied, and that the cue word could be applied covertly or aloud. At the end of each of the two sessions, participants completed a 1-item manipulation check to test to which extent the assigned self-talk cue-words were applied. The purpose of the training was to educate the experimental group about the effects of self-talk on performance, and to practice using self-talk without practising it on the main VTS task, in order to prevent a learning effect on the performance scores for the final assessment (session 4).

The control group: Participants from the control group received the same instructions regarding dart throwing, as well as they had to execute 60 dart throws in which the scores were

recorded. The only difference was that the participants from the control group did not receive any information regarding self-talk.

Session 4. The final assessment included two tasks. First, a 10-item questionnaire was applied to measure the participants' perceived state of self-control strength. Subsequently, we attempted to manipulate participants' self-control strength by applying a transcription task, which has found to be effective in previous studies (Bertrams et al., 2010). Each participant transcribed a neutral text for 8 minutes on a computer screen from one Word document to another. In contrast to the non-depleting manipulation task in the baseline assessment, participants were informed to leave out the letters *a* and *o*, which are the most common letters in the Greek alphabet. Also, participants were informed to transcribe the text as fast as possible and with as few mistakes as possible. This task has found to require self-control strength, as one has to override one's normal writing routines (Schmeichel, 2007). After the transcription task, a 4-item manipulation check was applied to test for the effectiveness of the transcription task on perceived state of self-control strength.

Immediately after the completion of the 4-item manipulation check, the second task of the final assessment was conducted. After receiving relevant instructions, participants completed two main tests (WAF-S) on the VTS test battery. More specifically, the tests WAF-S visual and WAF-S auditory were applied. These tests are specifically developed to measure selective attention to relevant visual and auditory stimuli. Standardized instructions for the two tests were displayed on a monitor. Participants from both groups (control and experimental) were informed to react as fast as possible and as correct as possible to the relevant stimuli. In addition, participants from the experimental group were informed to apply an assigned self-talk cue with the aim to enhance selective attention to the given stimuli. Each of the two tests lasted approximately four minutes. After the completion of the two tests (WAF-S visual and WAF-S auditory) all participants completed a manipulation check protocol regarding the applied strategy during the two tests.

Measures

Control measures and manipulation checks. In order to support the integrity of the experiment a series of manipulation checks were conducted. First, participants answered three items on a 7-point Likert-type scale (from 1 *not good at all* to 7 *very good*) assessing participants perceived level of typing on a computer keyboard (e.g., "What is your level of fast typing?") The scale showed adequate internal consistency (Cronbach's alpha: .87).

In order to rule out differences in the state of self-control between the two groups at the beginning of the baseline and final assessment, a short version of the State Self-Control Capacity Scale (SSCCS; Ciarocco, Twenge, Muraven & Tice, 2015) was applied. Participants answered 10 items on a 7-point Likert-type scale (from 1 *not true at all* to 7 *very true*) assessing the participants perceived state of self-control (e.g., "I feel sharp and focused"). The scale showed adequate internal consistency for both the baseline and final assessment (Cronbach's alpha: .90 and .92 respectively)

A transcription task was applied in order to experimentally manipulate self-control strength (Bertrams, Englert & Dickhäuser, 2010). At baseline assessment, participants transcribed a text for 8 minutes with the single instruction to transcribe as fast as possible with a few mistakes a possible. At the final assessment, participants received the same instructions in addition to the important instruction to always leave out the letters *a* and *o*, which are the two most common letters in the Greek alphabet. Overriding one's normal typing routine is considered as an action requiring self-control, and has previously found to deplete self-control strength compared to a normal transcription task (cf. Schmeichel, 2007).

After completion of the two transcription tasks (baseline and final assessment), a 4-item manipulation check (Englert, Zwemmer, Bertrams & Oudejans, 2015; e.g., "How depleted do you feel at the moment?") was applied to measure the effect of the two transcription tasks on the momentarily available self-control strength. The participants answered on a 7-point Likert-type

scale (from 1 *not at all* to 7 *very much*). The scale showed adequate internal consistency for both the baseline and final assessment (Cronbach's alpha: .77 and .72 respectively). In addition we counted the number of transcribed characters at baseline and final assessment based on the assumption that the transcription task, where the participants had to leave out the letters *a* and *o* (final assessment) would be more difficult, and therefore the participants were expected to transcribe fewer characters.

The participants' use of self-talk cue-words in training and at the final assessment was also recorded. Regarding the training sessions, participants from the experimental group answered a 1-item manipulation check after each of the two training sessions ("To which extent did you use the assigned self-talk cue?") on a 10-point scale (from 1 *not at* all to 10 *very* much). Regarding the final assessment, the participants from the experimental group were asked a) if they used the assigned cue-words, b) if yes, to which extent they used the assigned cue-words (from 1 *not at all* to 10 *all the time*), c) if they used any other strategy, d) if yes, to report the used strategy, and e) to which extent this strategy was used (from 1 *not at all* to 10 *all the time*). Participants from the control group were asked to report their strategy-use during the completion of the two tests. Specifically, participants from the control group were asked a) to report if they used a specific strategy, b) if yes, what this strategy was, and c) to which extent the strategy was used (from 1 *not at all* to 10 *all the time*). Similarly, the participants were asked to report their self-talk use during the two tests: a) if self-talk was used, b) if yes, which self-talk cues were used, and c) to which extent the cues were used (from 1 *not at all* to 10 *all the time*).

Performance. Attentional performance was assessed on the Vienna test system (VTS) test battery, which has a number of settings specifically developed to measure attention. Regarding the second task, performance was measured by reaction times and percentage of correctness in two tasks (visual and auditory) on the VTS test battery measuring selective attention.

Results

Manipulation check

Self-talk use in training. In order to test whether the participants from the experimental group used self-talk during the two training sessions, a 1-item manipulation check was applied ("To which extent did you use thee assigned self-talk cue?") on a 10-point scale (from 1 *not at* all to 10 *very* much). In the first training session (session 2) the participants reported a mean score of 8.29 (SD= 1.27), and for the second training session (session 3) a mean score of 8.38 (SD= 1.20) was reported for the use of self-talk. These scores indicate an adequate use of self-talk for the experimental condition during the two training sessions.

Self-talk use in the final assessment. The manipulation check protocol was examined to assess whether participants from the experimental group and the control group used self-talk during the final assessment. Participants from the experimental group reported a mean score of 8,33 (SD= .97). Four participants from the experimental group reported an insufficient score (< 7) on the use of self-talk. Also, 12 participants from the control group reported a consistent (≥ 7) use of self-talk in the final measure. In order to ensure the integrity of the two conditions, the 4 participants from the experimental group and the 12 participants from the control group were excluded from the subsequent analyses. Furthermore, 1 participant from the control group and 4 participants from the self-talk group were identified as outliers and were therefore excluded from the subsequent analyses. The final sample for the analysis included 21 participants from the experimental group and 20 participants from the control group.

Baseline differences and control measures

A series of control analysis were conducted to test for baseline differences between the experimental and control group in perceived typing skills, percentage of correct responses on the tests S3 and S6 and reaction times on S3 and S6. First, a t-test was conducted to test for differences

in perceived typing skills, revealing no significant differences between the two groups in perceived typing skills, t (39) = -1.11, p = .28. A one-way MANOVA conducted on percentage of correct responses for the baseline test (S3 and S6) showed no significant differences between the two groups in S3, F (1, 39) = .587, p = .448 or in S6, F (1, 39) = .628, p = .433. Finally, a one-way MANOVA on the reaction times for the baseline test revealed no significant differences between the groups in S3, F (1, 39) = 2.241, p = .142 or in S6, F (1, 39) = 2.291, p = .138.

Ego depletion manipulation

A series of analyses of repeated measures were conducted to test for differences in self-control state, task difficulty (level of ego-depletion after the manipulation) and number of transcribed characters for the two tasks between the two groups (experimental and control group) at the two conditions (baseline and final assessment) as well as within the two groups at baseline and final assessment.

A two-way (condition by group) repeated measures ANOVA was conducted to test for differences on state of self-control strength between the two groups as a function of condition. The analysis revealed a non-significant condition effect, F (1, 39) = .610, p = .439, and a non-significant condition by group interaction, F (1, 39) = .965, p = .332, in state of self-control strength.

A two-way repeated measures ANOVA was performed to test for differences in level of ego-depletion between the two groups as a function of the ego-depletion manipulation. The analysis revealed a significant condition effect, F (1, 39) = 51.738, p < .01, and a non-significant group by condition interaction, F (1, 39) = .37, p = .546, in task difficulty. Examination of the mean scores revealed that participants scored significantly higher after the final assessment transcription task compared to the baseline assessment transcription task, indicating that the ego-depletion manipulation was equally effective across groups.

Finally, a two-way repeated measures ANOVA was conducted to test for differences in the number of transcribed characters in the transcription task between the two groups as a function of condition. The analysis revealed a significant condition effect, F (1, 39) = 167.622, $p < .01$, and a non-significant condition by group interaction, F (1, 39) = .003, $p = .958$, in number of transcribed characters. Examination of the mean scores showed that the participants transcribed significantly more characters in the baseline assessment compared to the final assessment supporting the assumption that the transcription task in the final assessment induced a state of ego-depletion. Descriptive statistics for all baseline measures are presented in Table 1.

Table 1. Descriptive statistics for the baseline measures.

	Control	Experimental
State of self-control	2.77±1.06	2.38±0.89
Perceived typing skills	3.53±1.04	3.87±0.92
Transcribed characters	748.35±239.55	812.90±218.99
Level of ego-depletion	3.15±0.90	3.33±1.01
Reaction time S3	0.67±0.16	0.60±0.10
Reaction time S6	0.36±0.10	0.31±0.09
Percentage of correct responses S3	93.00±4.23	94.10±4.88
Percentage of correct responses S6	97.97±3.02	98.75±3.25

Attentional performance

A one-way MANOVA was conducted to test for differences on percentage of correct reactions for the two tests between the control group and the experimental group. The analysis showed a significant multivariate effect, F (2, 38) = 4.018, $p < .05$. The examination of the univariate statistics revealed a significant effect for the visual test, F (1, 39) = 8.246, $p < .01$, with

the self-talk group exerting a higher percentage of correct reactions for the visual test. The statistics revealed a non-significant effect for the auditory test, F (1, 39) = 1.073, p = .307, between the two groups.

A one-way MANOVA was conducted to test for differences on reaction times for the two tests between the two groups. The analysis showed a significant multivariate effect, F (2, 38) = 3,895, $p < .05$. Examination of the univariate statistics revealed a marginal effect for the visual test, F (1, 39) = 3.936, p = .054, and a significant effect for the auditory test, F (1, 39) = 7.987, $p < .01$, with the self-talk group exerting faster reaction times on both tests compared to the control group. Descriptive statistics for all final measures are presented in Table 2.

Table 2. Descriptive statistics for the final test

	Control	Experimental
Control variables		
State of self-control	2.74±1.10	2.69±0.95
Transcribed characters	447.35±104.85	509.43±135.75
Level of ego-depletion	4.14±0.85	4.17±1.00
Dependent variables		
Reaction time visual	0.33±0.08	0.29±0.44
Reaction time auditory	0.48±0.16	0.37±0.08
Percentage of correct responses S3	92.25±4.42	96.05±4.04
Percentage of correct responses S6	78.75±15.48	83.48±13.72

Discussion

The purpose of the present study was to examine whether a self-talk intervention could counter the negative consequences of ego-depletion on attention, which is one of the main notions

of the strength model of self-control (Baumeister et al., 2007). Specifically, the aim was to examine the effect of a self-talk intervention on selective attention in a state of ego-depletion. Overall, the results showed that the use of self-talk led to better performance in selective attention, compared to the control group. In particular, the self-talk group had faster reaction times in the visual and the auditory tests, and greater percentage of correct responses for the visual test compared to the control group. However, no differences were found in percentage of correct reactions for the auditory test. The results indicate that self-talk can be an effective self-regulation strategy to enhance selective attention in a state of ego-depletion.

Before testing the hypothesis, we wanted to evaluate the effectiveness of the ego-depletion manipulation and the self-talk intervention. We attempted to induce ego-depletion by applying the dual-task paradigm. After completing the final assessment transcription task, which was the depleting condition, participants reported a significantly higher level of ego-depletion compared to the baseline assessment transcription task, which was a non-depleting condition. Moreover, participants transcribed significantly fewer characters in the depleting condition compared to the non-depleting condition indicating that the ego-depletion manipulation was successful.

The purpose of the two self-talk training sessions was to introduce the participants of the experimental group to self-talk, and to consistently and systematically use appropriate self-talk, since including self-talk training have found to be more effective than studies not including self-talk training (Hatzigeorgiads et al., 2011). The self-talk manipulation checks showed that most participants from the experimental condition reported an adequate use of self-talk in the two training sessions. Regarding the final assessment, a few participants from the experimental group reported an inadequate use of self-talk. Also, several participants from the control group reported a systematic use of self-talk as a strategy. Acknowledging the fact that people intuitively talk to themselves, and in order to ensure the integrity of the experiment, participants from the self-talk

group reporting and inadequate use of relevant self-talk cues and the participants from the control-group reporting a systematic and consistent use of self-talk were excluded from the subsequent analysis.

The findings of our study indicate a positive effect of self-talk on performance and are in line with the self-talk literature in general. A recent meta-analysis on self-talk and sport performance suggested that self-talk strategies have a moderate effect on sport performance (d = .48). In addition, analyses of moderators showed that the effect size of self-talk in fine task was .67, for novel tasks was .73, and for interventions including self-talk training the effect was .80. The average effect size of our study, which was a novel, fine task setting including self-talk training, was d = .55. Therefore the average effect size of self-talk on performance was similar to the overall effect size of the meta-analysis. However, our results yielded a slightly lower effect size than the effect sizes on self-talk interventions including novel tasks, fine tasks or self-talk training.

Regarding the ego-depletion literature, the strength model of self-control posits that a state of ego-depletion can negatively influence attentional processes that require self-control. Therefore, a state of ego-depletion has found to have a detrimental effect on participants' ability to deal with distractions (Englert et al., 2015) and to struggle to pay attention to task-relevant stimuli (Schmeichel & Baumeister, 2010). Three main strategies to deal with the negative consequences caused by ego-depletion have been reported in the literature. Studies have supported the effects of self-control training on the amount of time to ego-depletion, which can be considered as a pre-competition strategy. Moreover, methods such as glucose intake, rest and recovery have also been tested and found to be beneficial on post-competition replenishment of self-control strength (although glucose intake might be beneficial in some situations during competition). Thus, the development of a self-regulation strategy aiming to counter the negative consequences of ego-depletion during competition might be of high importance. Kolovelonis, Goudas and Dermitzaki

(2012) examined the effectiveness of self-talk as a self-regulation strategy in a dart-throwing task. The results revealed that participants' applying a self-talk strategy were significantly better in exerting a self-regulated behaviour compared to their counterparts, although this study was conducted in a non-depletion condition. Therefore, self-talk was found to be an effective self-regulation strategy. The findings from our study are in line with these results, indicating that practicing and applying task-relevant self-talk cues can function as a self-regulation strategy by directing attention towards task-relevant stimuli, and to some extent counter the negative consequences that are caused by decreased strength of self-control. To our knowledge, this is the first study to examine the effects of self-talk use in a state of ego-depletion.

Galanis et al. (2016) recently conducted a study on the effectiveness of self-talk use on 6 aspects of attentional focus in a low-complexity computer based task. They found that the self-talk group had significantly better reaction times compared to the control group. However, no differences were found in percentage of correct responses. Comparing our findings with the findings from Galanis et al., both studies support the effectiveness of self-talk on participants' reaction times. However, our study showed that the self-talk group had a significantly higher percentage of correct responses than the control group, but only for the visual test and not for the auditory test. One explanation might be that in our study a state of ego-depletion was induced, which might have influenced participants to be more likely to get distracted by task-irrelevant stimuli as a result of decreased strength of self-control. Therefore, our task might have appeared more complex to the participants compared to the same task in a non-depleting setting, which indicates that self-talk also can serve as an effective strategy to direct attention towards task-relevant stimuli in a high-complexity setting. However, as we only found differences for the visual test, this interpretation should be cautiously considered.

Another explanation is related to the distraction hypothesis indicating that participants in a state of ego-depletion are more likely to get distracted by irrelevant stimuli. The findings from our study indicate that self-talk might have enhanced participants' attention by reducing internal or external distracting stimuli. This explanation is supported by previous preliminary evidence from the self-talk literature examining the effectiveness of self-talk use on attention in relation to internal and external distractions. Hatzigeorgiadis et al. (2004) found that the use of self-talk led to a reduction of internal distractions in the form of interfering thoughts. Moreover, a study examining the effectiveness of self-talk in a distraction-induced environment, where participants received a non-continues and sudden loud noise as the distracting stimuli revealed that the experimental group performed significantly better than the control group (Charachousi, Tsetsila, Tsimeas, Galanis, & Hatzigeorgiadis, 2014) indicating that applying self-talk as a self-regulation strategy can help athletes direct their attention to task-relevant stimuli and avoid task-irrelevant distracting stimuli.

Several issues should be taken into account for the interpretation of the present findings. The results of our study indicate that self-talk can function as an effective strategy in guiding attention in direction of task-relevant stimuli in a state of ego-depletion. However, the fact that the participants in the study were student we recommend cautious interpretations regarding the development of self-regulation strategies for athletes. Future research could use athletes as a sample to examine the effects of self-talk on selective attention in a state of ego-depletion.

In the present study it was found that applying self-talk in ego-depletion conditions produced better attentional performance, thus suggesting that self-talk countered to some extent the negative consequences of ego-depletion. It would be interesting for future studies to examine with more precision the degree to which self-talk counters the aversive effect of ego-depletion; i.e. whether the positive effects of self-talk are lower, equal, or greater than the negative consequences of ego-depletion. To achieve that, future studies could use within, rather than between, subject

design, with athletes performing well learned tasks to overcome learning effects, that would occur in the present study where students performed a novel task. .

The findings in our study offer valuable information for researchers as well as practitioners. The findings contribute to current theory trying to explain the mechanisms through which self-talk enhances performance. Moreover, this is the first study examining the effect of self-talk in a state of ego-depletion. Therefore the results open a new line of research in which researchers can examine strategies to reduce or counter the negative consequences of ego-depletion. Finally, the results from our study offer valuable information for practitioners and athletes aiming to develop interventions to enhance sports performance. Although self-control training can have an effect on self-control strength and the amount of time to experienced ego-depletion, one cannot neglect the evidence reporting decreased abilities to perform actions requiring self-control strength, when a state of ego-depletion is reached. Developing and practicing relevant self-talk strategies might be a beneficial mechanism trough which athletes can counter the negative consequences of ego-depletion, and therefore experience enhanced sports performance.

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