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Self-Talk and Sports Performance: A Meta-Analysis

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Abstract
Based on the premise that what people think influences their actions, self-talk strategies have been developed to direct and facilitate human performance. In this article, we present a meta-analytic review of the effects of self-talk interventions on task performance in sport and possible factors that may moderate the effectiveness of self-talk. A total of 32 studies yielding 62 effect sizes were included in the final meta-analytic pool. The analysis revealed a positive moderate effect size (ES = .48). The moderator analyses showed that self-talk interventions were more effective for tasks involving relatively fine, compared with relatively gross, motor demands, and for novel, compared with well-learned, tasks. Instructional self-talk was more effective for fine tasks than was motivational self-talk; moreover, instructional self-talk was more effective for fine tasks rather than gross tasks. Finally, interventions including self-talk training were more effective than those not including self-talk training. The results of this study establish the effectiveness of self-talk in sport, encourage the use of self-talk as a strategy to facilitate learning and enhance performance, and provide new research directions.

Keywords
cognition and behavior, interventions, mental strategies, review, self-instructions

People often talk to themselves. They may express feelings (“Great!”; “Damn!”), ask themselves questions (“Where did I leave the keys?”), and give themselves instructions (“Turn left here.”). It seems an odd thing to do; after all, what can we tell ourselves that we do not already know? Yet talking to ourselves has been shown to have benefits in various domains.

The idea that self-talk can have benefits is among the fundamental principles underlying the development of cognitive-behavioral therapies: treatments aiming at changing individuals’ thoughts, interpretations, and behaviors. One of the treatment approaches developed within the cognitive behavioral therapies frame is self-instructional training (Meichenbaum, 1977). Self-instructional training has been described as a form of self-management (Rokke & Rehm, 2001). Meichenbaum suggested that statements addressed to oneself influence individuals’ attentional and appraisal processes, thus regulating behavioral performance. Self-instructional training has been claimed to be useful in facilitating the learning of new skills and in enhancing the performance of adaptive responses (Rokke & Rehm, 2001). Accordingly, successful interventions involving the use of self-instructional strategies have been developed and implemented in several contexts: children with learning difficulties (Kamann & Wong, 1993); students with emotional and behavioral disorders (Callicott & Park, 2003); and individuals coping with pain (Sanders, Shepherd, Cleghorn, & Woolford, 1994), hospitalization distress (Zastowny, Kirschenbaum, & Meng, 1986), anxiety disorders, and depression (Kendall, 2006; Treadwell & Kendall, 1996).

The use of self-instructional strategies has also flourished during the last two decades in the field of sport psychology. In the field of sport, these strategies have been most commonly described as self-talk interventions and involve the use of self-talk cues aimed at facilitating learning and enhancing performance through the stimulation of appropriate responses.

History of Self-Talk in Sports

The first studies examining the effectiveness of self-talk strategies in the sport literature can be traced back to the late 1980s. Ziegler (1987) examined the impact of what she called stimulus cueing on tennis strokes, using self-talk cues such as “ball,”

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"hit," or "ready" timed according to the execution of the task to direct athletes' attention to the appropriate stimuli. Rushall, Hall, Roux, Sasseville, and Rushall (1988) examined the effect of thought content instructions on skiing performance, using cues such as "full movement range" to provide guidance, and "feel great" to boost confidence. Research that followed examined the impact of positive self-statements (e.g., Van Raalte et al., 1995) and self-instructions (e.g., Mallett & Hanrahan, 1997) on task performance. In the Van Raalte et al. study, students using a positive self-talk cue ("I can do it") performed better on a dart throwing accuracy task than did students in a control group. Mallett and Hanrahan implemented a self-talk training intervention in elite sprinters and tested its effectiveness on performance in the 100-m race. A race plan was developed with the use of appropriate cues for the three segments of the race. In particular, participants were instructed to use the cue "push" for the acceleration phase (0-30 meters), the cue "heel" for the maximum velocity phase (30–60 meters), and the cue "claw" for the speed endurance phase (60–100 meters). The intervention resulted in an important reduction in times in comparison with baseline measures.

Progressively, a categorization of self-talk cues into two broad dimensions was established, with cues described either as instructional or motivational. Motivational self-talk includes cues aiming at psyching up (e.g., "let's go"), maximizing effort (e.g., "give it all"), building confidence (e.g., "I can do it"), and creating positive moods (e.g., "I feel good"). Instructional self-talk includes cues aiming at focusing or directing attention (e.g., "see the target") and providing instruction with regard to technique (e.g., "high elbow"), strategy (e.g., "push"), or kinesthetic attributes of a skill (e.g., "smoothly"). Subsequently, studies began to explore and compare the effectiveness of the two self-talk types on performance and the findings suggest that instructional and motivational self-talk may have different effects on task performance (Hatzigeorgiadis, Theodorakis, & Zourbanos, 2004; Theodorakis, Weinberg, Natsis, Douma, & Kazakas, 2000).

Given the robust evidence regarding the facilitating effects of self-talk on performance, but also considering that different self-talk cues may have different performance effects, subsequent research has started to investigate the functions of self-talk (i.e., the mechanisms through which self-talk facilitates performance). Attempting to explore these mechanisms Theodorakis, Hatzigeorgiadis, and Chroni, (2008) identified five relevant dimensions. They suggested that self-talk can help by enhancing attentional focus, increasing confidence, regulating effort, controlling cognitive and emotional reactions, and triggering automatic execution.

Factors Possibly Affecting the Effectiveness of Self-Talk

Overall, the self-talk literature has provided strong indications that self-talk is an effective strategy for facilitating learning and enhancing performance. Nevertheless, interesting questions have been raised regarding the methodology of the studies (e.g., Hardy, Oliver, & Tod, 2009), and the factors that may moderate the effectiveness of self-talk. These factors can be classified into four broad categories dealing with (a) the tasks that are used, (b) the participants' characteristics, (c) the specifics of self-talk, and (d) the characteristics of the intervention. Our meta-analysis was designed to identify the effect size of self-talk interventions on task performance in sport and investigate these factors as possible moderators.

Task characteristics

Two important distinctions regarding the characteristics of sport tasks concern motor demands and novelty. Regarding motor demands, the distinction is between tasks involving mostly fine motor skills, which require dexterity, hand-eye coordination, precision, and accuracy (e.g., dart throwing, golf-putting, shooting in basketball) and tasks involving mostly gross motor skills, which require physical conditioning, endurance, strength, and power (e.g., cycling, long distance running, long-jump, shot-put). Hatzigeorgiadis (2006) provided preliminary evidence that self-talk strategies mainly enhance attention to the task. Assuming that performance in precision and coordination tasks depends more on concentration than in strength and endurance tasks, we hypothesized that self-talk interventions would have a higher impact on tasks requiring fine skills than on tasks requiring gross skills.

Regarding novelty, the distinction is between novel and well-learned tasks. Several studies have used tasks for which participants have no prior experience (e.g., water-polo tasks in students who have never played water-polo; Hatzigeorgiadis et al., 2004), whereas others have used tasks that are well mastered by participants (e.g., tennis forehand in tennis players; Landin & Hebert, 1999). Considering that, in novel tasks, there is more scope for improvement and that performance enhancement can be achieved faster compared to well-learned tasks, we hypothesized that self-talk interventions will have a greater impact on novel rather than well-learned tasks.

Participant characteristics

Another factor raised by Hardy et al. (2009) involves the identity of the participants. In numerous studies the sample consists of students (e.g. Cutton & Landin, 2007). Furthermore, even though many studies have employed athletes, the range in terms of experience and level varies from beginners (e.g., Ziegler, 1987) to more experienced and elite athletes (e.g., Mallett & Hanrahan, 1997). This distinction coincides in certain cases with the one between novel and well-learned tasks, as studies with athletes typically use only well-learned tasks. However, we deemed it appropriate to test whether this distinction was meaningful, because both novel and well-learned tasks have been used in studies with students. We hypothesized that students and beginners will benefit more from the use of self-talk than would more experienced athletes.

Self-talk characteristics

Three characteristics of the self-talk are of interest: the content, the selection, and the overtness. One of the most interesting questions regarding the effectiveness of self-talk concerns the type (i.e., content) of self-talk. The distinction between instructional and motivational cues provided new directions for the self-talk literature. As mentioned previously, research generally supported the distinction and the differential effects that instructional and motivational self-talk can have on performance. Theodorakis et al. (2000) proposed what was later described by Hardy et al. (2009) as the ''matching hypothesis'': taking into consideration the requirements of the tasks, instructional self-talk should be more effective for tasks requiring precision and timing, whereas motivational self-talk should be more effective for task requiring strength and endurance. Hatzigeorgiadis, Zourbanos, Mpoumpaki, and Theodorakis (2009) further suggested that different self-talk cues may serve different functions (i.e., operate through different mechanisms) and may have different effects depending on the requirements of the task. Thus, no specific hypotheses were formed with regard to the overall effectiveness of instructional and motivational self-talk, however, the matching hypothesis stated above was tested.

Another characteristic is whether the self-talk cues are assigned or self-selected. Studies were initially based on assigned self-talk (e.g., Van Raalte et al., 1995) to ensure that appropriate cues were selected and used by participants. However, in some recent studies researchers have allowed the selection of self-talk cues by participants either from a designated list (e.g., Schüler & Langens, 2007) or their own preference (Malouff & Murphy, 2006). The third characteristic is whether self-talk is internal (covert, silent) or external (overt, out loud). With regard to overtness, researchers initially preferred external self-talk to ensure that self-talk cues were actually used (Ming & Martin, 1996). Nevertheless, feedback from participants has shown that some find it awkward and distracting to use external self-talk (e.g., Masciana, Van Raalte, Brewer, Brandon, & Coughlin, 2001), and, therefore, in many subsequent studies participants have been advised to use internal self-talk or have been given the choice between internal and external self-talk (e.g., Harvey, Van Raalte, & Brewer, 2002). What is important to find out regarding the above characteristics is whether providing choice with regard to the use of the self-talk cues (for both content and overtness) influences the effectiveness. We hypothesized that self-selected cues and overtness will be more effective than assigned.

Characteristics of the intervention

A final factor that seems important in determining the success of a self-talk strategy is the type of the intervention. Several studies have incorporated shorter (e.g., 3–5 days) or longer (e.g., several weeks) interventions, including training on the use of the self-talk strategy (Perkos, Theodorakis, & Chroni, 2002), whereas in other studies no training on self-talk has been applied (e.g., Harvey et al., 2002). In the former, participants had the chance to practice the use of self-talk, whereas in the latter participants received information on the use of self-talk and some familiarization attempts. As with any mental strategy, training was expected to have a significant impact on effectiveness, and, therefore, we hypothesized that the effect of studies using any sort of training will be greater that the effect of studies not using training.

Numerous studies have tested the effectiveness of mental skills packages, interventions implementing a variety of mental techniques, such as goal setting, relaxation, imagery, and performance routines, in combination with self-talk (e.g., Patrick & Hrycaiko, 1998; Thelwell & Greenlees, 2003). As Hardy (2006) indicates these studies provide limited evidence with regard to the effectiveness of any individual strategy. Thus, these studies were not included in our meta-analysis. Nevertheless, a separate effect was estimated for these studies for reasons of comparison with studies using self-talk only.

Scope of the Meta-Analysis

Studies were obtained through manual and electronic journal searches, review articles, as well as personal correspondence. We used the following databases: EBSCO, SCOPUS, Sport Discus, PsycINFO, PsycARTICLES and Medline. Electronic databases were searched using keywords such as *self-talk, self-instruction, self-statements, self-verbalizations, verbal cues, stimulus cueing,* and *thought content instructions* in combination with the terms *sport, performance, motor performance,* and *task performance*. The search was restricted to studies published in English-language journals. The reference sections of the retrieved articles were manually searched for additional studies.

Studies using self-talk strategies for performance enhancement in different tasks were selected. In particular, studies were required to report at least one experimental test of the effect of self-talk on task performance. In addition, studies combining self-talk with other mental strategies for performance enhancement were sampled, but only for comparison with studies using pure self-talk interventions. As our purpose was to test the effectiveness of interventions aiming to improve performance, groups or conditions using negative (e.g., Van Raalte et al., 1995) or inappropriate self-talk (e.g. Theodorakis, Chroni, Laparidis, Bebetsos, & Douma, 2001) were excluded. In addition, groups or conditions using assisted self-talk (e.g., R. A. Hamilton, Scott, & MacDougall, 2007) were also excluded as assisted self-talk involves the use of external aids, such as headphones, and was not considered pure self-talk intervention. If there was insufficient data for the calculation of effect sizes, the authors were contacted to provide the necessary statistical information. The final pool of studies included studies for which sufficient data for the computation of an effect size were obtained.

Because several experimental designs have been used to test the effectiveness of self-talk interventions, the calculation of effect size had to be based on different formulas. Therefore,

research design was also tested as a moderator to identify possible method effects. Hunter and Schmidt's (1994) meta-analytic approach was used. Further information regarding the calculation of the effect sizes, the coding of the moderators and the data analysis is presented in the Appendix. A full list of the studies and the effect sizes included in the meta-analysis is presented in the online supplement at pps.sagepub.com/supplemental.

Analysis and Discussion

Overall, our findings suggest that self-talk strategies can make a valuable contribution to skill acquisition, learning, and task performance enhancement in sport. Furthermore, examination of potential moderators revealed that the effectiveness of self-talk strategies may vary depending on the appropriate matching of task and type of self-talk, on task novelty, and on the implementation of training in self-talk interventions.

Effect size

A total of 37 studies were initially identified as satisfying the inclusion criteria. From those, five studies were not included in the final pool because of inadequate data for the calculation of effect size. Overall, a total of 62 effect sizes calculated from 32 studies were finally processed. The meta-analysis revealed a positive moderate effect size, which was significantly different from zero (effect size = .48, 95% confidence intervals (CI) = .38, .58). The percentage of variance accounted for by sampling error was 57%, showing considerable heterogeneity among the effect sizes from the different studies, thus justifying the investigation of the hypothesized moderators (Hunter & Schmidt, 1994). The fail-safe statistic indicated that it would be unlikely that a sufficient number of unpublished studies ($K_0 = 102$) would exist to reduce the effect to a trivial size (.15). The results of all analyses are summarized in Table 1.

Moderators

Motor demands, self-talk content and matching hypothesis. We were interested in the effects of task motor demands and self-talk content individually and also interactively to test the matching hypothesis. Motor demands of the task was a significant moderator: A greater effect characterized the relatively fine tasks, $d = 0.67$, 95% CI (0.53, 0.82), compared to the relatively gross tasks, $d = 0.26$, 95% CI (0.18, 0.34). Previously, Hatzigeorgiadis (2006) has argued that self-talk is mostly effective in enhancing concentration regardless of the type of self-talk that is used. Considering the requirements of fine motor tasks, it could be argued that such tasks can benefit more from the enhancement of concentration compared to gross tasks. It should be stressed that this is a speculative explanation of the above findings that should be tested.

Content of the cue was a nonsignificant moderator. Effect sizes for instructional, $d = 0.55$, 95% CI (0.40, 0.70), and motivational $d = 0.37$, 95% CI (0.25, 0.49), cues were not different. However, the analyses for the matching hypothesis showed expected results and trends. Instructional self-talk was more effective for the fine tasks than for the gross tasks. In addition, instructional self-talk was more effective for the fine tasks than was motivational self-talk. For gross tasks, the effect of motivational self-talk was not significantly higher than that of instructional self-talk, however, the trend was in the expected direction. The interaction supporting the matching hypothesis is presented in Figure 1. As in the literature, most studies have used fine tasks (maybe because in such tasks it is easier to achieve improvement) and instructional self-talk cues (maybe because these cues are more appropriate for the selected tasks); more studies using gross tasks and motivational cues should be sought to provide a more balanced literature. However, it is important to notice that partial support was provided for the matching hypothesis.

Task novelty and participants. Regarding experience, both novelty of performed task and type of participants were tested. Novelty of the task was a marginally significant moderator: novel, $d = 0.73$, 95% CI (0.47, 1.00), tended to exceed well-learned, $d = .41$, 95% CI (0.31, 0.50), tasks. According to learning principles (Schmidt & Bjork, 1992) individuals are more likely to show greater improvement at the early stages of learning than at the later stages. Accordingly, the use of mental strategies was expected to be more effective when novel tasks were used. Nevertheless, it is worth noting that the difference was not substantially in favor of the novel tasks and that the effect size was also meaningful for well-learned tasks, thus suggesting that self-talk can be effective and useful in later stages of skill acquisition and performance enhancement.

Type of participants was a nonsignificant moderator. Similar effects were revealed for students, $d = 0.50$, 95% CI (0.35, 0.66), beginner athletes, $d = 0.47$, 95% CI (0.32, 0.62), and more experienced athletes, $d = 0.38$, 95% CI (0.10, 0.65). This hypothesis was largely based on the assumption that for more experienced athletes it would be harder to improve. However, this was not the case, suggesting that the use of self-talk was effective for all kinds of participants. A possible explanation may be that in most cases researchers implement interventions including training of self-talk when sampling athletes, which proved to increase the effectiveness of self-talk (see results on training in the next section). To increase our confidence in this finding, more studies with experienced athletes should be conducted, because only eight effect sizes involved such athletes in the present investigation.

Training. Training was a significant moderator. Studies where some sort of training was implemented had greater effect, $d = 0.80$, 95% CI (0.57, 1.03), than studies without training, $d = 0.37$, 95% CI (0.29, 0.45). Even though there were not enough data to test the duration of training as a continuous moderator, it appeared that the larger effect sizes were evident in studies using longer training and implementation sessions. Nonetheless, the size of the effect for studies not using training was meaningful, suggesting that self-talk, besides being an easy to learn and apply strategy, is also a strategy that can give immediate results, at least for the earlier stages of learning. From both perspectives, this is a very important finding. First, training can enhance the effectiveness of the technique and

Table 1. Results of all Meta-Analyses

Moderators and levels	*k*	*N*	*Q*	*SD*	*Var*	*SE*	d^+	d^+ 95% CI	
								LL	UL
Overall	62	2741	108*	.27	57	.05	.48	.38	.58
Motor demands									
Fine	37	1490	69*	.31	53	.07	.67	.53	.82
Gross	25	1251	12.00	.00	100	.04	.26	.18	.34
Novelty									
Novel	15	647	39*	.41	38	.14	.73	.47	1.00
Learned	47	2094	57	.14	82	.05	.41	.31	.50
Participants									
Students	32	1390	64*	.32	49	.08	.50	.35	.66
Beginner athletes	22	1157	35*	.22	61	.08	.47	.32	.62
Experienced athletes	8	194	7	.00	100	.14	.38	.10	.65
Self-talk content									
Instructional	38	1619	84*	.35	44	.08	.55	.40	.70
Motivational	20	882	15	.00	100	.06	.37	.25	.49
Matching hypothesis									
Instructional/fine	24	917	45*	.32	53	.10	.83	.64	1.02
Instructional/gross	14	702	4	.00	100	.04	.22	.14	.31
Motivational/fine	10	438	9	.00	100	.09	.41	.22	.59
Motivational/gross	10	444	6	.00	100	.08	.33	.19	.48
Cue selection									
Assigned	46	2048	94*	.31	48	.07	.49	.36	.62
Self-selected	16	693	14	.00	100	.07	.44	.30	.58
Overtness selection									
Assigned	30	1357	57*	.29	52	.08	.49	.33	.64
Self-selected	27	1196	48*	.27	55	.08	.48	.33	.64
Training									
No training	39	2000	31	.00	100	.04	.37	.29	.45
Training	23	741	53*	.43	42	.12	.80	.57	1.03
Research design									
Post – experimental/control	5	299	2	.00	100	.09	.37	.19	.54
Pre/post – experimental	16	926	33*	.28	47	.10	.36	.17	.55
Pre/post – experimental/control	35	1410	42	.15	83	.06	.53	.41	.65
Multiple baseline	6	106	10	.46	58	.29	1.31	.75	1.88

Note. k = number of effect sizes in meta-analysis; N = total sample size in meta-analysis; Q = Cochran's Q statistic; SD = residual standard deviation of d; Var = % variance attributed to sampling error variability; d^+ = averaged corrected standardized difference effect size; SE = standard error of d; $d^+95\%\ CI$ = 95% confidence intervals; LL = lower limit of confidence interval; UL = upper limit of confidence interval.
* $p < .05$.

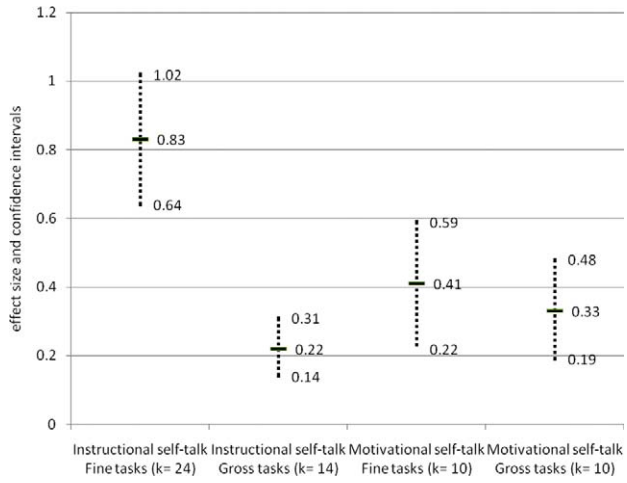

Fig. 1. The matching hypothesis on the effectiveness of self-talk: Interaction between task demands and self-talk content.

therefore training should be recommended. Second, immediate effects are very encouraging for individuals to believe in and continue to use and practice the technique.

Cue and overtness selection. Cue and overtness selection were nonsignificant moderators. For cue selection, similar effects were revealed when the cues were assigned, $d = 0.49$, 95% CI (0.36, 0.62), and self-selected, $d = 0.44$, 95% CI (0.30, 0.58). For overtness selection, similar effects were revealed when participants were assigned to use, $d = 0.49$, 95% CI (0.33, 0.64), and allowed to select between, $d = 0.48$, 95% CI (0.33, 0.64), overt and covert self-talk. Concerning the selection of cues, it could be argued that researchers have been effective in selecting appropriate self-talk cues. Concerning the overtness dimension, an examination of the studies assigning overt or covert of self-talk showed that researchers have mostly assigned covert self-talk. Covert self-talk also seems to be most

preferred by participants, thus the effect of free selection may be balanced because researchers have actually assigned the type of overtness that participants prefer.

Research design. Study design was a significant moderator. The analysis showed that the identified effect size for studies using multiple-baseline designs was larger, $d = .1.31$, 95% CI (0.75, 1.88), than (a) studies using postintervention measures for experimental and control groups, $d = 0.37$, 95% CI (0.19, 0.54); (b) studies using pre- and postintervention measures for experimental and control groups, $d = 0.53$, 95% CI (0.41, 0.65); and (c) studies using pre- and postintervention measures for experimental group only, $d = 0.36$, 95% CI (0.17, 0.55). This result can be explained because studies using multiple baseline designs have used longer interventions that justify larger effect size and have used smaller samples which normally produce larger effects. Notably, the top three (and five out of the top eight) effect sizes came from studies using multiple-baseline designs (from a total of six). The decision not to exclude these studies from the final analysis was based on the rationale that these studies were consistently the most effective (suggesting an intervention method effect rather than outlying values).[1]

Finally, we compared studies implementing self-talk interventions and studies implementing mental training packages interventions. Twelve studies testing the effects of mental packages or the effects of strategies combining self-talk with other mental skills were included in the analysis.[2] It was revealed that studies implementing mental training packages showed greater effect, $d = 0.98$, 95% CI (0.44, 1.53), than studies implementing self-talk interventions, $d = 0.48$, 95% CI (0.38, 0.58), however the difference was not significant. The lack of significance (despite the magnitude of mean differences) may be attributed to the variability of the effects that were identified for the studies implementing mental packages, but also to the small number of such studies. Nonetheless, the seemingly superiority of mental packages over self-talk interventions should be interpreted with extra caution for two more reasons. First, most of the studies implementing mental packages used single-subject multiple-baseline designs. Second, most of the studies implementing mental packages included extended training. Both these characteristics proved significant moderators for studies implementing self-talk interventions. Thus, the difference can be possibly attributed to the design of the study and the training of the participants. Indeed, when compared to self-talk studies using multiple-baseline designs and self-talk studies implementing training the differences in the effect sizes were small.

Implications and Conclusions

Applied practice

The identification of a moderate effect of self-talk on task performance in sport encourages the promotion and use of self-talk by athletes, sport educators, coaches, and sport psychologists. Furthermore, considering the findings from the moderator analyses, practical implications regarding the use of self-talk could be proposed. Even though it was not possible to test multiple interactions of moderators due to the limited number of studies, some considerations regarding what constitutes an effective intervention can be attempted. The most important aspect for a self-talk intervention to reach its potential impact is training. Coaches, educators, and athletes are strongly advised to practice and persist with their self-talk plans to maximize possible gains. These gains seem to be bigger when new skills are taught, so the use of self-talk at this stage of skill acquisition may have immediate effects. Nevertheless, for self-talk strategies to be effective, selecting appropriate type and content of self-talk in relation to the characteristics of the task and the needs of the individuals may be key. Finally, even though the present findings did not support a role for choice in the selection of self-talk cues, this may be due to the expertise of the researchers deciding and applying the self-talk plans. Thus, effective coach–athlete communication in selecting the specific cues to be used and the way these cues are expressed is also recommended.

Future research

Based on our study of the existing literature and in light of the current meta-analysis, directions for future research can be suggested. Self-talk research should encompass a wider range of tasks and skills. As Hardy et al. (2009) noticed, research in certain instances has focused on specific tasks, maybe because the application of self-talk in these tasks has already proven effective. Even though this tactic has proven useful for examining questions beyond the effectiveness of self-talk (such as the functions through which self-talk operates), it narrows the generalizability of the conclusions that can be drawn. Therefore, studies using tasks with varying characteristics in terms of motor and cognitive demands is warranted. Most important, what seems to be missing from the sport psychology literature, is a more systematic examination of the effectiveness of self-talk interventions in competitive settings. Martin, Vause, and Schwartzman (2005) attributed the limited number of psychological interventions in relation to competitive performance to the complexity and the pace of sport skills and associated performances and the difficulty to access samples, especially for purposes of controls. In addition, the less-controlled conditions, in terms of experimental integrity, that result in reduced publication success may discourage researchers from conducting such studies. Nonetheless, research on the impact of self-talk on competitive sport performance will further advance the self-talk literature.

Boundaries and limitations

The present meta-analysis has only included published studies. That some studies do not get published due to lack of significant effects obviously introduces a selection bias to the results. However, studies that do not get published may often have serious methodological shortcomings that decrease the validity of

the results. In addition, as Smith and Egger (1998) argue, including unpublished studies can itself introduce bias, as the population of such studies cannot be located, and those located may be an unrepresentative sample of the unpublished studies. Finally, the restriction of selection to English publications only due to the language barriers should be acknowledged.

One limitation of the present study is that some of the effect sizes in the moderator analyses were estimated based on small samples. As small samples are more likely to produce larger effects, particular caution is needed in interpreting the results of some of the moderator analyses. Another issue relevant to the effect sizes is the calculation of effect sizes in studies employing different designs. To overcome this limitation, study design was tested as a moderator to account for method effects.

The present study aimed to advance our understanding of the effects of self-talk interventions on task performance in sport and test factors that may play a regulatory function in this relationship. Overall, self-talk was confirmed to be an effective strategy for enhancing task performance in sport. Furthermore, the study of the literature and the characteristics of the articles that were examined identified moderators that could further explain the self-talk phenomenon, enhance our knowledge regarding the effectiveness of self-talk interventions, and provide research directions.

Appendix

Data analysis

Effect size. An important issue that had to be decided was the calculation of the effect size, as different designs were evident in the literature. Even though Morris and DeShon (2002) argued that it is not entirely appropriate to combine studies using different research designs in one meta-analysis, the relatively restricted number of studies (for some of the designs) did not allow for separate meta-analyses to be performed. Furthermore, considering that meta-analysis is a method used to detect variability in study results, it was deemed useful to include studies using different designs. Attempting to control for the above limitation, research design was tested as a moderator to identify possible method effects.

All effect sizes were calculated based on mean scores and standard deviations. Following the recommendations of the relevant literature, effect size (*d*) was calculated as follows: (a) for studies using postintervention measures for experimental and control groups, the typical standardized mean differences were computed using group means and the pooled standard deviation (Cohen, 1987); (b) for studies using pre- and postinterventions measures for experimental and control groups, the standardized mean difference in change scores (from pre- to posttest) were computed using the pooled pretest standard deviation (Morris, 2008); (c) for studies using pre- and postintervention measures for experimental group only (including studies using single-subject multiple-baseline designs), the standardized mean change was computed using the pretest standard deviation (Hojat & Xu, 2004).

In case the articles included multiple studies, multiple samples, or multiple self-talk treatment conditions, the corresponding effect sizes were calculated. If multiple dependent measures were obtained through a single manipulation (e.g. multiple indicators of task performance), the calculated effect sizes were averaged to produce one overall effect size for this particular treatment (De Coster, 2004). Outlying effects were identified, and these values were set at the next closest value in the data, following Hagger, Wood, Stiff, and Chatzisarantis' (2010) procedures. The fail-safe statistic (Hedges & Olkin, 1985) was calculated to account for possible publication bias.

Meta-analytic strategy. Hunter and Schmidt's (1994) meta-analytic approach to correct effect size for sampling error variability was used. In addition, the 95% confidence intervals were considered. Following Hunter and Schmidt's recommendations, the homogeneity of the overall effect was evaluated based on the 75% criterion. According to this criterion, if less than 75% of the variance is attributed to sampling variance, then the hypothesized moderators should be tested by conducting new meta-analyses for each moderator level. Moderators were considered influential if the analyses revealed nonoverlapping 95% confidence intervals for the different group levels.

Moderators and coding. All effect sizes were categorized into the identified moderator levels, unless no relevant information was provided or a treatment combined simultaneously more than one moderator levels (e.g. instructional and motivational self-talk in one group or condition). For the categorization of the cases into the levels of the moderators, independent study ratings were conducted for each study included in this meta-analysis to assess potential coder drift (Orwin, 1994). Antonis Hatzigeorgiadis and Nikos Zourbanos coded the studies independently. Examination of the coding revealed that the two coders agreed in 97% of the coding points. For the remaining 3%, a third coder was asked, and a consensus between the three was achieved.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Notes

1. Analyses excluding studies using multiple baseline design were performed. The results were similar to those reported here and are available upon request from Antonis Hatzigeorgiadis.
2. These are Cumming, Nordin, Horton, and Reynolds (2006); Cutton and Landin (2007); R. A. Hamilton, Scott, and MacDougall (2007); S. A. Hamilton and Fremour (1985); Kendall, Hrycaiko, Martin, and Kendall (1990); Latinjak, Torregrosa, and Renom (2011); Papaioannou, Ballon, Theodorakis, and Auwelle (2004); Patrick and Hrycaiko (1998); Rogerson and Hrycaiko (2002); Thelwell and Greenlees (2003); Thelwell and Maynard (2003); and Thomas and Fogarty (1997).

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