



The interplay between self-talk and body posture on physical performance: Analyzing a moderated serial multiple mediation model

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ABSTRACT

Prior research has shown that non-verbal behavior (e.g., overt head movements) can moderate the effects of positive and negative self-talk on physical performance. In the current studies, we aimed to extend existing research on self-talk by examining a different non-verbal behavior (i.e., body posture), as well as specifying some conditions under which body posture can interact with self-talk on physical performance from the Self-Validation Theory perspective. Most importantly, we proposed and tested a moderated serial multiple mediation model. In Studies 1 and 2, self-talk (i.e., positive vs. negative) and body posture (i.e., upright vs. slumped) were manipulated between participants. In Study 1, soccer players performed slalom and dribbling tests. In Study 2, athletes performed a push-up test. We hypothesized and found that positive (vs. negative) self-talk influenced physical performance to a greater extent for participants in the upright posture (i.e., validating) condition than for participants in the slumped posture (i.e., invalidating) condition. Furthermore, Study 3 was designed to analyze a moderated serial multiple mediation model. In this third study, self-talk was positive, body posture was manipulated, and the meaning of body posture was measured as a moderator. Results supported the proposed model, identifying the perceived validity of self-statements (i.e., the self-validation mechanism) and self-efficacy as serial mediators. That is, the meaning (i.e., validity-invalidity) moderated the effects of body posture on athletes' physical performance in a pull-up test, through the indirect effects of the perceived validity of self-statements and self-efficacy. Implications for self-talk research and application are discussed.

1. Introduction

Self-talk has been briefly defined as “verbalizations or self-statements addressed to the self” (Hardy, 2006, p. 84). This widely accepted definition considers self-talk as an act of intrapersonal communication, as well as a type of persuasion in which the sender and the receiver of the message are the same individual (e.g., see Hardy et al., 2018; Latinjak, Hatzigeorgiadis, et al., 2019; Latinjak & Hatzigeorgiadis, 2020; Van Raalte & Vincent, 2017; for a review). That is, self-talk occurs when an athlete talks to oneself either out loud (i.e.,

overt) or internally (i.e., covert), for instance, to increase their perceived self-efficacy in performing a sport-related task (e.g., see Theodorakis et al., 2012). The valence of the content of self-talk has been one of the most studied dimensions (see Hardy, 2006). Specifically, positive self-talk consists of both overt and covert self-statements that athletes say to themselves and are encouraging or self-assuring in tone (e.g., “I can do it”), whereas negative self-talk refers to both overt and covert self-statements that are discouraging or self-deprecating in tone (e.g., “I can't do it”). In their systematic review, Tod et al. (2011) found that positive self-talk had a significantly beneficial effect on performance;

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however, the relationship between negative self-talk and performance was non-significant (see Hatzigeorgiadis et al., 2011, for a meta-analysis on self-talk).¹

Recent research by Horcajo et al. (2019) has shown that non-verbal behavior (e.g., overt head movements) can interact with positive and negative self-talk, moderating the effects on physical performance. Specifically, they predicted and found that head movements typically associated with validity (i.e., nodding one's head) magnified the effects of both positive and negative self-statements on various measures of athletes' physical performance (i.e., vertical jump, squat, and deadlift tests). In contrast, head movements typically associated with invalidity (i.e., shaking one's head) attenuated (indeed non-significant) the effects of both positive and negative self-statements on athletes' physical performance. The authors proposed that these patterns of effects could potentially be explained by a self-validation process that is especially (but not uniquely) well-known in persuasion research (Petty et al., 2002). However, it is important to note that Horcajo et al. (2019) did not provide mediational evidence for the proposed mechanism of self-validation.

In the current studies, we aimed to extend the existing research on self-talk by 1) examining a different non-verbal behavior (i.e., body posture), 2) specifying some conditions under which body posture can interact with self-talk on physical performance from the Self-Validation Theory perspective, 3) assessing other measures of physical performance (i.e., slalom and dribbling in soccer, pull-up, and push-up tests), and 4) testing and providing evidence for a moderated serial multiple mediation model.

2. The effects of self-talk on physical performance from the SVT framework

The Self-Validation Theory (SVT, Briñol & Petty, 2022) has recently been proposed as a comprehensive and integrative framework through which the use of thoughts can be examined across diverse domains in psychology. The core proposal of SVT is that thoughts become more consequential for judgment and action as the perceived validity of the thoughts is increased.² That is, merely generating thoughts is insufficient for those thoughts to have an impact on judgment and action, rather it is necessary for an individual to also perceive one's thoughts as valid. In terms of thought validity, SVT refers to having "a subjective sense that one's thoughts are valid or appropriate to use", and that individuals will rely on any given thought more either "when they perceive that thought is likely to be true (i.e., cognitive validation) or because they feel good about that thought (i.e., affective validation)"

¹ Recently, a new integrative conceptualization and classification of self-talk has been proposed (Latinjak, Hatzigeorgiadis, et al., 2019; Latinjak & Hatzigeorgiadis, 2020; see also Latinjak, Hardy, et al., 2019; Van Raalte et al., 2019; for a discussion). Although we were aware of Latinjak et al.'s conceptualization, in the current research, we assumed the broadly used classification of self-talk, which distinguishes between positive and negative self-talk (e.g., see Hardy, 2006; Van Raalte & Vincent, 2017; for reviews). In accordance with Latinjak and colleagues' classification, the self-talk implemented in our research could specifically fit into the category of strategic self-talk, which "reflects self-talk as a deliberately employed strategy, mostly developed through interventions, involving the use of cue words or phrases to enhance performance or achieve other related outcomes." By contrast, organic self-talk "reflects self-talk as inherent thoughts and self-statements athletes address to themselves." (Latinjak et al., 2019a, p. 2).

² Briñol and Petty (2022, p. 340) use the term 'thoughts' "to refer to any mental content that can come to mind (e.g., beliefs, goals, judgments, attitudes, etc.) and perceived 'validity' to refer to judging one's thoughts as 'acceptable' (valid) to use." In fact, "the theory is called SVT because people validate their own thoughts based on their own perceptions. External information can affect these perceptions, but ultimately what matters is how people assess their own thoughts."

(Briñol & Petty, 2022, p. 340). In accordance with SVT, the perceived validity of thought is proposed as the general *mediator* for the self-validation effects. Importantly, vastly different variables can influence the perceived validity of thoughts, such as source credibility (Tormala et al., 2007) and majority/minority status (Horcajo et al., 2010), as well as receiver mood (Briñol et al., 2007) and mortality salience (Horcajo, Briñol, et al., 2022; see Briñol & Petty, 2022, for a review). Most relevant to the current research, as previously described, validity (vs. invalidity) associated with an athlete's own non-verbal behavior (e.g., head movements) can be self-attributed to positive or negative self-statements, subsequently influencing whether self-talk will be consequential (or not) on physical performance (Horcajo et al., 2019).³

The occurrence of the self-validation process can vary as a function of some specified *moderators*. First, it is important to note that self-validation is a metacognitive process (i.e., "thinking about thinking"), thus requires extensive deliberative thinking in order to operate (i.e., high elaboration conditions, see Petty et al., 2002). That is, for self-validation to occur, not only must individuals generate some initial thought to validate, but they also must have the motivation and ability to engage in additional thinking about the validity of that thought. Second, the validating (vs. invalidating) variable (e.g., head movements) must follow (or occur during, but not prior to) a primary/initial thought (e.g., the self-statements). Individuals generally do not metacognitively consider whether their thought is valid until after thought has been generated. Third, the meaning of potential validating (vs. invalidating) variables can vary between individuals and situations, and thus, thoughts are consequential for subsequent judgments or actions only when the specific variable (e.g., head movements) is interpreted as an indicator of validity. When this same variable is interpreted as an indicator of invalidity, and this invalidity is self-attributed to those thoughts, then those thoughts are not expected to be consequential. Finally, the outcomes of the self-validation process are also moderated by the specific content of thought (e.g., the valence). That is, validating one's positive thoughts (e.g., encouraging self-statements related to a sport task) leads to "beneficial" effects on action (e.g., better physical performance), but validating one's negative thoughts (e.g., discouraging self-statements related to a sport task) is also consequential, leading to "detrimental" effects on action (e.g., worse physical performance).

In the present research, we kept high elaboration constant across all studies. We manipulated the validating variable (i.e., body posture) while athletes said their self-statements to themselves. The meaning of the validating variable (i.e., upright vs. slumped posture) was measured in Study 3. The valence of the self-statements (i.e., positive vs. negative) was manipulated in Studies 1 and 2, and kept constant (i.e., positive) in Study 3. Additionally, we explored another relevant moderator proposed by the SVT, based on the *differential appraisals hypothesis* (i.e., certainty vs. pleasantness appraisals, see Briñol & Petty, 2022), analyzing cognitive versus affective validation in the moderated mediation model examined in Study 3.

Prior evidence from SVT research influenced some of our assumptions. For instance, Briñol et al. (2009) studied how body posture affected self-evaluations by influencing thought validity. Participants were asked to think about and write down either their best (i.e., positive thoughts) or worst (i.e., negative thoughts) qualities while maintaining either an upright or slumped posture. Next, participants completed measures of potential mediators and reported their self-evaluations (as the dependent variable). In accordance with the self-validation process, the direction of thoughts (i.e., positive vs. negative) had a greater impact on self-evaluations when participants were in the upright (vs. slumped) posture, which also increased thought confidence (i.e., the measure of

³ In line with Horcajo et al. (2019), we assumed that self-statements, such as manipulated in the current studies, can be understood as 'verbalized thoughts' which can be analyzed under the SVT framework.

the perceived validity of thought) compared to the slumped posture. Although currently the procedure they used to test mediation would be criticized (see Hayes, 2022, p. 543), thought confidence partially mediated the effects of body posture on self-evaluations.

3. Overview

In the current studies, we aimed to extend SVT to the sport performance field, examining the interactive effects of body posture and self-talk on physical performance. Most importantly, we proposed a moderated mediation model with two serial mediators (i.e., perceived thought validity and self-efficacy). Specifically, in Studies 1 and 2, self-talk (i.e., positive vs. negative self-statements) and body posture (i.e., upright vs. slumped) were manipulated between participants, and physical performance was measured (Study 1: Slalom and dribbling tests; Study 2: Push-up test). Study 1 focused on an initial examination of the predicted interaction between self-talk and body posture on athletes' performance from a single sport (i.e., soccer), while Study 2 aimed to analyze our hypotheses on athletes' performance from multiple sport disciplines to test the generalizability of our findings. Finally, Study 3 was designed to further refine our understanding of the observed effects by analyzing the role of a relevant moderator (i.e., the meaning of body posture) and potential mediators in the relationship between self-talk, body posture, and physical performance. Thus, in the third study, self-talk was kept constant for all participants (i.e., positive self-statements), and body posture was manipulated as per the prior two studies. In addition, the specific meaning (i.e., confidence/certainty vs. doubt/uncertainty) of body posture was individually measured for each athlete. Physical performance was assessed by a pull-up test. The proposed model of moderated serial multiple mediation was examined by including measures of perceived validity in self-statements (i.e., the self-validation mechanism) and self-efficacy as mediators of the effects on physical performance.

4. Hypotheses

H1. We predicted that positive self-statements would produce better physical performance than negative self-statements.

H2. We predicted that an upright posture would be more associated with validity (vs. invalidity) than a slumped posture.

H3. The positive (vs. negative) self-statements would influence physical performance to a greater extent for individuals in the upright posture (i.e., validating) condition than for individuals in the slumped posture (i.e., invalidating) condition.

H4. Even though we proposed that each body posture would have a default meaning, such that the upright posture was more associated with validity (vs. invalidity) than the slumped posture, in Study 3 we hypothesized that the specific meaning of the body posture for each participant would moderate the effects of the upright (vs. slumped) posture on physical performance. That is, each body posture would validate (vs. invalidate) the self-statements as a function of the meaning (i.e., validity vs. invalidity) that each individual associated with the body posture.

H5. In Study 3, we hypothesized a moderated serial multiple mediation model. The self-talk used in the current research referred to being capable (i.e., encouraging self-statements, such as "I can do it") versus incapable (i.e., discouraging self-statements, such as "I can't do it") of performing at a high level in some physical tests, and was thus related to self-efficacy beliefs in the specific physical tasks assessed. Therefore, our proposed model stipulated that the interactive effects of body posture (independent variable) and the meaning of the body posture (moderating variable) on physical performance (dependent variable) would be serially mediated by the perceived validity of self-statements (i.e., the

self-validation mechanism, mediator 1) and self-efficacy (mediator 2).

4.1. Study 1

In the first study, we analyzed the effects of self-talk and body posture (i.e., independent variables) on two physical tests related to soccer performance (i.e., slalom and dribbling, as the dependent variables).

5. Method

Permission to conduct the three studies that comprised the present research was granted by the institutional ethics committeeóridó. Moreover, we also received permission from soccer clubs' managers and trainers (Study 1), and gymnasium managers (Study 3). In addition, all participants were required to read and sign an informed consent form before the studies began.⁴

5.1. Design and participants

Participants were randomly assigned to a 2 (self-talk: positive vs. negative) \times 2 (body posture: upright vs. slumped) between-participants factorial design. Given that no prior research had specifically examined our key predicted interaction (i.e., hypothesis 3), an a priori power analysis was performed using G*Power (Faul et al., 2009), which assumed a generic medium value for the interaction effect size (Cohen's $f = 0.25$). Results of this analysis suggested that the desired sample size for a two-tailed test ($\alpha = 0.05$) with 0.80 power was $N = 128$. Our final sample ($N = 120$) was slightly below this number because our data collection was limited by the amount of participants that engaged in the planned sessions, as well as difficulties related to recruiting participants who met the study's inclusion criteria and appropriately performed the study's procedure.⁵ Relevantly, we collected participants during one competitive season, and we opted to complete the final sample before the end of that season, thus without having to wait until the next season to slightly expand it (for additional details on participants and power analysis, see Supplementary Materials). Therefore, the sample consisted of one hundred and twenty soccer players (109 males, and 11 females) from Spain, aged between 18 and 40 years ($M = 21.43$; $SD = 4.07$).

5.2. Procedure

Participants were told that the aim of this research was to study the relationship between some cognitive variables (e.g., attention, memory, etc.) and performance on soccer-related tests. Because participants were told that their performance would be assessed, we had a good reason to believe that personal relevance would be high for these participants (see Supplementary Materials, for analyses on an additional measure of personal relevance in our three studies). After completing the informed consent, soccer players went on to perform a researcher-directed warm-up that lasted 5 min. Immediately following the warm-up, the researcher proceeded to assess a baseline in the soccer-related tests, which always followed the same order (i.e., slalom and then dribbling). In accordance

⁴ In each of our three studies, we report all dependent variables that were analyzed for our target research question. Likewise, all levels of all predictors or manipulations, whether successful or not, are reported (for additional measures and analyses, see Supplementary Materials). Finally, the excluded observations or participants (if any) and the reasons for making those exclusions (if any) are also reported.

⁵ In our three studies, those participants who did not adequately complete manipulations, as well as the dependent measures, were not included in the databases. In addition, our inclusion criteria also excluded participants with plausible fatigue, for example because of having done intense training prior to participating in the study.

with Huijgen et al. (2010), participants were first asked to sprint at maximum speed, circling the cones that had been placed in a zigzag pattern for 30 m. Second, on the same circuit in which the slalom task was carried out, participants were asked to dodge the cones while dribbling a soccer ball, as fast as they could, while always maintaining control of the ball.

After the baseline measures, soccer players filled out a questionnaire in which the first task was to write down three thoughts (i.e., self-statements) about either their ability or inability to perform well on the second set of slalom and dribbling tests. That is, the valence of self-talk was manipulated by asking each participant to write three statements about themselves that were either encouraging or discouraging. Next, the researcher told each participant which body posture they should maintain (i.e., either upright or slumped) while they engaged in self-talk. After the posture instruction, participants were asked to say to themselves, either aloud or internally (as preferred by each participant), the three self-statements that they had previously generated, all while maintaining the assigned body posture. In no case was the researcher able to listen to the self-talk, and only observed from a distance to visually confirm that the posture was performed correctly while each soccer player engaged in self-talk.

Finally, participants carried out warm up exercises for 1 min, after which the slalom and dribbling tests were again completed in the same order as the first measurement. After these tests, participants were asked to complete some additional measures (e.g., age, sex, competition level in soccer) in a questionnaire, then were informed about all the details of the study and were thanked for their participation.⁶

5.2.1. Independent variables

Self-talk. The self-talk manipulation was adapted from previous research (e.g., Hamilton et al., 2007; Horcajo et al., 2019; Son et al., 2011; Van Raalte et al., 1995). Participants assigned to the positive [negative] self-talk condition were asked to think about and then write down three self-statements that reflected their belief that “At this moment, you are capable [incapable] of performing at a high level in the soccer-related tests that you will do later.” Participants were shown two examples of either positive or negative self-talk, according to condition. However, all self-statements were generated individually, thus were personalized and meaningful to each participant (see Horcajo et al., 2019; Magnusson & van Roon, 2013). Furthermore, we asked participants to write down their self-statements before saying them to themselves because this allowed us to check if participants had followed the instructions for each condition (i.e., positive vs. negative self-statements). All participants in each condition followed the instructions properly. In addition, participants were asked to say to themselves, either aloud or internally (as preferred by each participant), the three self-statements that they had previously generated in the order in which they wrote them, repeating the same sequence three times, all while maintaining the assigned body posture. From a practical perspective, allowing each participant to use self-talk in a way (i.e., either overt or covert) that feels most natural and comfortable to them enhances ecological validity. Thus, the aim was to mimic real-life situations where athletes engage in self-talk, either overtly or covertly, as preferred, prior to performing the sport task.

Body posture. The body posture manipulation was also adapted from prior research (e.g., Briñol et al., 2009; Riskind & Gotay, 1982). Participants were told that their ability to maintain a body posture and think or speak at the same time would be assessed. In the upright posture condition, participants were told to maintain a posture that required

them to push their chest out and keep their back straight. By contrast, in the slumped posture condition, participants were told to maintain a posture that required them to look down towards their knees while curling their back and shoulders forward. The researcher’s instructions also included a picture that illustrated either the upright posture or the slumped posture (see Appendix 1 in Supplementary Materials).

Dependent variables. We used the “Slalom Sprint and Dribble Test” (Huijgen et al., 2010) to assess physical performance in soccer players. The times of the slalom and dribbling tests were measured using a stopwatch, including seconds, tenths, and hundredths of a second. Specifically, both a slalom performance index and a dribbling performance index were created as the subtraction of the post-experimental manipulation measurement to baseline measurement. Higher scores in these indexes indicated a better slalom performance ($M = 0.15$; $SD = 0.45$) and a better dribbling performance ($M = 0.43$; $SD = 1.14$).⁷

6. Results

Each dependent variable was submitted to a 2 (self-talk: positive vs. negative) \times 2 (body posture: upright vs. slumped) factorial analysis of variance (ANOVA).⁸

6.1. Slalom

Inconsistent with our hypothesis (H1), there was not a significant main effect of self-talk on slalom, $F(1, 116) = 1.94$, $p = .166$, $\eta_p^2 = 0.016$. As expected, there was not a significant main effect of body posture, $F(1, 116) = 0.37$, $p = .541$, $\eta_p^2 = 0.003$. Most importantly, the predicted interaction between self-talk and body posture was significant, $F(1, 116) = 7.20$, $p = .008$, $\eta_p^2 = 0.058$. As hypothesized (H3), among participants in the upright posture condition, those assigned to the positive self-talk condition performed significantly better ($M = 0.35$, $SD = 0.43$) than those assigned to the negative self-talk condition ($M = 0.02$, $SD = 0.37$), $F(1, 116) = 8.44$, $p = .004$, $\eta_p^2 = 0.068$. By contrast, among participants in the slumped posture condition, no difference was found between those assigned to the positive self-talk condition ($M = 0.08$, $SD = 0.41$) and those assigned to the negative self-talk condition ($M = 0.18$, $SD = 0.53$), $F(1, 116) = 0.82$, $p = .367$, $\eta_p^2 = 0.007$ (see Figure 1). Moreover, the interaction showed that among participants in the positive self-talk

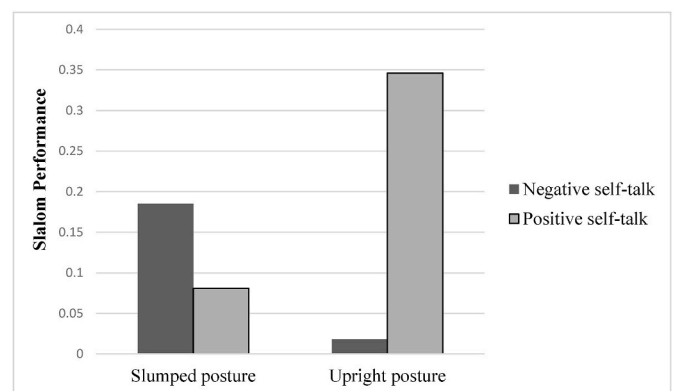


Figure 1. Slalom performance as a function of self-talk and body posture (study 1).

⁶ At the very end of each of our studies, after all planned, highly relevant measures had been completed, participants were asked to respond to a few additional measures. Some relevant measures are reported in the Supplementary Materials. Other measures are not reported in this manuscript because they had other exploratory purposes for future research.

⁷ One participant failed to complete the dribbling task for the baseline measurement, therefore was not included in the analyses regarding the dribbling performance.

⁸ For additional analyses in each of our three studies, see Supplementary Materials.

condition, those assigned to the upright posture condition performed significantly better ($M = 0.35$, $SD = 0.43$) than those assigned to the slumped posture condition ($M = 0.08$, $SD = 0.41$), $F(1,116) = 5.26$, $p = .024$, $\eta_p^2 = 0.043$. However, among participants in the negative self-talk condition, there was no significant difference between those assigned to the slumped posture condition ($M = 0.18$, $SD = 0.53$) and those assigned to the upright posture condition ($M = 0.02$, $SD = 0.37$), $F(1,116) = 2.22$, $p = .139$, $\eta_p^2 = 0.019$.

6.2. Dribbling

Unexpectedly, there was not a significant main effect of self-talk on dribbling, $F(1, 115) = 0.25$, $p = .621$, $\eta_p^2 = 0.002$, and the main effect of body posture was close to be significant, $F(1, 115) = 3.53$, $p = .063$, $\eta_p^2 = 0.030$. Also contrary to our hypotheses, we did not find a significant interaction between self-talk and body posture on dribbling, $F(1,115) = 0.00$, $p = .984$, $\eta_p^2 = 0.000$.

6.2.1. Study 2

In order to replicate and extend the results found in Study 1, we decided to carry out a second study that used a very similar procedure, but with a different sample of participants from other sport and exercise disciplines. Thus, in this second study, we analyzed the effects of self-talk and body posture (as independent variables) on a different measure of physical performance (i.e., a push-up test, as the dependent variable).

7. Method

7.1. Design and participants

Participants were randomly assigned to a 2 (self-talk: positive vs. negative) \times 2 (body posture: upright vs. slumped) between-participants factorial design. Because Study 2 included a substantially different measure of physical performance, again an a priori power analysis was performed using G*Power, which assumed a generic medium value for the interaction effect size (Cohen's $f = 0.25$). As in Study 1, results of this analysis suggested that the desired sample size for a two-tailed test ($\alpha = 0.05$) with 0.80 power was $N = 128$. Our final sample ($N = 117$) was also below this number because our data collection was limited by the number of participants that were available for the planned sessions, as well as difficulties related to collecting participants who met the study's inclusion criteria and appropriately performed the study's procedure. Importantly, this second study had to be conducted online due to mobility limitations related to the COVID-19 pandemic, which made it even more difficult to recruit enough athletes to complete the intended sample during one competitive season. The final sample consisted of one hundred and seventeen participants (65 males, 51 females, and one unidentified) from different regions of Spain. Relevantly, in this study, we wanted to balance sex because Study 1 was generally composed of males. Participants' age ranged between 18 and 36 years ($M = 21.76$; $SD = 3.04$). Regarding the specific sport or exercise, our sample was very heterogeneous, as it consisted of 20 different sport and exercise disciplines (for additional details on participants and power analysis, see Supplementary Materials).

7.2. Procedure and variables

Whereas Study 1 was carried out in person, in Study 2 participants were asked to complete an online questionnaire (using Qualtrics, see <https://www.qualtrics.com>), and perform a physical test that was done

via a video call (using Zoom, see <https://www.zoom.us>). The purpose of the video call was to assess the physical performance of each athlete while also ensuring the correct manipulation of each experimental condition.⁹ By way of informed consent, each participant agreed to be observed in the video call and was informed that no recording of the call would be made.

In this second study, physical performance was assessed with a Push-Up Test according to guidelines from prior research (e.g., Baumgartner et al., 2002; Mozumdar et al., 2010). Specifically, for each push-up, participants were required to begin with fully extended and locked arms, and to touch their chest to the ground on descent. They were asked to perform push-ups until they could not successfully complete another push-up. Two measurements of physical performance were made (i.e., the baseline and post-experimental manipulations). A physical performance index was created, which was computed by subtracting the number of push-ups in the baseline measurement from the number of push-ups in the post-experimental manipulations measurement. Higher scores on this index indicated a better physical performance ($M = 0.40$, $SD = 4.63$). All other details of this second study's procedure were identical to Study 1. In particular, self-talk and body posture were identically manipulated. Lastly, athletes provided additional information (e.g., age, sex, sport or exercise, competition level), then they were debriefed and thanked for their participation.

8. Results

8.1. Physical performance

The dependent variable (i.e., the number of push-ups) was submitted to a 2 (self-talk: positive vs. negative) \times 2 (body posture: upright vs. slumped) factorial analysis of variance (ANOVA). In line with our hypothesis (H1), there was a significant main effect of self-talk. That is, participants assigned to the positive self-talk condition performed better ($M = 1.28$, $SD = 4.55$) than those assigned to the negative self-talk condition ($M = -0.55$, $SD = 4.56$), $F(1, 113) = 5.28$, $p = .023$, $\eta_p^2 = 0.045$. No significant main effect of body posture on physical performance was found, $F(1, 113) = 0.34$, $p = .564$, $\eta_p^2 = 0.003$. Most importantly, the predicted interaction between self-talk and body posture was significant, $F(1,113) = 8.08$, $p = .005$, $\eta_p^2 = 0.067$. Consistent with our prediction (H3), among participants in the upright posture condition, those assigned to the positive self-talk condition performed significantly better ($M = 2.85$, $SD = 5.61$) than those assigned to the negative self-talk condition ($M = -1.39$, $SD = 5.27$), $F(1,113) = 13.22$, $p < .001$, $\eta_p^2 = 0.105$. In contrast, among participants in the slumped posture condition, no significant differences were found between those assigned to the positive self-talk condition ($M = 0.03$, $SD = 3.02$) and those assigned to the negative self-talk condition ($M = 0.48$, $SD = 3.30$), $F(1,113) = 0.15$, $p = .700$, $\eta_p^2 = 0.001$ (see Figure 2). Moreover, the interaction showed that among participants in the positive self-talk condition, those assigned to the upright posture condition performed significantly better ($M = 2.85$, $SD = 5.61$) than those assigned to the slumped posture condition ($M = 0.03$, $SD = 3.02$), $F(1,113) = 6.11$, $p = .015$, $\eta_p^2 = 0.051$. However, among participants in the negative self-talk condition, there was no significant difference between those assigned to the slumped posture condition ($M = 0.48$, $SD = 3.30$) and those assigned to the upright posture condition ($M = -1.39$, $SD = 5.27$), $F(1,113) = 2.46$, $p = .120$, $\eta_p^2 = 0.021$ (see Supplementary Materials, for a joint analysis of Studies 1 and 2, as well as additional measures and further analyses).

⁹ As noted, these novelties in the procedure were necessary because this second study was carried out during mobility restrictions due to the COVID-19 pandemic.

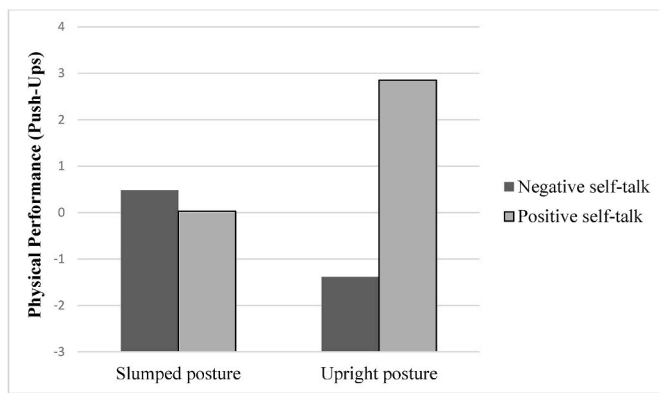


Figure 2. Physical performance in the push-up test as a function of self-talk and body posture (study 2).

8.1.1. Study 3

In Studies 1 and 2, the hypothesized interaction was significant, consistent with our predictions. However, given that mediational evidence was not demonstrated, an important goal of our third study was to test mediation, specifically a moderated serial multiple mediation model. Furthermore, in Study 3, we examined a highly relevant moderator of the effects of body posture on physical performance: The meaning of body posture. According to the SVT (see Briñol & Petty, 2022), a non-verbal behavior such as body posture can have different meanings as a function of individual and situational variables (see also Briñol et al., 2017; Körner et al., 2022). That is, each body posture can be relatively associated with validity (e.g., confidence and certainty) or invalidity (e.g., doubt and uncertainty). When the meaning associated with a specific body posture is perceived as carrying high validity for an individual, this association then increases the impact of thoughts (e.g., self-statements) on subsequent action (e.g., physical performance). However, when the meaning associated with the same body posture is linked to perceptions of low validity (or invalidity), this association then decreases the impact of thoughts on subsequent action (or could even reverse the effect). Even though we assumed that the body postures analyzed in the current studies can generally have a default meaning with the upright posture being more associated with confidence (vs. doubt) than the slumped posture (e.g., Briñol et al., 2009; see also Supplementary Materials), we included a specific measure of the meaning as a predictor variable in Study 3's design, which allowed us to analyze its potential moderating role.

To methodologically simplify the design of this study, we chose to focus only on positive (strategic) self-talk. We aimed to examine the effects of a specific type of self-statements, known as strategic self-talk, which is particularly relevant to interventions in sport settings (see Latinjak & Hatzigeorgiadis, 2020). In addition, having already showed the predicted interaction between self-talk (positive vs. negative) and body posture (upright vs. slumped) in Studies 1 and 2, we intended to simplify the interpretation of the complex conditional effects of body posture (as moderated by the meaning attributed to body posture) and the indirect effects (through perceived validity of self-statements and self-efficacy as mediators) on physical performance during positive self-talk. Moreover, to maintain a clear focus on the key aspects of the relationship between positive self-talk, body posture, and physical performance, we chose to assess performance only after the experimental manipulation of body posture. This decision was mainly driven by the desire to avoid additional complexity. Specifically, in our Study 3, we included tasks to measure meaning, perceived validity of self-statements, and self-efficacy immediately after generating self-statements and performing the self-talk task with implemented body posture. Thus, due to time constraints and the convenience to conduct the study in a real gym as part of an actual workout, we decided against adding a baseline measure at the beginning of the study. This approach

helped to prevent excessive prolongation of the study, which could potentially affect participant engagement and compliance.

Importantly, Study 3 included an assessment of the perceived validity of self-statements (i.e., the self-validation mechanism) and a measurement of self-efficacy as the proposed mediators. As noted in our hypothesis, this last measure was included because the self-talk used in this research referred to ability beliefs to perform a specific physical task (i.e., self-efficacy, see Bandura, 1997), and thus, we hypothesized that self-efficacy would be a necessary mediator on physical performance. In line with prior theory and research, “self-talk may facilitate performance through increasing self-efficacy beliefs as a source of internal verbal persuasion” (Theodorakis et al., 2012, p. 201; see also Hardy, 2006). For example, Hatzigeorgiadis, Zourbanos, Goltios, & Theodorakis (2008) showed that the use of motivational self-talk improved self-efficacy and performance in young tennis players. Moreover, that increase in self-efficacy was related to an increase in performance, thus suggesting that self-efficacy may be a potential mediator of the beneficial effects of self-talk on sport performance. In the present research, we assumed that self-efficacy (in a sport context) might play the role that attitude research has assigned to the attitude construct when predicting behaviors (e.g., see Eagly & Chaiken, 1993). In accordance with our theoretical framework (i.e., SVT, Briñol & Petty, 2022), we proposed that self-efficacy would play a more suitable role as a mediator between thoughts (i.e., self-statements) and behavior (i.e., physical performance), along with the perceived thought validity (i.e., the mediator proposed by SVT) as serial multiple mediators of the effects on physical performance.

9. Method

9.1. Design and participants

Body posture (i.e., upright vs. slumped) and the meaning of the body posture (continuous variable) were analyzed as predictors, and the proposed mediators (i.e., the perceived validity of self-statements, and self-efficacy) and physical performance served as criterion variables. According to Hayes (2022), the literature on power and sample size determination for moderated mediation is scarce. The absence of power analysis tools specifically designed for testing models of moderated mediation within the PROCESS software further complicates this issue. However, it is worth noting that utilizing bootstrapping techniques, as used in our study to test the hypothesized moderated serial multiple mediation model, can offer higher power compared to traditional theory-based approaches (see also Hayes, 2022, for a discussion on the relative importance of power analysis). Nevertheless, as a guide, taking an effect size for the predicted interaction between body posture and meaning like that expected and achieved (Cohen's $f = 0.25$) in the two prior studies, the desired sample size for a two-tailed test ($\alpha = 0.05$) with 0.80 power was $N = 128$. Importantly, we wanted to get as many participants as possible during an academic semester to avoid falling short of the target. The final sample ($N = 146$) exceeded our goal due to the high turnout in the number of athletes who attended the planned training sessions in the gymnasiums. Thus, one hundred and forty-six CrossFit®¹⁰ athletes (118 males, 27 females, and one unidentified) from four different gymnasiums located in the metropolitan area of Madrid (Spain) participated anonymously in this study. The age of the participants ranged from 18 to 51 ($M = 33.39$, $SD = 7.21$). Participants were selected because they had some prior experience in a highly sport-specific test (i.e., the Pull-Up Test), and were enrolled in an actual CrossFit® training that incorporated this study as part of their WOD (i.e., Work of the Day), thus providing high ecological validity (see Supplementary Materials, for more details).

¹⁰ CrossFit is a registered trademark of CROSSFIT, LLC.

9.2. Procedure and variables

To increase personal relevance, participants were told that the purpose of this study was to examine psychological processes and physical performance in CrossFit®. Participants only engaged in positive self-statements, completing the positive self-talk task used in our prior studies. Furthermore, body posture was manipulated (i.e., upright vs. slumped) while athletes said to themselves their previously generated positive self-statements. After this manipulation, participants were asked to complete a questionnaire, which included measures of the meaning of body posture, the perceived validity of self-statements, and self-efficacy. In this questionnaire, two items assessed the meaning of body posture based on our theoretical approach to body posture, as manipulated in our series of studies (i.e., upright vs. slumped). That is, in accordance with prior research (e.g., Briñol et al., 2009; see Körner et al., 2022, for a review on body posture), we assumed that the upright posture would generally be more associated with a meaning of confidence and certainty, whereas the slumped posture would generally be more associated with a meaning of doubt and uncertainty. The measurement of the meaning of body posture was methodologically based on the semantic differential technique (Osgood et al., 1957; see also Mehrabian, 1972; Mehrabian & Russell, 1974). This technique involves the use of bipolar scales, in our case with the concepts of ‘confidence’ and ‘certainty’ versus ‘doubt’ and ‘uncertainty’ serving as the response options at opposite ends of a continuum. Relevantly, this measurement approach was also in line with research on self-validation, in which the terms confidence and certainty have not been distinguished but rather are used synonymously, as with the terms doubt and uncertainty (see Briñol & Petty, 2022, for a review). Thus, each participant responded to these two items on 9-point semantic differential scales related to the meaning of body posture they adopted while they said to themselves their self-statements: “To what extent does that posture for you have a meaning related to either confidence or doubt?”, and “To what extent is this posture for you related to having either certainty or uncertainty?” (1 = Very related to doubt [uncertainty], 9 = Very related to confidence [certainty]).

Scores on these two items were highly correlated ($r = 0.79$, $p < .001$), thus averaged to form a single index ($M = 5.89$; $SD = 2.00$). To examine our key predictions in this study (H4 and H5), we computed this index by reversing scores for participants in the slumped posture condition. Therefore, higher scores on this index indicated a match with the default meaning; that is, higher confidence and certainty for the upright posture, and higher doubt and uncertainty for the slumped posture. By contrast, lower scores on this index indicated the contrary meaning; that is, higher confidence and certainty for the slumped posture, and higher doubt and uncertainty for the upright posture. Thus computed, this index allowed us to test our predicted interaction between body posture and meaning on our criterion variables, as well as the moderated serial multiple mediation model.

In order to examine the self-validation process, we included five items, each with 9-point scales, similar to items used in prior research on self-validation (e.g., Gascó et al., 2018; Horcajo et al., 2010; Petty et al., 2002). That is, to broadly assess the *perceived validity* of self-statements (i.e., the proposed “integrative mediator” for self-validation effects), we included measures of both cognitive and affective validation (see Briñol & Petty, 2022). Thus, athletes were asked: “How *certain* [*confident*] were you about the thoughts (i.e., self-statements) that you said to yourself?” (i.e., the cognitive validation measures), and “To what extent did having those thoughts make you feel good?”, and “To what extent were you satisfied with those thoughts?” (i.e., the affective validation measures). These four items were anchored at 1 = *Very little* to 9 = *Very much*. Participants were also asked to respond to the following question: “In general, I think that those thoughts that I wrote and told myself have for me (1 = *low validity*; 9 = *high validity*, e.g., Horcajo et al., 2020)” (i.e., a general item of thought validity, see Briñol et al., 2018). Item-ratings were highly correlated ($\alpha = 0.88$). Nevertheless, a dimensionality

analysis with principal components was performed on the covariance matrix, with direct oblimin rotation for these items, because of the inclusion of measures for the two types of validation (i.e., either cognitive or affective), as well as a general item of perceived thought validity in self-statements. This principal component analysis showed a single component that explained 68.33% of the variance. Thus, the total of the five items was averaged to create a composite index of perceived validity of self-statements. Higher scores in this index indicated higher perceived validity ($M = 7.79$, $SD = 1.08$).

To assess self-efficacy (SE), participants completed a SE measure regarding the pull-up test (i.e., maximum number of pull-ups until exhaustion). Adapted from Horcajo, Santos and Higuero (2022), we used a 12-item measure of SE constructed following the guidelines provided by Bandura (1997, 2006). Each participant had to rate “How sure are you that you can successfully perform at each specified level?”, from 2 to 24 or more pull-ups, with increases of 2 pull-ups per item (i.e., 2, 4, 6, 8 pull-ups, etc.). That is, they rated their SE from 0 to 10 for every item using single unit intervals from 0 (“Cannot do at all”); through intermediate degrees of assurance, 5 (“Moderately sure can do”); to high assurance, 10 (“Highly sure can do”). Item-ratings were highly inter-correlated ($\alpha = 0.93$), thus averaged to form a single measure ($M = 4.12$; $SD = 2.06$), in which higher scores indicated higher SE.

After completing this questionnaire, physical performance was assessed. Participants were asked to perform the maximum number of pull-ups possible until they could not successfully complete another pull-up. For each pull-up, they were required to start with arms fully extended and finish with their chin above the bar (e.g., Jones et al., 2018; Vigouroux et al., 2019). Higher scores indicated better physical performance ($M = 12.00$; $SD = 5.82$). Following the physical performance test, additional information (e.g., sex, age, CrossFit® experience) was collected. Finally, participants were debriefed and thanked for their participation.

10. Results

All criterion measures (i.e., the number of pull-ups, the perceived validity of self-statements, and self-efficacy) were individually regressed onto the predictors (i.e., body posture and meaning), as well as their interaction term (i.e., Body Posture \times Meaning), using a regression analysis which included body posture (dummy coded, 1 = upright, and 0 = slumped) and meaning (mean-centered continuous variable) in the first step, followed by the interaction term in the second step. As recommended by Cohen and Cohen (1983), main effects and interaction were interpreted in the first step in which they appeared in the regression analysis. In addition, the critical interaction was also tested using the PROCESS add-on for SPSS (model 1; see Hayes, 2022) because this procedure enabled us to compute the conditional effects at different levels (i.e., percentiles 16th and 84th) of the moderating variable (i.e., the meaning of body posture), as well as the simple slopes to plot Figure 3. In this case, body posture was coded as 0.5 = upright, and -0.5 = slumped (see Hayes, 2022; Igartua & Hayes, 2021).

10.1. Physical performance

In this study, with this specific sample of athletes, the moderating role of the meaning of body posture was even larger than expected. In fact, the results did not reveal a significant main effect of body posture on physical performance, $B = -0.23$, $t(141) = -0.20$, $p = .838$, 95% CI $[-2.43, 1.97]$ ($sr = -0.017$).¹¹ There was also no significant main effect of meaning, $B = 0.11$, $t(141) = 0.39$, $p = .699$, 95% CI $[-0.44, 0.66]$ (sr

¹¹ This statistic refers to the semipartial correlation and quantifies the strength of the relationship between each independent variable and the dependent variable while controlling for the influence of the other independent variables included in the analysis.

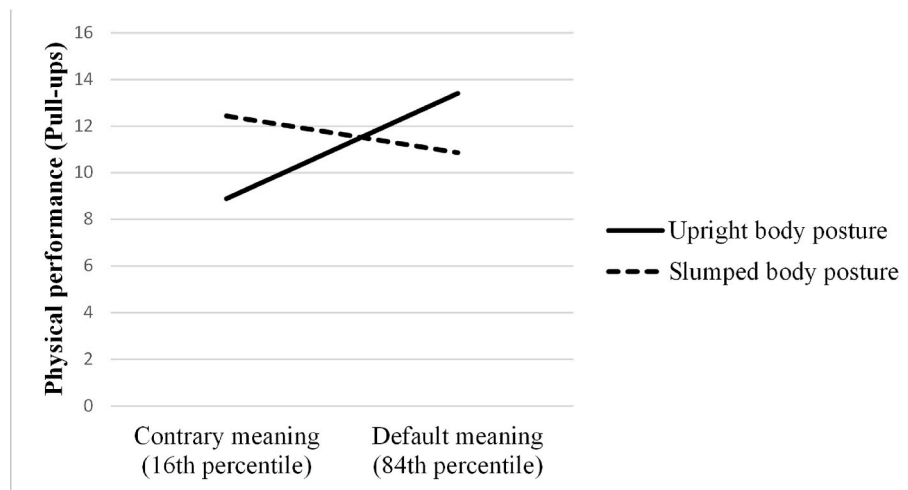


Figure 3. Physical performance in the pull-up test as a function of body posture and meaning (study 3).

= 0.033). Most important to the present research, the hypothesized interaction (H4) between body posture and meaning on physical performance was significant, $B = 1.52$, $t(140) = 2.62$, $p = .010$, 95% CI [0.37, 2.67] ($R^2 = 0.047$).¹² That is, the predicted interaction showed that among participants who associated their body posture with the hypothesized default meaning (84th percentile), those assigned to the upright posture condition tended to perform somewhat better than those assigned to the slumped posture condition, although this difference did not reach significance, $B = 2.55$, $t(140) = 1.67$, $p = .096$, 95% CI [-0.46, 5.55]. By contrast, among participants who did not associate their posture with the hypothesized default meaning, but with the contrary meaning (16th percentile), those assigned to the slumped posture condition performed better than those assigned to the upright posture condition, $B = -3.55$, $t(140) = -2.12$, $p = .035$, 95% CI [-6.86, -0.25], as predicted by the SVT (see Figure 3).¹³

Moreover, the interaction showed that among participants in the upright posture condition, the more they associated body posture with the hypothesized default meaning, the greater performance, $B = 1.13$, $t(140) = 2.37$, $p = .019$, 95% CI [0.19, 2.07]. However, among participants in the slumped posture condition, no significant relationship was found between the meaning associated with body posture and physical performance, $B = -0.39$, $t(140) = -1.18$, $p = .240$, 95% CI [-1.05, 0.27].¹⁴

10.2. The conditional indirect effects of body posture on physical performance

Most critical to the present research, in order to test the moderated serial multiple mediation that hypothetically underlies the relationship between body posture and physical performance, the PROCESS macro for SPSS was used (model 85, using 10,000 bootstrapping samples to generate 95% confidence intervals; see Hayes, 2022; Igartua & Hayes, 2021). This model enables an estimation of the (conditional) indirect effects of body posture (coded as 0.5 = upright, and -0.5 = slumped) on physical performance through the perceived validity of self-statements

(as a first mediator, i.e., the self-validation mechanism) and self-efficacy (as a second mediator), at the different levels of the meaning of body posture (i.e., moderator, mean-centered continuous variable), which was proposed to moderate 1) the relationship between body posture and physical performance, 2) the relationship between body posture and the perceived validity of self-statements, and 3) the relationship between body posture and self-efficacy.

Results revealed that the confidence interval of the index of moderated mediation did not include the value 0, $b = 0.36$, $SE = 0.17$, 95% CI [0.070, 0.739], thus supporting the proposed model of moderated serial multiple mediation (see Figure 4). Examining the conditional indirect effects at the different levels of meaning, we found that when the meaning of body posture was more associated with the hypothesized default meaning (84th percentile), the indirect effect was statistically significant, $b = 0.74$, $SE = 0.42$, 95% CI [0.119, 1.741]. However, when the meaning of body posture was more associated with the contrary meaning (16th percentile), the indirect effect did not reach significance $b = -0.68$, $SE = 0.45$, 95% CI [-1.679, 0.102], although the pattern was clear in showing that body posture (i.e., upright vs. slumped) led to opposite indirect effects on physical performance depending on the hypothesized default meaning versus the contrary meaning.

Cognitive validation. Although the dimensionality analysis indicated a single dimension for the measures of the perceived validity of self-statements, we wanted to separately analyze the conditional indirect effects for cognitive (vs. affective) validation measures in order to make a more relevant contribution to SVT research by further specifying the validation process found in our study. Thus, when including only the cognitive validation measures as the first mediator (the two items were grouped in an averaged index due to the high correlation between them; $r = 0.88$, $p < .001$) and self-efficacy as the second mediator, results revealed that the confidence interval of the index of moderated mediation did not include the value 0, $b = 0.52$, $SE = 0.20$, 95% CI [0.182, 0.989], thus supporting the proposed model of moderated serial multiple mediation. Analyzing the conditional indirect effects at the different levels of meaning, we found that when the meaning of body posture was more associated with the hypothesized default meaning (84th percentile), the indirect effect was statistically significant, $b = 1.04$, $SE = 0.53$, 95% CI [0.240, 2.301]. In addition, when the meaning of body posture was more associated with the contrary meaning (16th percentile), the indirect effect was also significant, $b = -1.05$, $SE = 0.57$, 95% CI [-2.283, -0.013], showing that body posture (i.e., upright vs. slumped) led to opposite indirect effects on physical performance depending on the hypothesized default meaning versus the contrary meaning. This pattern more clearly showed the predicted results than the one found with all items of perceived validity of self-statements.

¹² The R-squared values for the interaction reported in these analyses represent the additional amount of variation in the overall model explained by including the interaction term.

¹³ For a discussion on the use of either standard deviations (-1SD vs. +1SD) or percentiles (16th vs. 84th) to visualize interactions using the PROCESS macro for SPSS, see Hayes (2022, pp. 259).

¹⁴ Results of the regression analyses on both the perceived validity of self-statements and self-efficacy as dependent variables are reported in Supplementary Materials.

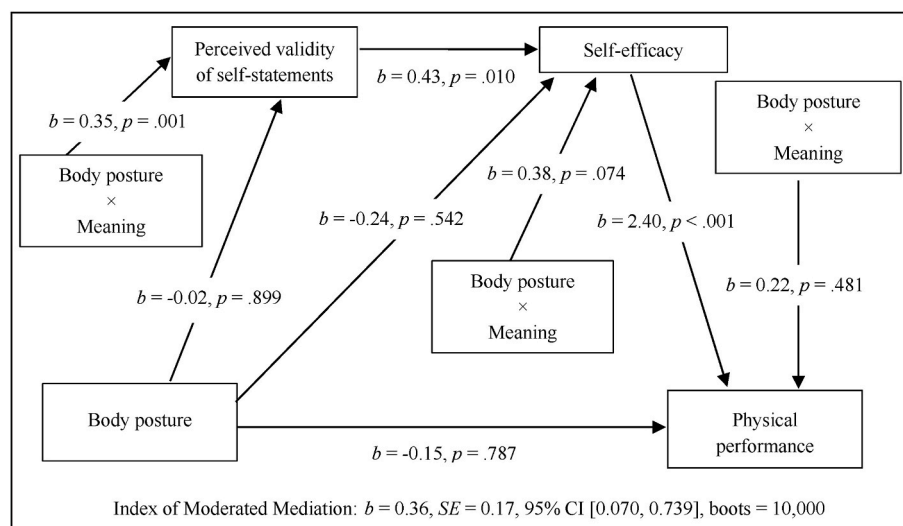


Figure 4. Analysis of Moderated Serial Multiple Mediation Model on Physical Performance (i.e., the Number of Pull-Ups)

Note. B symbol refers to unstandardized coefficients found by using the Model 85 (launched by the PROCESS macro for SPSS, see Hayes, 2022).

Affective validation. When only the affective validation measures were included as the first mediator (the two items were grouped in an averaged index due to the high correlation between them; $r = 0.75, p < .001$) and self-efficacy as the second mediator, results revealed that the confidence interval of the index of moderated mediation included the value 0, $b = 0.15, SE = 0.11, 95\% CI [-0.064, 0.403]$, thus, in this case, did not support the proposed model of moderated serial multiple mediation.

11. Discussion

The results from our three studies supported our hypotheses. Importantly, positive (vs. negative) self-talk influenced physical performance as a function of body posture. That is, the upright (vs. slumped) posture magnified (vs. attenuated) the effects of positive and negative self-talk on physical performance in the slalom (Study 1) and push-up tests (Study 2). Moreover, when the specific meaning of these postures for each participant was examined as a potential moderating variable in Study 3, meaning actually moderated the effects of body posture on physical performance in the pull-up test. Finally, findings from Study 3 supported a moderated serial multiple mediation model, identifying the perceived validity of self-statements (i.e., the self-validation mechanism) and self-efficacy as mediators.

The present studies analyzed the effects of one type of self-talk (namely, strategic self-talk in terms of the recent classification from Latinjak, Hatzigeorgiadis, et al., 2019) and thus does not allow conclusions regarding other types of self-talk (e.g., organic self-talk). Without delving into the distinction between strategic versus organic self-talk (see Latinjak, Hardy, et al., 2019; Latinjak & Hatzigeorgiadis, 2020; Van Raalte et al., 2019; for a discussion), our findings might help understand some controversial results regarding the effects of self-talk on sport performance. On the one hand, some studies have found that positive self-talk decreased performance in some cases (e.g., Harvey et al., 2002; Van Raalte et al., 2000). The present research has shown that positive (strategic) self-talk increased physical performance when individuals relied on their self-statements; that is, when individuals' body posture was associated with confidence and certainty and this validity of their posture was attributed to their positive self-talk, which magnified its effects, first on self-efficacy, then on physical performance, compared to when their body posture was associated with doubt and uncertainty (Study 3). Furthermore, positive and negative self-talk did not differentially influence physical performance when athletes did not rely on their positive self-statements because their body posture (i.e.,

slumped) was associated with invalidity (Studies 1 and 2). Importantly, future research should examine whether our findings can be extended to organic self-talk. For example, future studies should analyze the effects of body posture when self-talk is intentionally used by athletes to self-regulate and enhance their performance (i.e., goal-directed self-talk, see Latinjak, Hatzigeorgiadis, et al., 2019). Furthermore, as a potential avenue for future interventions, athletes could *intentionally* use their body posture as part of their goal-directed self-talk in sport settings (see Horcajo et al., 2019, for a discussion). Future research should also examine whether this intentional use of body posture leads to the same effects and the self-validation process observed in the current research, or yields other psychological processes (and/or other effects, see Briñol & Petty, 2008), as a function of other individual and situational variables.

On the other hand, Tod et al. (2011) found that the relationship between negative self-talk and performance was non-significant. It has been suggested that, although generally detrimental to sport performance, negative self-talk can increase motivation in some individuals, and as a consequence, performance in some circumstances (see Van Raalte & Vincent, 2017). Indeed, validating negative self-statements (by performing a body posture associated with confidence and certainty) could lead some athletes to also rely on encouraging self-talk at the same time (e.g., "I can't do it ... but I will"). Although one could propose this and other potential explanations for those effects, in the present studies, we found that the upright (vs. slumped) posture also magnified (vs. attenuated) the effects of negative self-talk on physical performance, as a function of those body postures that were associated with validity (vs. invalidity), in accordance with the SVT predictions.

Regarding the limitations of Studies 1 and 2, the use of negative self-statements could potentially disrupt individuals' inherent self-regulation processes. Although many prior studies have analyzed the effects of positive versus negative self-talk, in our research, manipulating the valence of self-talk was conceptually crucial as it allowed us to examine the effects of the proposed mechanism of self-validation in Studies 1 and 2 (Briñol & Petty, 2022; see also Horcajo et al., 2019, for a similar procedure). A more critical limitation of the present research was the simplified design of Study 3 (e.g., using only a positive self-talk condition, as well as only a post-manipulation measure of physical performance), which, although was beneficial for isolating specific variables and helping participant engagement, may have potentially limited the breadth of our findings. We agree that future research could benefit from incorporating a negative self-talk condition and a baseline measure to our proposed model in Study 3, thus providing a more

comprehensive picture of the effects of positive versus negative self-talk and body posture on physical performance from an SVT perspective.

Indeed, this research is not exempt from other relevant limitations. First, in Study 1, the dribbling test did not yield results consistent with our predictions. Although in some cases a null effect can be difficult to explain, we propose that, speculatively, the matching hypothesis could account for this finding (see Hardy et al., 2009; Hatzigeorgiadis et al., 2011; Theodorakis et al., 2000). That is, activities such as slalom, pull-up, and push-up tests involve gross motor skills, thus performance may be more influenced by encouraging versus discouraging (i.e., motivational) self-talk, such as that used in the current research. In contrast, sport-related activities such as dribbling could involve both gross and fine motor skills, technique, and coordination skills, and thus, performance may benefit to a greater extent from instructional self-talk. However, because findings have been inconsistent regarding the matching hypothesis, and other variables (e.g., skill level) can moderate the effects of motivational (vs. instructional) self-talk on different sport tasks (e.g., Van Raalte & Vincent, 2017, for a review), we remain cautious with our speculation. In fact, future research should analyze whether the effects found in the present research can be extended to instructional self-talk and other measures of sport-related performance that involve other very different skills.

Second, the absence of control groups in our studies does not allow us to specify whether the effects obtained were due mostly to the manner in which either the upright posture or the slumped posture (or a combination of both) influenced the perceived validity of self-statements, or to how positive and negative self-talk separately influenced the extent to which athletes used their self-statements to form their self-efficacy and perform the physical tests (see Horcajo et al., 2019, for a discussion). Having said that, it is important to highlight the fact that, in the present research, the critical question focused on the relative comparison between positive and negative self-talk as a function of body posture, as well as providing empirical evidence for mediation. Nevertheless, future studies should extend our findings by using a more complete experimental design that includes no-treatment control groups (e.g., with a neutral body posture, or with a neutral self-talk, etc.). Likewise, other relevant variables not analyzed in the current studies should be examined in future research, such as the use of self-talk including non-first-person pronouns (rather than first-person pronouns, see Kross et al., 2014), covert (vs. overt) self-talk (see Hardy, 2006), or even the paralinguistic features communicated through voice (e.g., vocal pitch, intonation, speech rate, loudness, etc.) which prior research has shown can affect appraisals of confidence and consequently thought validity (see Guyer et al., 2021).

Third, Study 3 included a measure of the meaning of body posture, and to our knowledge, this constituted the first empirical evidence that illustrates the effects of the meaning of a non-verbal behavior on physical performance under the SVT framework. Future studies should also manipulate the meaning of body posture (see Briñol et al., 2017), in addition to including measures (as examined in our Study 3), as this could be a promising direction for future research (Körner et al., 2022). In line with our results, “the specific meaning associated with certain body positions may help us understand how and why body positions affect the actor” (Körner et al., 2022, p. 77). Indeed, in Study 3 we analyzed the moderator (i.e., meaning) that has been least empirically analyzed (along with appraisals) in prior SVT research to date, thus also contributing to build empirical evidence supporting this moderator in the study of self-validation processes. As suggested by Körner and colleagues, cultural differences in the meaning of the body posture should be analyzed in future studies (see also Matsumoto & Kudoh, 1987; Park et al., 2013). Likewise, the effectiveness of positive versus negative self-talk can be influenced by cultural context. For instance, prior research has found that negative self-talk may be more beneficial than positive self-talk in some collectivistic cultures (e.g., Peters & Williams, 2006). Therefore, future studies should specifically analyze the effects of positive versus negative self-talk on physical performance as a function

of body posture, examining other potential moderating (e.g., individual, situational, and cultural) factors from an SVT perspective.

Fourth, a model of moderated serial multiple mediation was proposed and supported, although future research should attempt to replicate and further develop this model. For example, based on the SVT framework (see Briñol & Petty, 2022), self-validation processes could also be applied to constructs such as self-efficacy (mediator 2 in our model). Consistent with recent research (Horcajo et al., 2022), metacognitive certainty (i.e., validity, from the SVT framework) in self-efficacy is an additional variable that can also be assessed and is consequential for physical performance. Thus, we suggest that at least one additional construct (i.e., the metacognitive certainty in self-efficacy) should be analyzed (and incorporated) in any model to be proposed by future research. The metacognitive certainty in self-efficacy was not included in the current research to simplify the design of Study 3. In sum, future research should be conducted to specify and add new moderators and mediators on the basis of the model proposed here. Most importantly, additional analyses indicated that cognitive validation could have played a more crucial role than affective validation. As could have been hypothesized, body posture (i.e., upright vs. slumped) likely made salient certainty appraisals (instead of pleasantness appraisals, see Briñol & Petty, 2022). In this way, according to postulate 2 of SVT, cognitive validation was more likely to occur, as shown in our findings. It is important to highlight that when all measures were jointly analyzed as operating in conjunction rather than in isolation (as suggested by our dimensionality analysis), the moderated serial multiple mediation model was supported as predicted. Future research should also analyze potential moderators based on the certainty versus pleasantness appraisals (e.g., providing evidence for affective validation under other different conditions) regarding the interactive effects of self-talk and body posture on physical performance.

In terms of practical applications, we suggest that, by itself, engaging in positive self-talk is not sufficient to increase physical performance, rather it is also necessary that athletes rely on their positive self-talk. That being said, our findings suggest that an athlete who maintains a body posture associated with validity while this athlete verbalizes positive self-talk can result in improved performance, compared to when this athlete did not rely on the same positive self-talk (what occurs when maintaining a body posture associated with invalidity). Moreover, the detrimental effects of negative self-talk on physical performance can be attenuated when athletes adopt a body posture associated with invalidity while verbalizing their negative self-statements. Importantly, future research should explore the intentional (vs. incidental) use of body posture to produce beneficial effects on sport performance (see Horcajo et al., 2019, for a discussion). That is, future studies should examine to what extent the present findings can be generalized to intentional body posture (i.e., deliberately performed by the athletes with the goal of improving their performance) which is associated with validity (or invalidity). Also, research should examine whether the present findings can be generalized to self-talk occurring in applied contexts of competition.

In line with the well-known phrase by Kurt Lewin, “Nothing is so practical as a good theory”, the present research advances our knowledge about when, how, and why self-talk can be (or not be) consequential on physical performance. In doing so, our findings expand prior research on self-talk and extend the SVT to the domain of sports (specifically, physical performance), thus providing meaningful insights not only for researchers, but also for athletes, coaches, applied sport psychologists, etc. In conclusion, we want to highlight that the current studies advance prior understanding of the effects of self-talk on physical performance by showing mediational evidence for a metacognitive mechanism (i.e., self-validation), as well as by specifying some moderating conditions (e.g., the meaning of the posture). Thus, we suggest that the present studies make relevant contributions to the literatures on self-talk, body posture, self-validation, and sport performance.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.psychsport.2023.102534>.

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