NeuroRegulation

Strategic Self-Talk and Readiness Potential in Pistol Shooting: A Pilot Study on the Attentional Self-Talk Mechanism

Orestis Panoulas[1], Marika Berchicci[2,3], Luca Bovolon[2,3], Manos Tzormpatzakis[1], Theodoros Proskinitopoulos[1], Evangelos Galanis[1], Nektarios Stavrou[4,6], Maurizio Bertollo[3,5], and Antonis Hatzigeorgiadis[1]*

[1]University of Thessaly, Department of Physical Education and Sport Science, Trikala, Greece
[2]G. d'Annunzio University, Department of Psychology, Chieti-Pescara, Italy
[3]G. d'Annunzio University, Behavioral Imaging and Neural Dynamics (BIND) Center, Chieti-Pescara, Italy
[4]University of Athens, Department of Physical Education and Sport Science, Athens, Greece
[5]G. d'Annunzio University, Department of Medicine and Aging Sciences, Chieti-Pescara, Italy
[6]International Sport Shooting Federation Academy, Helsinki, Finland

Abstract

Considerable evidence through self-reports and behavioral data suggests that the facilitating effects of strategic, instructional self-talk can be attributed to attentional mechanisms. Nonetheless, the psychophysiological underpinnings of such mechanisms have been scantly explored. The aim of this pilot study was to provide preliminary evidence regarding the attentional mechanism of instructional self-talk by analyzing the readiness potential during the motor planning phase of a pistol shooting task. A within-subject, noncontrolled design was used involving nine novice participants who completed five sessions. These included familiarization with the task and preintervention assessment, three training sessions, and postintervention assessment. The SCATT shooting system was used to record and assess shooting performance and aim stability. A 32-channel EEG cap was used for the acquisition and analysis of the readiness potential. The analysis showed a positive trend for performance improvement from pre- to postintervention assessment. In parallel, considerable in effect size amplitude changes in the readiness potential before movement initiation were observed. These preliminary findings provide indications that the effectiveness of strategic, instructional self-talk in pistol shooting may be partly attributed to the amplitude changes in the readiness potential, highlighting an attention-based mechanism that reflects a potential effortless neurocognitive preparation of action effect.

Keywords: instructional self-talk; attention; preparatory motor planning; psychophysiology; EEG; sport

Citation: Panoulas, O., Berchicci, M., Bovolon, L., Tzormpatzakis, M., Proskinitopoulos, T., Galanis, E., Stavrou, N., Bertollo, M., & Hatzigeorgiadis, A. (2025). Strategic self-talk and readiness potential in pistol shooting: A pilot study on the attentional self-talk mechanism. *NeuroRegulation, 12*(3), 165–171. https://doi.org/10.15540/nr.12.3.165

***Address correspondence to**: Orestis Panoulas, Department of Physical Education and Sport Science, University of Thessaly, 42100, Karyes, Trikala, Greece. Email: orestispanoulas@uth.gr

Edited by:
Rex L. Cannon, PhD, Currents, Knoxville, Tennessee, USA

Reviewed by:
Rex L. Cannon, PhD, Currents, Knoxville, Tennessee, USA
Randall Lyle, PhD, Mount Mercy University, Cedar Rapids, Iowa, USA

Introduction

There is substantial evidence supported through meta-analytic and systematic reviews indicating that self-talk strategies in sport are effective for enhancing performance and facilitating learning (Hatzigeorgiadis et al., 2011; Tod et al., 2011). However, the varying effects observed in different sport settings and populations have forwarded the need to investigate the mechanisms underlying its effectiveness. Researchers exploring the effectiveness of self-talk have predominantly delved into two broad clusters of mechanisms, an attentional and a motivational (Galanis & Hatzigeorgiadis, 2020). Regarding the attentional mechanism, recent literature has provided evidence that self-talk can improve the focus of attention (Bell & Hardy, 2009), reduce reaction times in cognitive attention tasks (Galanis, Hatzigeorgiadis, Comoutos et al., 2022), and enhance sport task performance under attention-hindering conditions such as external distractions (Galanis et al., 2018), ego depletion (Galanis, Nurkse et al., 2022), and physical exertion (Galanis, Hatzigeorgiadis, Charachousi et al., 2022). While these studies provide valuable evidence for the attentional interpretation of self-talk effectiveness, they have primarily relied on self-reports, behavioral measures, and indirect effects through performance measures.

The integration of psychophysiological indices into the self-talk mechanism literature will deepen our understanding of the actual processes underlying the attentional mechanism. In this context, Sarig et al. (2023) utilized an eye-tracker apparatus to demonstrate that instructional self-talk prolonged the quiet eye duration and enhanced performance in golf putting. Another recent study (Bellomo et al., 2020) employed electroencephalography (EEG) to provide initial evidence into the brain underpinnings of instructional self-talk. The researchers observed increased parietal alpha power and weaker connectivity between frontal and parietal electrodes compared to other scalp sites, which may suggest that instructional self-talk facilitates a top-down control of action. Furthermore, self-talk has been shown to improve performance in an elbow joint position sense test, while depicting efficient electromyography (EMG) activity (Naderirad et al., 2023). Researchers suggested that lowered muscle activity and a reduced muscle cocontraction ratio seems to be linked to improved attentional focus. Considering these psychophysiological research perspectives, our study attempted to investigate the brain activation during strategic, instructional self-talk through EEG in a pistol shooting task.

According to the hypothesis proposed by Hatfield and Kerick (2007), performance in self-paced fine motor tasks, such as shooting, requires attentional skills characterized by increased neural efficiency. This efficiency is manifested through reduced energy expenditure or mental effort in the motor planning phase of a movement. Further support for the neural efficiency hypothesis comes from event-related potential studies on shooting and self-paced trigger pull movements (Di Russo et al., 2005), indicating that experts exert less effort and require less time to plan the execution of a motor action. This allows them to allocate the appropriate amount of task-related attentional resources while eliminating irrelevant stimuli. Additionally, minimizing the impact of distractions has also been linked to improved shooting performance, as shown in Bahrami et al. (2020). Considering these findings, along with the evidence regarding the attentional impact of self-talk, there is ground to postulate that strategic, instructional self-talk might serve as an effective cognitive strategy to enhance neural efficiency.

The purpose of our study was to investigate how event-related potentials change in response to strategic, instructional self-talk, thereby advancing an attentional interpretation of self-talk effectiveness. Event-related potentials are defined as manifestation indicators of cortical activation that occur in preparation for or in response to specific events (Woodman, 2010). One example of an event-related potential is the movement-related cortical potential, which features a slow-rising negativity starting before movement execution, peaks during motor initiation, and is followed by a positive reafferent potential. In self-paced movements, the movement-related cortical potential includes the readiness potential, which reflects the activation of premotor brain regions prior to the movement onset (Shibasaki & Hallett, 2006). This readiness potential has been interpreted as a sign of planning and preparation (Schurger et al., 2021). It is derived by averaging multiple responses (e.g., trigger pulls) to enhance the signal-to-noise ratio. According to Wright et al. (2011), a reduced negative amplitude of the readiness potential, coupled with later onset latency, has been associated with lessened time and attentional resources required in motor programming.

In the present study, we examined the effects of strategic, instructional self-talk on shooting performance, aim stability, and brain activity that occur during the preparatory phase preceding the trigger pull in novice participants. Drawing on a previous study that involved a similar shooting task and self-talk training (Tzormpatzakis et al., 2022), we expected instructional self-talk would enhance both shooting performance and aim stability. Furthermore, we explored the impact of strategic, instructional self-talk on brain activity during the motor planning phase, although we did not establish a specific hypothesis due to the infancy stage in the area of self-talk research and the lack of relevant findings.

Methods

Participants and Procedures

Considering the lack of prior studies on the relationship between strategic self-talk and readiness potential, and the pilot character of this innovative study, ten participants were recruited based on sample sizes from previous studies exploring EEG with pistol shooting (Bertollo et al., 2012; Di Russo et al., 2005). Ultimately, nine (six male) sport science students (*M* age = 24.7, *SD* = 0.72) completed the study's requirements; one individual dropped out after the baseline measure due to illness. All participants were right-handed and had no prior experience with pistol shooting. The study was designed in accordance with the Declaration of Helsinki and was approved from the bioethics committee of the institution where the research took place (re: 23002). A within-group, noncontrolled design was implemented for this pilot study. Participants attended five laboratory sessions including familiarization with the protocol and preintervention assessment, three shooting training sessions incorporating self-talk, and a postintervention assessment. During the first session, participants were informed about the study's requirements and procedures and provided informed consent. Then, they were introduced to the pistol shooting task, received relevant instructions, and observed a demonstration of the shooting technique. Each participant practiced ten familiarization shots, during which they received technical feedback. Following this, the EEG cap was set up, and the preintervention assessment took place, where participants completed 40 air-pistol shots in two blocks of 20 shots, with a 5-min break in between each block. The same 40-shot protocol was repeated in the following three training sessions (without the EEG cap). In these sessions, participants were also introduced and practiced using instructional self-talk. During the first training session, the experimenter introduced the concept of self-talk, and participants performed the shots using an instructional self-talk cue for each set of shots ("front sight" and "grip"). In the second session, participants performed the shots by using two different self-talk cues ("soft pull" and "stability"). In the third training session, participants were asked to choose among the previously used self-talk cues the one they found most beneficial for their performance, which would be eventually used for the postintervention assessment. Finally, during the postintervention assessment, participants performed the set of 40 shots using the self-talk cue of their choice, while EEG and performance metrics were recorded.

Apparatus and Measures

***Air Pistol and Shooting Simulator*.** A Pardini K10 Air Pistol along with the SCATT system, a shooting training system (Precision Sport Electronics SRL, Bucuresti, Romania), were utilized in this experiment. SCATT includes an optical device attached to the air pistol, which continuously tracks the aiming point by emitting light towards the target, and a computer software that analyzes shooting performance. Each shot is recorded when the trigger is pulled while the aiming point is on the target, enabling the capture of successive shots. The software logs the trajectory of each shot throughout the aiming period, which can later be analyzed offline. The target diameter was set at 6 cm and the distance between the participant and the target was 10 m, in accordance to the international shooting competition rules (https://www.issf-sports.org /theissf/rules/english_rulebook.ashx).

Two performance variables were assessed: (a) shooting score which was calculated as the total of the 40 shots, with scores for each shot ranging from 0 to 10.9, and (b) stability of aim, measured in millimeters, with smaller distances between the average points of the tracing representing greater stability in a given time-interval preceding each shot.

***Electroencephalography (EEG)*.** The 32-channel waveguard original cap (Advanced Neuro Technology, Enschede, Netherlands) with shielded wires to minimize the impact of external interference was used. The placement of the 32 electrodes followed the 10–20 electrode system (Oostenveld & Praamstra, 2001). The EEG data were recorded on the ASAlab software (Advanced Neuro Technology, Enschede, Netherlands) and then analyzed using BrainVision Analyzer 2.2 (Brain Products, Germany). To accurately classify the moment of shot release in the raw EEG data recordings, an electronic microphone with a sampling frequency of 1024 Hz was used. The microphone operated with the Power lab 16/30 acquisition system (AD Instruments, Australia) and was synchronized with the ASAlab EEG software to record the trigger for each shot.

Data Analysis

The EEG signal was sampled at 1024 Hz, and each participant underwent a multistep preprocessing pipeline. Initially, the common average reference technique was applied to re-reference the signals. Next, filtering was conducted using a 50 Hz notch filter, with low-pass and high-pass cutoff frequencies set at 0.5 Hz and 35 Hz, respectively. To mitigate noisy channels, topographical interpolation was carried out, followed by independent component analysis (ICA) to eliminate ocular and movement artifacts. In the following step, the raw data were inspected to identify segments containing artifacts. Subsequently, the data were segmented into epochs lasting 2000 ms, starting from 1500 ms before the shot and ending at 500 ms after it. On average, 7% of shots were rejected due to artifacts criteria violations, resulting an average 93% of the shots being selected and used for signal averaging. The baseline for each epoch was calculated from −2000 to −1500 ms before movement onset. Finally, grand averaging was applied to assess the readiness potential across all participants for both the pre- and postassessments.

In the present study, a data-driven approach was endorsed to select specific electrode sites to be considered for the analysis, as there was no prior evidence to guide specific research hypotheses. Among the electrode sites around the premotor and the primary motor cortices depicting the readiness potential during the motor planning phase. FC1 and Cz were selected for analysis because notable activation differences were observed. The averaged amplitude for three 500 ms temporal windows related to the preshooting phase (−1500/−1000 ms, −1000/−500 ms, −500/0 ms) was selected for statistical analysis. Given the pilot nature of the study and the limited power to test for statistical significance, effect sizes (Cohen's *d*) were calculated to examine the within-subject trends from pre- to postintervention assessments for performance, shooting stability, and EEG across the three temporal windows.

Results

Shooting Performance and Stability

Descriptive statistics and effect sizes for changes in shooting performance and shooting stability are presented in Table 1. The results when comparing pre- to postintervention scores revealed a considerable positive effect for shooting performance (d = .43) and aim stability (d = .53). Differences between post- and preintervention scores were calculated and correlation analysis showed that changes in shooting scores were related to changes in aim stability (r = −.39).

Table 1
Descriptive Statistics and Effect Sizes for the Pre- and Postassessments

	Pre		Post		
	M	*SD*	*M*	*SD*	*d*
Shooting					
Shooting Score	141.34	107.19	192.06	67.40	.43
Aim Stability (mm)	89.74	47.49	80.37	21.03	.18
EEG (μV)*					
CZ 1500–1000	0.48	0.22	0.41	0.38	.21
FC1 1500–1000	0.09	0.37	0.07	0.23	.04
CZ 1000–500	0.01	0.58	−0.04	0.23	.07
FC1 1000–500	−0.18	0.32	−0.16	0.30	.06
CZ 500–000	−1.49	0.54	−1.18	0.49	.54
FC1 500–000	−0.79	0.62	−0.39	0.44	.49

* = EEG activity averaged for every 500 ms.

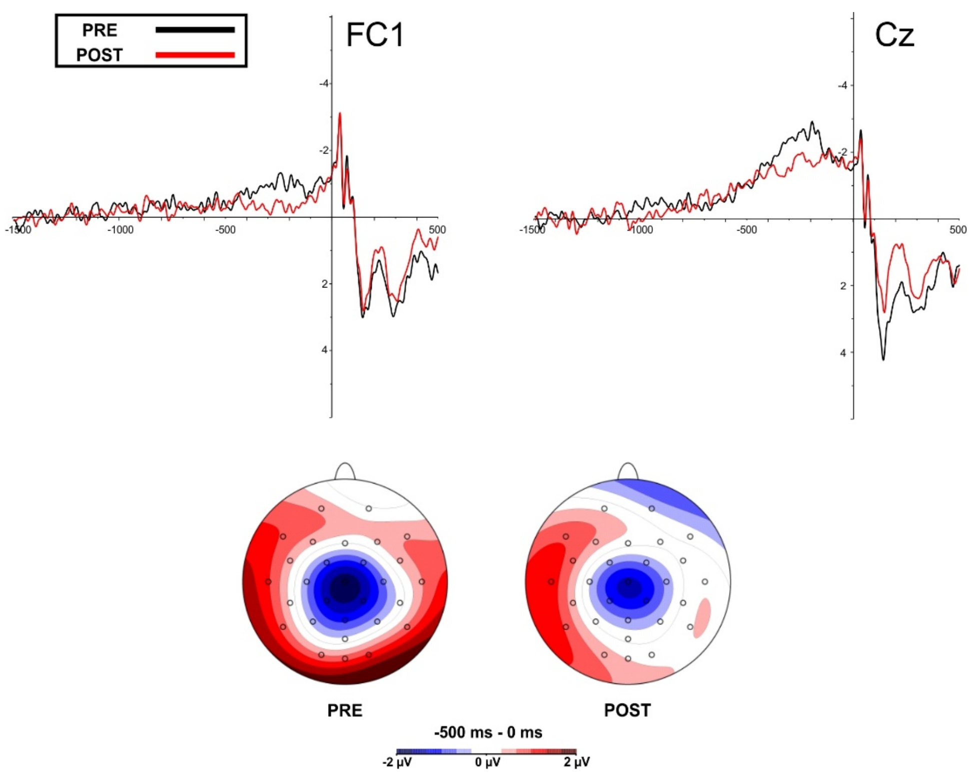
EEG

As depicted in Figure 1 (upper panel), the waveforms of both CZ and FC1 sites showed a similar decrease in negative amplitude during the first two time-windows (from −1500 ms to −1000 ms and from −1000 ms to −500 ms) when comparing the pre- and postintervention assessments. However, a different pattern emerged during the last temporal window preceding the pull of the trigger (from −500 ms to 0 ms). Indeed, during the last 500 ms prior to movement onset, both sites displayed a reduced negative amplitude in the post- compared to preintervention assessment. Furthermore, the topographic maps (Figure 1, lower panel) revealed a similar distribution of readiness potential in the assessments. Nonetheless, the motor-related negativity displayed in the postintervention map assessment was less negative than that of the preintervention map assessment.

Descriptive statistics and effect size of the changes observed from pre- to postintervention assessments are presented in Table 1. When comparing the average scores across the three selected temporal windows over Cz and FC1 sites, the effect sizes between pre- and postintervention assessments showed smaller effects for the −1500 ms to −1000 ms and from −1000 ms to −500 ms temporal windows (ranging from .04 to .21), compared to the effect sizes for the −500 to 0 ms temporal window, for both CZ and FC1 (d = .54 and .49 respectively).

Differences between post- and preintervention measures were calculated for the EEG variables. When examining the relationship between changes in shooting variables and changes in the readiness potential during the final time interval (−500 ms to 0), it was found that changes in CZ and FC1 were positively related to changes in aim stability (r = −.50 and r = −.53 respectively), but not with shooting performance (r = −.13, and r = .03 respectively).

Figure 1. *Topographic Maps.*



Note. Upper panel: Waveforms related to pretraining assessment in black and posttraining assessment in red over FC1 and Cz sites. Lower panel: Top-down view of the scalp topography over the −500/0 ms window for pre- and posttraining sessions.

Discussion

The investigation into self-talk mechanisms has primarily relied on behavioral and self-report measures. To advance our understanding of the mechanisms underpinning self-talk functioning, this pilot study adopted a psychophysiological perspective to explore potential associations between instructional self-talk and the motor planning phase in a pistol-shooting task. The results indicated a reduced negative amplitude in motor-related regions during the last 500 ms before shooting in the post- compared to the preintervention assessment. This finding suggests a reduction in resource allocation just prior to the movement onset, which may align with the neural efficiency hypothesis (Hatfield & Kerick, 2007).

Previous studies have examined amplitude changes of readiness potential in relation to learning progress and expertise levels. In particular, research focused on skill learning has shown that learning progress is linked to a reduced negative amplitude of the readiness potential on the frontal cortex (Fz electrode site) and the primary motor cortex (Cz electrode site). This reduction suggests that less cortical resources are required to plan actions (Lang et al., 1992, Niemann et al., 1991). Accordingly, in relation to the level of expertise, a study comparing expert and novice marksmen (Di Russo et al., 2005) showed that experts exhibited a reduced negative amplitude of the readiness potential along with a later onset of the activity over the primary motor cortex. Our findings seem to coincide with this body of evidence, suggesting that the learning progress, facilitated by self-talk, led to readiness potential amplitude changes, possibly suggesting greater neural efficiency.

Self-talk in sport literature has supported the attentional effects of strategic self-talk on facilitating learning and improving performance. In our study, participants showed a considerable improvement in shooting performance, a moderate effect in aim stability, and a reduced negative amplitude of the readiness potential (i.e., the later component from −500 ms to 0) located in the primary and premotor cortex areas. Taken together, the findings provide indications that participants' training, which included instructional self-talk, increased performance in a newly acquired skill through improved allocation of attention during the motor preparation phase and enhanced stability.

Considering that our study was a pilot, noncontrolled attempt to provide preliminary evidence regarding the links between instructional self-talk and changes in the readiness potential, the interpretation of the results should be cautious. Our participants were novices with no prior shooting experience; thus, performance effects may be attributed to the learning process. However, there is compelling evidence supporting the effectiveness of strategic self-talk in novel tasks (Hatzigeorgiadis et al., 2011). Moreover, the results of a study applying a similar self-talk protocol in a controlled trial involving pistol shooting with novices (Tzompratzakis et al., 2022), showed a large effect when comparing the improvement of the strategic self-talk group with that of the control group. The above evidence provides a window for postulating that in our study the performance improvement and, respectively, the changes in the readiness potential were at least partly due to the strategic self-talk intervention; still, as already acknowledged, the lack of a control group is a limitation.

Future research should employ more comprehensive controlled trials with novices to reinforce our proposed readiness potential interpretation of self-talk effectiveness. Moreover, research involving more experienced or expert participants will enable us to further validate our interpretation but also explore further hypotheses, such as processing efficiency in motor programming, based on psychophysiological data. Yet, we consider this preliminary evidence valuable, as the study is among the first attempting to map event-related potential correlates of strategic instructional self-talk; thus, opening new pathways, beyond indirect evidence and behavioral data, for the investigation of self-talk mechanisms, which will enhance our understanding of the links between self-verbalizations and the functioning of the brain.

Author Disclosure

The authors report there are no grant support, financial interest, or conflicts of interest to disclose.

References

Bahrami, A., Moradi, J., & Rasouli, P. (2020). The relationship between cognitive styles, attention and performance of shooting skill. *International Journal of Motor Control and Learning, 2*(3), 23–30. https://doi.org/10.29252/ijmcl.2.3.23

Bell, J. J., & Hardy, J. (2009). Effects of attentional focus on skilled performance in golf. *Journal of Applied Sport Psychology, 21*(2), 163–177. https://doi.org/10.1080/10413200902795323

Bellomo, E., Cooke, A., Gallicchio, G., Ring, C., & Hardy, J. (2020). Mind and body: Psychophysiological profiles of instructional and motivational self-talk. *Psychophysiology, 57*(9), Article e13586. https://doi.org/10.1111/psyp.13586

Bertollo, M., Robazza, C., Falasca, W. N., Stocchi, M., Babiloni, C., Del Percio, C., Marzano, N., Iacoboni, M., Infarinato, F., Vecchio, F., Limatola, C., & Comani, S. (2012). Temporal pattern of pre-shooting psycho-physiological states in elite athletes: A probabilistic approach. *Psychology of Sport and Exercise, 13*(2), 91–98. https://doi.org/10.1016/j.psychsport.2011.09.005

Di Russo, F., Pitzalis, S., Aprile, T., & Spinelli, D. (2005). Effect of practice on brain activity: An investigation in top-level rifle shooters. *Medicine & Science in Sports & Exercise, 37*(9), 1586–1593. https://doi.org/10.1249/01.mss.0000177458.71676.0d

Galanis, E., & Hatzigeorgiadis, A. (2020). Self-talk mechanisms. In A. T. Latinjak & A. Hatzigeorgiadis (Eds.), *Self-talk in sport* (pp. 136–153). Routledge. https://doi.org/10.4324/9780429460623-10

Galanis, E., Hatzigeorgiadis, A., Charachousi, F., Latinjak, A. T., Comoutos, N., & Theodorakis, Y. (2022). Strategic self-talk assists basketball free throw performance under conditions of physical exertion. *Frontiers in Sports and Active Living, 4*, Article 892046. https://doi.org/10.3389/fspor.2022.892046

Galanis, E., Hatzigeorgiadis, A., Comoutos, N., Charachousi, F., & Sanchez, X. (2018). From the lab to the field: Effects of self-talk on task performance under distracting conditions.

The Sport Psychologist, 32(1), 26–32. https://doi.org/10.1123/tsp.2017-0017

Galanis, E., Hatzigeorgiadis, A., Comoutos, N., Papaioannou, A., Morres, I. D., & Theodorakis, Y. (2022). Effects of a strategic self-talk intervention on attention functions. *International Journal of Sport and Exercise Psychology, 20*(5), 1368–1382. https://doi.org/10.1080/1612197X.2021.1963304

Galanis, E., Nurkse, L., Kooijman, J., Papagiannis, E., Karathanasi, A., Comoutos, N., & Hatzigeorgiadis, A. (2022). Effects of a strategic self-talk intervention on attention functions and performance in a golf task under conditions of ego depletion. *Sustainability, 14*(12), Article 7046. https://doi.org/10.3390/su14127046

Hatfield, B. D., & Kerick, S. E. (2007). The psychology of superior sport performance: A cognitive and affective neuroscience perspective. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of sport psychology* (3rd ed., pp. 84–109). John Wiley & Sons, Inc. https://doi.org/10.1002/9781118270011.ch4

Hatzigeorgiadis, A., Zourbanos, N., Galanis, E., & Theodorakis, Y. (2011). Self-talk and sports performance: A meta-analysis. *Perspectives on Psychological Science, 6*(4), 348–356. https://doi.org/10.1177/1745691611413136

Lang, W., Beisteiner, R., Lindinger, G., & Deecke, L. (1992). Changes of cortical activity when executing learned motor sequences. *Experimental Brain Research, 89*, 435–440. https://doi.org/10.1007/BF00228259

Naderirad, N., Abdoli, B., Farsi, A., & Hassanlouei, H. (2023). The effect of instructional and motivational self-talk on accuracy and electromyography of active and passive muscles in elbow joint position sense test. *International Journal of Sport and Exercise Psychology, 21*(4), 600–615. https://doi.org/10.1080/1612197X.2022.2078854

Niemann, J.,Winker, T., Gerling, J., Landwehrmeyer, B., & Jung, R. (1991). Changes of slow cortical negative DC potentials during the acquisition of a complex finger motor task. *Experimental Brain Research, 85*, 417–422. https://doi.org/10.1007/BF00229418

Oostenveld, R., & Praamstra, P. (2001). The five percent electrode system for high-resolution EEG and ERP measurements. *Clinical Neurophysiology, 112*(4), 713–719. https://doi.org/10.1016/S1388-2457(00)00527-7

Sarig, Y., Ruiz, M. C., Hatzigeorgiadis, A., & Tenenbaum, G. (2023). The effects of instructional self-talk on quiet-eye duration and golf-putting performance. *The Sport Psychologist, 37*(3), 201–209. https://doi.org/10.1123/tsp.2023-0023

Schurger, A., Hu, P., Pak, J., & Roskies, A. L. (2021). What is the readiness potential? *Trends in Cognitive Sciences, 25*(7), 558–570. https://doi.org/10.1016/j.tics.2021.04.001

Shibasaki, H., & Hallett, M. (2006). What is the Bereitschaftspotential? *Clinical Neurophysiology, 117*(11), 2341–2356. https://doi.org/10.1016/j.clinph.2006.04.025

Tod, D., Hardy, J., & Oliver, E. (2011). Effects of self-talk: A systematic review. *Journal of Sport and Exercise Psychology, 33*(5), 666–687. https://doi.org/10.1123/jsep.33.5.666

Tzormpatzakis, E., Galanis, E., Chaldeaki, A., & Hatzigeorgiadis, A. (2022). Application of strategic self-talk: An experimental study on the effects on shooting stability and performance. *International Journal of Kinesiology & Sports Science, 10*(1), 52–56. https://doi.org/10.7575/aiac.ijkss.v.10n.1p.52

Woodman, G. F. (2010). A brief introduction to the use of event-related potentials in studies of perception and attention. *Attention, Perception, & Psychophysics, 72*, 2031–2046. https://doi.org/10.3758/APP.72.8.2031

Wright, D. J., Holmes, P. S., & Smith, D. (2011). Using the movement-related cortical potential to study motor skill learning. *Journal of Motor Behavior, 43*(3), 193–201. https://doi.org/10.1080/00222895.2011.557751

Received: March 29, 2025
Accepted: April 22, 2025
Published: September 15, 2025