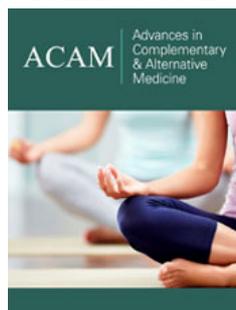


Self-Talk, Emotions and Motor Performance: A Mini Review

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Abstract

People, including athletes, talk to themselves every day. Self-Talk (ST), which is also referred as self-statement, inner voice, inner dialogue or speech, self-communication, covert speech, private or silent speech, self-directed verbalizations, verbal thinking, and verbal mediation, is a cognitive intervention that proved its effectiveness in sport. ST intervention has been shown to enhance motor performance with a moderate effect size. ST shows a better effect on the fine motor tasks than gross motor tasks, and new skills than well-learned skills. However, Underlying mechanism of this technique and how it can improve motor performance remains unclear. This mini review summarizes findings about ST, its categories, and suggested mechanisms. More comparative investigations between the different types of ST are needed to finish the controversy of which and when a type is more effective than another.

Keywords: Self-talk; Sport; Motivation; Emotions; Motor performance; Physiotherapy; Brain; Neuropsychology

Abbreviations: ST: Self-Talk; IST: Instructional Self-Talk; MST: Motivational Self-Talk; DMST: Demotivational ST; PST: Positive Self-Talk; NST: Negative Self-Talk; OST: Overt Self-Talk; CST: Covert Self-Talk; SVT: Squat Vertical Jump; NA: Nucleus Accumbens; SMA: Supplementary Motor Area; OFC: Orbitofrontal Cortex; ITG: Inferior Temporal Gyrus; TP: Temporal Pole

Introduction

With the normal growing process, humans tend more and more to use the language as a tool to internalize thoughts, reconstitute prior experiences into adapted plans, or articulate novel plans [1,2]. In this context, Vygotsky [1] distinguishes between two forms of language: social speech and private speech (i.e., self-talk) [1]. Therefore, language has communicative and regulatory functions [3]. When kids begin to talk and speak in sentences, they start to talk to themselves to shape their behavior [4]. The use of the Self-Talk (ST) starts by being overt, increases with child development, and becomes more abbreviated and internalized [1]. At preschool age, children talk to themselves and use this talk as a tool for planning goal-oriented actions. Moreover, almost ninety-six percent of adults are engaged in the ST in their lives [5]. The communication between one person and him/herself is a natural process that no one learns it, indeed some people talk to themselves more than they talk to others. The ST happens whenever someone is doing or learning something, the more the task is difficult the more the person talks to him/herself. In conclusion, it is argued that many psychological functions like motivation, attention, reasoning, problem-solving, planning, and plan execution are associated with the ST [4]. In sport psychology, researchers investigated ST's effect on tasks' performance and described the intuitive use of the ST by athletes [6]. Hardy et al. [7] qualitative investigation of the athletes' use of ST found what was called the four 'W's: where, when, what, and why athletes use ST. In the sporting environment is where they use ST. For "when", they reported using it before, during, and after the training or the competence [7]. "What" athletes say to themselves comes predominantly in the form of phrases rather than shorter verbal cues or intact sentences, and as positive ST rather than a negative one.

Positive self-talk and negative self-talk differently modulate brain states concerning cognitive performance. Behavior data showed that sRPM (short form of Raven's Progressive Matrices) increase was significantly higher after self-criticism than after self-respect, suggesting that negative self-talk may be more beneficial in the improvement of cognitive performance than positive self-talk [8].

The reasons why they talk to themselves are numerous: to express their worries, in the purpose of rumination after a failure or poor game strategy, to express the feeling of pressure especially in the case of competence against a better opponent, to motivate themselves, to focus, to give instructions to their person, to control their emotions and anxiety, and finally to express the desire to withdraw from a match, to stop the match, and to abandon the sport altogether in situations of anger or discouragement [7,9]. A systematic review and a meta-analysis studying the effectiveness of ST interventions on the performance of sport-related tasks support the effectiveness of this intervention [10,11]; (Figure 1). ST intervention has been shown to enhance motor performance with a moderate effect size [10]. ST shows a better effect on the fine motor tasks than gross motor tasks, and new skills than well-learned skills. In addition, categorization of ST can lead to different results. ST has been categorized according to its valence, its function, its overtness, and others. Many theories have been emerged to explain the difference resulted from distinct categories of ST. The "matching theory" suggests that Instructional Self-Talk (IST) is more effective in fine motor tasks and Motivational Self-Talk (MST) gives better results for gross motor tasks [12]. Another theory called "Matching hypothesis for the learned task", suggest that IST is more effective than MST for learning new skills [13]. Additionally, ST training led to (less) somatic state anxiety and (higher) state self-confidence, self-optimization, self-efficacy, and performance [14]. Mechanism behind the effect of ST on motor performance is still unclear. The most studied mechanism of ST performance enhancement is the

amelioration of the Self-Efficacy (SE) perception [15]. Athletes also reported that ST cues help them to build and improve their confidence [16]. Other suggested explanations, can be increasing attention and focus during the task execution [17], improving information processing [3], and building an image of the movement which helps to enhance the movement's execution and learning [18]. However, to our knowledge, no studies has been performed to examine cerebral activity during ST intervention in sport to support any of these suggested mechanisms. Indeed, most of the studies examining ST effectiveness used fine motor tasks like the dart-throwing task. This highlights the need of exploring the effects of ST interventions on the performance of gross motor tasks. One of these tasks that were used in this field is the Squat Jump (SJ). The SJ, which consists of jumping from a squat position without any countermovement, is one of the gross motor tasks that is used in many studies as a reliable and valid test of the explosive power of the lower limb [19]. It is also one of the most frequent exercises used to enhance the power production of the lower limb [20]. Two previous studies have addressed this issue, they investigate the effect of IST and MST on the jump height and the jump kinematics [21,22]. Rabahi et al. [23], used meaningful and meaningless words to examine the Squat Vertical Jump (SVJ) performance. Results showed that either loudly or silently pronouncing, hearing, or reading the verb saute (jump in French language) can significantly improve the SVJ performance. Using specific verbs for other motor actions (pince=pinch, leche =lick) or non-specific (bouge=move) showed no or little effect on SVJ. On the other hand, pronouncing a meaningless verb for the French subjects (tiao=jump in Chinese) showed no effect as did reve (dream), tombe (fall) and stop. The verb gagne (win) improved significantly the SVJ height, as did its antonym perds (lose) suggesting a possible influence of affects in the subjects' performance [23]. In a previous experiment, Rahabi et al. showed also improvement of SVJ, when novice participants, generated (spoken or silent) of an action verb (saute=jump) [24].

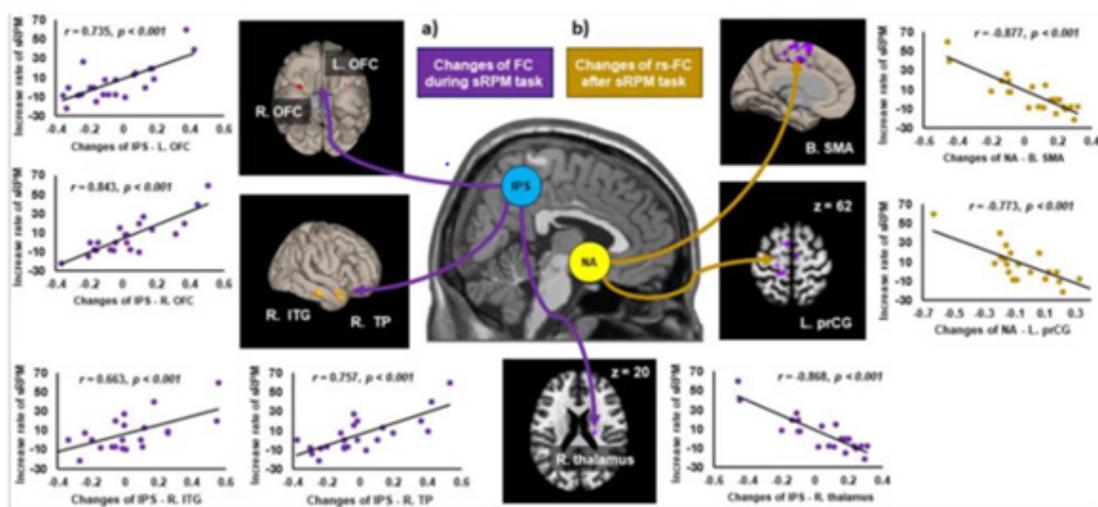


Figure 1: Scatter plots showing the relationships between during-task (a) and post-task (b) changes in inter-regional Functional Connectivity (FC) and score increase rates of the short form of Raven's Progressive Matrices (sRPM) in the self-respect group. rs-FC, resting-state functional connectivity; L. left, R. right, B. bilateral, NA nucleus accumbens, IPS intraparietal sulcus, SMA supplementary motor area, PrCG precentral gyrus, OFC orbitofrontal cortex, ITG inferior temporal gyrus, TP temporal pole. Image fully reproduced from kim et al. [8].

What Do We Know About ST?

Self-talk, which is also referred as self-statement, inner voice, inner dialogue or speech, self-communication, covert speech, private or silent speech, self-directed verbalizations, verbal thinking, and verbal mediation [25] is one of the psychological interventions used to enhance performance in sport [3]. Nevertheless, we have no clear definition of ST in the research literature. The first definition was made by Diaz [26], “addressed to the self (not to others) for self-regulation (rather than communication). As such, any study of private speech involves a fundamental judgment regarding the social versus private intent of the speaker” [26]. Bunker and his colleagues [27] viewed the ST as “anytime you think about something you are in a sense talking to yourself” [27]; according to this definition, the self-talk is seen as a key to cognitive control. Whereas Hackfort & Schwenkmezger [28] proposed that ST is a “dialogue (through which) the individual interprets feelings and perceptions, regulates and changes evaluations and convictions, and gives him/herself instructions and reinforcement” [28]. The term “dialogue” used by those authors implies the presence of two persons (one speaking and one listening) or two systems (a generative component and an auditory or perceptual component). Another suggested definition is the following: “what people say to themselves either out loud or as a small voice inside their head” [12], this definition considered two important points about ST: 1) it can be said overtly or covertly, and 2) it is addressed to the speaker him/herself not to others. Recently, Van Raalte defined ST as “an act of syntactically recognizable communication in which the sender of the message is also the intended receiver” [25]; the term: syntactically recognizable, offer a separation between the ST and verbalizations like shouts of frustration (ahhh!), and self-statements made by gestures or outside of the context of the language [29]. Many studies reported the effectiveness of the ST strategy to optimize the performance in many sport-related tasks [10,11,25]. Moreover, athletes use ST for many reasons, like motivation, improving performance, and enhancing skill development and execution [30]. Moreover, ST is used to express emotions, impressions, biases, and self-regulation. The ST is also effective in learning new skills [31], remediating errors, and maintaining an appropriate attentional focus [32,33]. It was suggested that ST effectiveness has four levels: 1) on the fundamental tasks, 2) on components of performance in different sports, 3) on sports performance in non-competitive settings, and 4) sports performance in competitive settings [34]. Although ST can be very beneficial in sport as reported before, feedback coming from some athletes confirmed an effect of distraction during the execution of the task, which leads to the loss of automation negatively affecting the person’s confidence [12,35].

Categories of Self-Talk

Valence

The first category of the ST is the valence, it is concerned with the content of ST and anchored with the bi-Polar Descriptors of Positive (PST) and Negative Self-Talk (NST) [36]. PST (e.g., I can do this) refers to the ST said as a form of praise, it helps the athlete to keep the attention all in the aim of improving the

performance. When the ST is said as a form of criticism and when it is considered inappropriate, counterproductive, discouraging, or anxiety-producing, in other world performance hindering, it is categorized as NST (e.g., There’s no way I can do this) [3,29]. From an encouragement statement point of view, Peters and Williams [37], defined PST as facilitative and NST as debilitating. Neutral ST refers to the ST cues that are not either positive or negative [37]. Many studies supported belief that the PST is better than the NST for performance, [11,36,38-40]. Moreover, athletes reported that use of PST motivates them and helps them to keep their calmness [41]. Also, the proponents of PST suggested that it can increase effort, reduce anxiety, and enhance self-confidence [42]. In contrast, other studies reported the opposite of this belief and found that PST was associated with worse performance [43], or no change in the performance [44]. Moreover, Hardy et al. [7] explored the relationship between negative±positive self-talk and demotivational±motivational interpretation of ST by the athletes. As a result, they found a positive relationship in between, they reported that the more the ST was positive the more it is viewed as motivational. Although a few athletes viewed the PST as demotivational, and there is a possibility that NST may be interpreted by some athletes as motivational [7,41]. This finding supports the suggestion that NST may not have a detrimental effect on skill performance as believed [11]. This last idea is supported by a study that found that NST failed to be a significant predictor of performance and explained this result by the individual interpretation of NST [40]. Van Raalte and her colleagues [41] reported that the tennis match winners and losers didn’t have any difference in using PST, but the winners used less NST than the losers [41]. Whereas this finding is different from Hardy et al. [15] study who reported no difference in the ST use between less and more skilled athletes [36]. Another study reported that the match winners and losers only differ in the way they respond to their ST [44].

Functions

Hardy [3] suggested that the ST has two functions: Motivational (MST) and Instructional (IST) [3]. MST, which is seen in literature as a subcategory of PST [29], refers to ST cues aiming to maximize effort (e.g., give it all), psych up (e.g., let’s go), creating a positive mood (e.g., I feel good), and building confidence (e.g., I can do it). Whereas IST aims to focus or direct attention (e.g., see the target), and to provide instruction concerning the strategy (e.g., push), the technique (e.g., high elbow), or the kinesthetic attributes (e.g., smoothly) of the movement [10]. Besides, IST is sometimes considered as neutral ST in the literature [29]. MST has three functions: 1) an arousal function which aims to assist in relaxation, psyching up and controlling the arousal levels; 2) a mastery function related to focus, confidence, mental toughness, and mental preparation; 3) and a drive function which is concerned with assisting the athletes to keep on course to achieve their goals by maintaining or increasing effort levels [3]. It was suggested by Theodorakis et al. [42] that the MST is more effective for tasks requiring strength and endurance because it is used to enhance effort and arousal, and the IST is more effective for tasks requiring

precision, accuracy, and timing because it can facilitate the task requirement for the athlete [45]. Improved endurance capacity and executive function in the heat, after MST were explained by altering the internal psychophysiological control of exercise [46]. Thus, when athletes with more expertise performed better on tasks of attention, working-memory-control and working-memory-capacity, MST and other forms of ST can have a major contribution in enhancing motor performance by improving auto-control on these executive cognitive abilities [47].

“Matching hypothesis for the learned task” is another related hypothesis to the ST functions. It was suggested by Zourbanos et al. [13] that IST is more effective than MST in learning new motor skills, the reason of this suggestion is that as previously mentioned IST enhance concentration which has a particular importance at early stages of learning. They tested their hypothesis using a handball overarm throw with the dominant arm (learned task) and non-dominant arm (new task). The results showed that IST is more beneficial when participants performed with their non-dominant hand, and MST is better concerning the performance with the dominant hand, as a conclusion this hypothesis was confirmed [13]. Another study tested the same hypothesis and found no significant difference between IST and MST when the participant used the non-dominant foot (new skill) in a shooting task [45]. Besides, this hypothesis was supported by Hatzigeorgiadis’s meta-analysis [10]. Finally, one study had compared IST and MST in a competitive context, this study found that most swimmers preferred MST over IST in a competitive context, so they suggested that MST is better in such conditions [48].

Overtness

Overtness categorization divides the ST into overt or covert. Overt Self-Talk (OST), also referred as external ST, is said out loud and can be heard by others; while Covert Self-Talk (CST) or internal ST is said using small voice inside one’s head, so it cannot be heard by authors [3]. Athletes use the ST in both ways, these two forms have the same learning of sentences mechanism, and serve similar self-regulatory functions [25], but differ in the acoustic aspects and the act of twisting tongue. For example, in the OST the athlete can alter the pitch and the volume of the statement, but this is not the case in the CST [3]. Researchers initially preferred the OST to ensure that the participants used the ST cues. On the other hand, participants reported that the use of the OST is somehow awkward and distracting, so they do not prefer it [10]. Also, in general, the athletes use the CST, and this is another reason why participants preferred CST [36]. Considering the question of which form leads to more performance enhancement, only two studies addressed this issue [35,49]. Bahari et al. [35] compared the effect of OST and CST in a force production task [35]. They found that in comparison to the control group, both OST and CST lead to an improvement in the performance of the task, but no significant difference between the two interventions was found, in other words, OST and CST have the same effect of the task performance. According to these results, they suggested that it is better to let the athlete choose between these two aspects [35]. Jabbari et al. [49] used the dart-throwing

task to compare overt and covert ST [49]. Results suggested that OST is better than CST to enhance performance; indeed, there was no significant effect of the CST of the performance when compared to the control group. However, the authors reported that the dart-throwing task requires coordination between the physical (muscle contraction) and mental (choosing the location of hitting the dartboard) components; thus, an interference between the CST and the information processing to the dart throwing may be the reason of the lack of significant effect of the CST (participants could not well allocate the ST phrase to the skill). In conclusion, there is a need for more research to solve this issue.

Self-determination dimension

ST used by athletes can be either assigned or freely chosen [50]. Assigned ST is not chosen by the athlete him/herself, it can be taken from the coach, the internet, from books, or somewhere else [3,29,50]. Whereas, freely chosen ST cues are determined by the athlete and occur in a natural manner [3,49]. The assigned ST is the most used in studies evaluating the ST because it gives a certitude that the participant is using appropriate cues, and it showed a performance enhancement in experiments [10]. On the other hand, in naturalistic settings, athletes usually use the freely chosen ST, and this form also led to improvement in the performance. Nevertheless, to our knowledge, only one study did a direct comparison between these two forms to know which one is better than the other in improving the motor performance [50]. In this study, the authors assessed the effectiveness of different types of ST (e.g., instructional, motivational, and combined) and the self-determined nature of the ST (assigned vs. freely chosen) on one mile run performance. The results of this study show that the freely chosen combined ST group produced more improvement than the assigned combined ST group. On the other hand, the assigned IST group is better than the freely chosen IST group. From the results of this study, it cannot be determined if the assigned ST is better than the freely chosen ST or the opposite, so there is a need for a more experimental study to answer this question [50].

Goal-directed and undirected

Recently in 2014, a new perspective to categorize the ST was proposed by Latinjak and his colleagues [51]. They used the goal-directed and undirected thoughts, which are used in general psychology, to suggest a new way to explore the ST in the sports domain. Goal directed thoughts are the one used to solve a problem, make some process in a task, or to take a decision [52]. While the thoughts that have no relation with the task that someone is doing, or the ones that have a link but do not influence the process or the performance of the task, in other words, the thoughts that had no purpose related to the ongoing task, are considered as undirected thoughts. Results showed that the most used ST by the athletes was undirected, and some of the statements could be interpreted as either goal-directed or undirected statements. The undirected ST happened spontaneously and involved mostly explaining past outcomes and foreseeing upcoming events, whereas goal-directed ST aimed at attaining control over cognitions and activation for action [47].

Dual-process theory

Based on the dual process-theory, which provides an account of how thoughts can arise in two different ways, or because of two different processes, Van Raalte et al. [25] divided the ST into system 1 ST and system 2 ST. According to them, system 1 ST, which is effortless, fast and emotionally charged, brings current experiences into awareness in a way that represents the immediate reaction to a situation [25]. Whereas, system 2 ST is slow, effortful, and consciously monitored, it results from planning and may lead to instructional, motivational, logical, and focused ST. System 2 ST occurs as a direct response to system 1 ST and it monitors the thought generated by this last [25].

Grammatical form

A final way to categorize the ST is its grammatical form [29]. One study evaluated this aspect in the sports domain, it used a team-based dart-throwing activity to examine the use of an individually focused ST versus a group-focused ST condition ("I am" versus "we are"). The results show no significant difference in performance improvement between the individually focused ST condition and either the group focused ST condition or the control condition [53]. Another one compared interrogative to declarative form of ST and found that both lead to performance enhancement without a difference between them [54].

Self-talk mechanisms

Self-efficacy: The Self-efficacy theory was found by Bandura [55]. He defined self-efficacy as "belief in one's capabilities to organize and execute the courses of action required to produce given attainments". Four sources are proposed to influence the SE: previous performance accomplishments, vicarious experiences, verbal persuasion, and interpretation of accomplishment. The ST can be one of the verbal persuasion's aspects [3,56]. Even if the verbal persuasion has been proposed to be a limited source of the Self Efficacy (SE), it can be an adjunct SE source [55]. SE has a strong link with the performance in sport settings [15,53,56], and a positive correlation to ST intervention [30,34,49,56,57]. Also, ST intervention has a positive influence on SE perception [15]. Chang et al. [56] found that both IST and MST interventions lead to higher SE score [56], this finding was supported by another study for MST [58], and for IST in another one [59]. Regarding ST valence, increasing PST led to increases in SE perception [15], and PST was used by coaches to increase athletes' SE feeling [60]. Further, Son et al. [53] found that 12% of the variability in SE scores was explained by the ST conditions [53].

Confidence: One of the possible mechanisms of the effectiveness of the ST on motor performance is enhancing the confidence of the athletes. Athletes in some studies reported that the use of the ST increased their self-confidence [16,33,61,62]. Besides, one study suggested that athletes use PST before the competition to build their confidence [7]. In addition to that, using Competitive Anxiety Inventory-2R which is an anxiety assessment tool, one study found

that ST intervention improves the participants' confidence [63]. It was also found that there is a positive correlation between SE, self-confidence, and performance when using ST to enhance a softball throwing performance [56]. According to a systematic review about the effects of ST, Tod and his colleagues reported that all studies using the PST showed no ST effect on the confidence, although, IST and MST demonstrated a positive effect of the confidence. This last difference may be attributed to the specificity of the ST cues [11].

Information processing: In his review, Hardy [3] suggested that the ST cues may influence the information processing, he also suggested that IST is more related to this concept than MST [3]. This hypothesis is based on the proposition that verbal cues could influence all the three functions of information processing to positively influence the performance, as proposed by Landin [32]. Those three functions are: perceptual processing, decision processing, and effector processing. The first two have a stronger association with skill acquisition than skill execution, and the last one is linked to both. The verbal cues may help the beginners in the decision-making process by reducing the number of available options, and once the correct decision has been made, verbal cues can be forwarded to impact in a positive way the effector processing functions [32].

Attention: Another proposed mechanism that may explain the benefits of the ST in sports is that the ST cues may lead to an increase in attentional focus and concentration. This suggestion is based on Landin's proposition that verbal cues could increase the focus and redirect the performer's attention [32]. Many experimental studies offered support and reported that ST utilization increases athlete's attention [16,17,33,61,62,64-67], Results of all these studies were based on what athletes reported. It was also suggested that the most beneficial attention form of ST will be "narrow-external" (based on Nideffer's (1976) attentional style) [3]. Hatzigeorgiadis et al. [65], found that the use of IST and MST reduces cognitive interference, therefore increases attentional focus which helps to improve the performance of the water-polo task [65]. Moreover, IST and MST seem to have a similar impact on concentration [64]. Another finding by Galanis et al. [31] was that ST may intensify either internal or external focus quality, and, ST appears to have a protective effect against distraction [31].

Conclusion

This mini review aimed to discuss literature about ST. Research perspective in this domain can use different categories of ST to improve motor performance of gross and fine motor skills in sport, physical education, and physiotherapy domains. Further studies shall be conducted to explain how the ST can affect positively and negatively motor performance. Researchers must use more reliable and objective measurement tools and neuroimaging techniques to discover mechanisms of this effect. Moreover, more comparison investigations between the different types of ST are needed to finish the controversy of which and when a type is more effective than another.

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