

The impact of goal-directed motivational versus instructional self-talk on the lift performance of skilled CrossFit Athletes

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Summary

Introduction. Self-talk (ST) has been shown beneficial to improve performance in various sports disciplines. Instructional ST (I-ST) aids to focus on technique and skills, whereas motivational ST (M-ST) can be used to boost strength and endurance. The latter has also been proposed more beneficial in skilled athletes. Olympic Weightlifting (OW) requires both a high level of technical skills and strength, and the current study investigated whether goal-directed M-ST or I-ST was more beneficial to improve lift performance in CrossFit (CF) athletes. The difference between more and less skilled CF athletes was explored in a secondary analysis.

Methods. Fifteen CF athletes were recruited (age 26.7 (± 5.2) years; 11 men; 6 more experienced). The lift performance was assessed during no ST, M-ST, and I-ST (3 test conditions allocated in a randomized order). Each lift was completed at 75%, 85% and 95% of the athlete's 1 repetition maximum for every condition (randomized order of weights). Athletes verbalized their self-determined ST phrases aloud prior to every lift (M-ST, I-ST), or completed the lifts as per their usual strategies (No ST). Lift performance was scored qualitatively (ordinal scoring: fail, pass with technical errors, pass), and quantitatively (temporal and kinetic parameters using bar path analysis). Lift performance was compared between the 3 test conditions, and the impact of ST was compared between more and less experienced CF athletes.

Results. The *qualitative scoring* of the lift performance did not differ significantly between the 3 test conditions ($p > .05$). However, the number of failed lifts reduced with ST, especially for the I-ST condition. M-ST increased the number lifts performed with technical errors. Additionally, M-ST reduced the number of failed lifts in the more experienced group, whereas I-ST reduced the number of fails in the less experienced group. Comparison between the ST conditions also showed no significant differences for any of the *temporal or kinetic parameters* extracted for both lifts. Results for the comparison between the more and less experienced group were highly variable.

Discussion and Conclusion. The current study could not demonstrate a statistically significant effects of ST on the lift performance of CF athletes. The underlying requirements of OW (technique and power) might require a combined M-ST and I-ST function to improve lift performance. Inspection of the data did show that I-ST reduced the number of failed lifts, whereas motivational ST had a negative impact on the quality of the lift performance, especially in less experienced CF athletes. Further studies are required to determine the optimal type of ST for OW and thus to define strategies that could assist coaches and athletes to optimize performance in this sport discipline.

1 Introduction

It is clear that our thoughts have a major impact on our mood, emotions and performance. Positive thought patterns help to boost confidence, maintain an optimistic attitude, promote concentration, enhance motivation, create an optimal level of arousal, and to ensure self-control and mental strength when confronted with failure or adversity (Burton & Raedeke, 2008). Negative thought patterns come to mind during times of stress and can result in over-analyzing or exaggerating the severity of a situation, irrational thoughts and eventually even trigger unfounded anxiety (Burton & Raedeke, 2008). Apart from a positive or negative context, one's thoughts can refer to the past (reactive) – i.e. a person evaluates and reacts to what has happened – or to the present/future (proactive) – i.e. to stimulate and direct action. Burton and Raedeke (2008) refer to such continuous stream of thoughts, either positive or negative, reactive or proactive, as self-talk (ST). ST mostly happens in silence, and it occurs naturally or automatically, day in and day out. However, ST can also be very conscious and verbalized out loud, which is seen in particular in a context where one has to achieve or to perform. In such situations, ST has a purpose and is based on a plan to achieve a desired outcome (Hatzigeorgiadis, Zourbanos, Galanis, & Theodorakis, 2011). In the sections below, an overview of the definition of ST, the different models that have been put forward and current knowledge regarding the impact of the use of ST in various sport disciplines is provided. Given the focus of the current research being the use of ST on the lift performance in CrossFit athletes, a more in-depth description of CrossFit, Olympic Weightlifting (OW) and performance standards is provided in the second part of the introduction. Finally, based on the current knowledge on the impact of ST and the requirements of the sport of OW, the research questions and hypotheses of this study are formulated.

1.1 Self-Talk: Definition, Models and Impact

1.1.1 Self-Talk Definition. Self-talk (ST) refers to statements that one says to himself/herself, either spontaneous and automatic or goal-directed and intentional, whereby the person himself/herself is the intended target of the statement (Hardy, Begley & Blanchfield, 2014). ST can be categorized in terms of its function, its valence and its overtness (Hardy, 2006). The function of ST, either instructional or motivational (Hatzigeorgiadis et al., 2011), has the intention to change focus and confidence (Hardy, Hall & Alexander, 2001; Theodorakis, Hatzigeorgiadis & Chroni, 2008), and to guide goal achievement (Latinjak, Zourbanos, Lopez-

Ros & Hatzigeorgiadis, 2014). Considering valence, ST can be categorized as positive or negative, i.e. encouraging or discouraging. Lastly, ST can be spoken aloud, mouthed but not spoken, or completely internal and silent (Hardy, 2006). Any thought or ST can also become automatic, if repeated often enough, and thereby ST can turn into a belief (Burton & Raedeke, 2008). Moreover, positive ST can lead to a mind-set in which a person does extremely well, whereas negative ST can result in a discouraging mind-set with irrational thoughts causing a person to underperform. To assure a beneficial use of ST, Burton and Raedeke (2008) suggested eight positive commandments that aid in the selection and choice of ST, i.e. (1) be an optimist, not a pessimist; (2) remain realistic and objective; (3) focus on the present, not the past or future; (4) appraise problems as challenges rather than threats; (5) view successes as replicable and failures as surmountable; (6) focus on process, not product; (7) concentrate on things you can control; and finally (8) separate your performance from your self-worth.

1.1.2 Self-Talk Models. Our behavior, mood and emotions are influenced by both the external environment and our internal environment (personal factors). This relationship reflects the interaction between a person's cognitive, affective and physiological states, and has been vastly used as a model for the study of human behavior (Bandura, 1986). The model implies that the interaction of one's thoughts and affect can energize, direct and regulate behavior in achievement or competitive contexts (Galanis, Hatzigeorgiadis, Zourbanos & Theodorakis, 2016). From a cognitive behavior therapy perspective, self-instructional training has been claimed to be useful to facilitate the acquisition of new skills and to enhance the performance of adaptive responses (Rokke & Rehm, 2001). The development of self-instructional training within various psychotherapy approaches eventually led to the growth of ST strategies and ST models. In the paragraphs below, a further description of the ABC of ST and different ST models in sport are provided.

The ABC of ST. Ellis (1996) proposed *the ABC of self-talk* (Figure 1; Ellis, 1996), whereby "A" represents the situation or the activating event, i.e. any event that happens to a person/athlete. The "C" stands for the consequences, feelings or responses to the respective situation. Consequences can be positive emotions and helpful behaviors; or negative emotions and unproductive behaviors. The "B" represents beliefs about the situation or the activating event. In other words, B are the thoughts that take place between point A and C, or the person's or athlete's interpretation of the situation or the activating event. Importantly, our interpretation regulates our emotions and behavior to a much greater extent than the situation or the activating event itself. Whilst we cannot always control what happens to us (situation or event), we can

control how to respond to uncontrollable situations or events. This is possible through learning and achieving of ST skills (Burton & Raedeke, 2008).

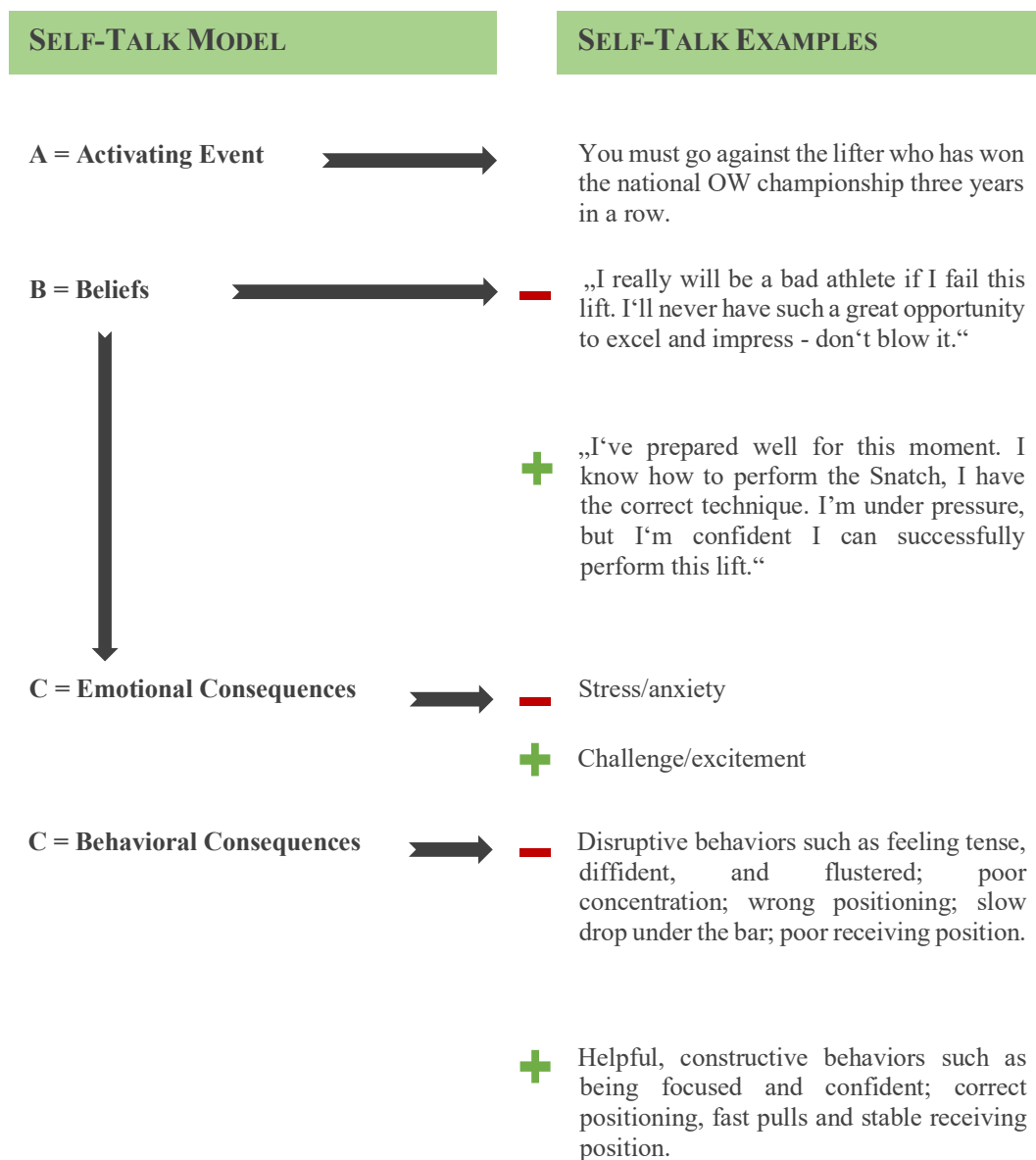


Figure 1. The ABC model of Self-Talk as presented by Ellis (1996). Examples of the Activating Event, the athlete's Beliefs and Emotional and Behavioral consequences are presented on the right-hand side.

OW = Olympic Weightlifting.

ST models in Sport. Hardy, Oliver and Tod (2009) proposed a specific framework for the study and application of ST in sports. This framework comprises personal factors, contextual or situational factors, ST itself and the consequences or effects of the ST that is being used. Personal factors include cognitive processing preferences, beliefs in ST, and other personality qualities or characteristics. Contextual or situational factors comprise task difficulty, the

environment, the competitive setting and/or the coaching behavior (if applicable). ST itself refers to the selected function (motivational or instructional), its valence and its overtness. Lastly, these authors put forward four domains of mechanisms to explain the effect and impact of the athlete's strategy on his or her sport performance, i.e. (i) cognitive mechanisms (concentration and attention), (ii) motivational mechanisms (self-confidence and motivation), (iii) behavioral mechanisms (technique of task execution) and (iv) affectual mechanisms (affect, anxiety) (Hardy et al., 2009). The importance of contextual or situational factors with respect to the impact of an athlete's use of ST, either instructional or motivational, was further supported by Hatzigeorgiadis et al. (2011), based on a meta-analysis. In view of developing sport-specific ST model, Theodorakis et al. (2008) additionally discussed potentially distinct effects of situational/contextual factors vs. social-environmental factors (e.g. coaching behavior, social context). Based on these discussions, Van Raalte, Vincent and Brewer (2016) further expanded the ST model and proposed a sport-specific version to highlight the dynamic interrelationships between: (a) personal factors; (b) contextual factors; (c) cognition and motivation; (d) previous experiences and affect; (e) behavior; and (f) ST (Figure 2; Van Raalte et al., 2016). These authors discussed that ST that results from cognitive processing, i.e. monitoring one's thoughts and actions to direct attention and enhance performance, requires deliberate and conscious mental efforts from the athlete. As such mental effort is not an unlimited resource, the exclusive or extensive usage of such cognitive processing for ST could deplete an athlete's cognitive ability and subsequently lead to a deterioration of performance (Kahneman, 2003; Schmeichel & Baumeister, 2010; Wegner, 1989). Conversely, ST that is based on previous experiences and affect, in other words emotionally charged ST, has been assumed to play a more limited role to steer an athlete's attention and performance. However, athletes could fall back on this type of ST when their cognitive resources have been exhausted (Evans & Frankish, 2009; Morf & Mischel, 2012). As a result of these findings, studies evaluating the effect of ST in various sport disciplines have focused on cognitive processing and motivation. These studies based on their research on the hypothesis that ST that is well-practiced and does not exhaust the athlete's cognitive processing can effectively enhance performance. This also means that newly learned ST or ST that is not sufficiently practiced can indeed drain an athlete's cognitive processing abilities and thereby might not have any beneficial effects on the athlete's performance (Hatzigeorgiadis et al. 2011).

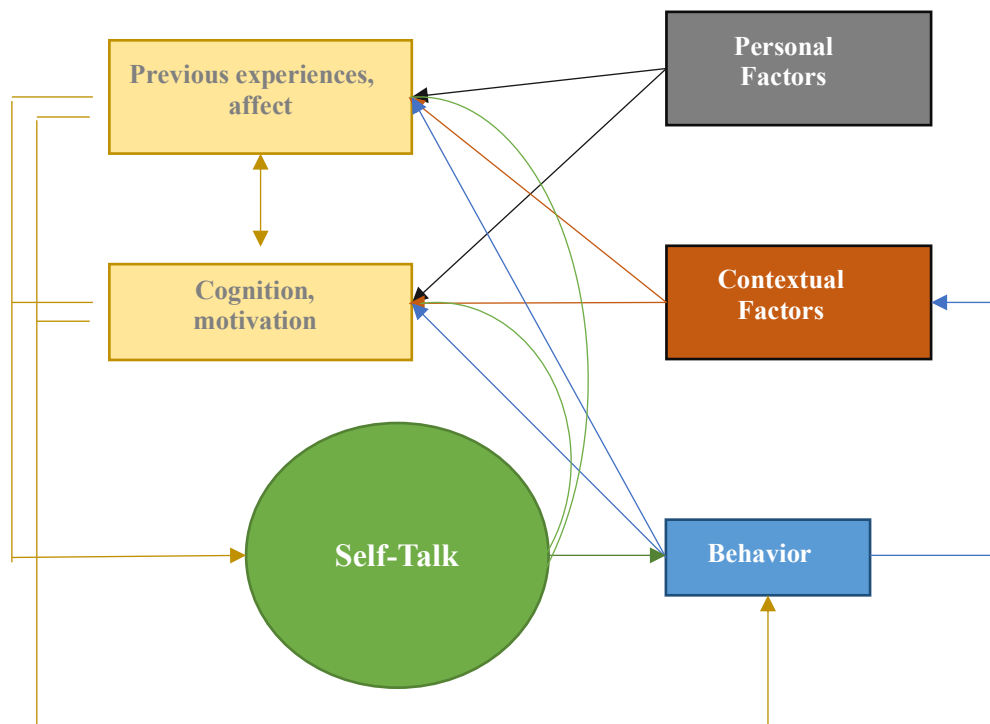


Figure 2. Sport-specific model of Self-Talk (ST). The personal and contextual factors, shown by the grey and orange arrows, shape previous experiences with ST and the cognitive mechanisms of an athlete. The athlete's previous experiences, his/her affect, cognition and motivation in turn impact on the athlete's ST and behaviour (shown in yellow arrows). The dependent relationship is shown in the green and blue arrows, i.e. ST itself impacts on behaviour, it shapes experiences and affect/cognition/motivation (green arrows), and influences the contextual factors (blue arrows). Figure based on Van Raalte et al., 2016

1.1.3 Impact of Self-Talk in various Sport Disciplines. Researchers have explored the effects of different types of ST on sport performance, whereby positive and self-determined ST has been identified as a technique to enhance competitive focus, and hence performance (Carr 2006; Harvey, Van Raalte & Brewer, 2002; Hatzigeorgiadis et al., 2011). Additionally, whilst various types of goal-directed ST have been identified (see Hardy (2006) for review), instructional and motivational ST have received a vast amount of attention in sports and improving sport performance, as well as in sport psychology literature (Tod, Hardy & Oliver, 2011; Hatzigeorgiadis et al., 2011). Instructional ST typically includes statements aimed at stimulating correct actions via proper attentional focus and movement patterns, i.e. instructional ST focusses on technique or a specific skill. Motivational ST on the other hand includes statements that focus on the positive affective state of an athlete to improve his or her confidence, to increase effort and to boost energy expenditure. Based on these qualities, the task-demand-oriented matching hypothesis was put forward by Theodorakis, Weinberg, Natsis, Douma & Kazakas, 2000. These authors proposed that instructional ST was more beneficial than motivational ST for precision and outcome-based motor skills, whereas motivational ST

was more beneficial than instructional ST for motor skills requiring strength and endurance (Theodorakis et al., 2000). Indeed, instructional ST has been shown to improve the accuracy of motor skills, and motivational ST has been shown to improve strength and endurance (Tod et al., 2011; Hatzigeorgiadis et al., 2011). Additionally, it has been demonstrated that the highly skilled athlete uses more ST than the less skilled athlete (Hardy, Hall & Hardy, 2004), and that the effects of ST on performance depend on the skill level of the athlete (Tod et al., 2011). Whilst instructional ST facilitates a novice athlete's understanding of the underlying task requirements, this might not be the case for a more skilled athlete. In skilled athletes, the attentional focus required during instructional ST can disrupt the highly practiced and automated motor skill execution (Beilock, Carr, MacMahon & Starkes, 2002; Zourbanos, Hatzigeorgiadis, Bardas & Theodorakis, 2013). Skilled athletes might thus benefit more from motivational ST, irrespective of the actual underlying task requirements. This theory was further supported by the work of Hardy et al. (2014), who showed that motivational ST was more beneficial for a skilled dominant foot task execution that relied on accuracy. For skilled athletes, one can assume that instructional ST does not contribute to their understanding of the underlying details of the effective task and their mental representation of the task requirements, as they are already highly proficient in the task at hand. Consequently, motivational ST might be more beneficial for the skilled athlete to improve his or her motor performance. Finally, an understanding of ST must also distinguish between assigned and self-determined ST, i.e. athletes given a specific phrase for ST (assigned) vs. athletes choosing their own ST (self-determined) (Hardy, 2006). The results for assigned ST have been found highly mixed in different sport disciplines (Landin & Hebert, 1999; Cutton & Landin, 2007; Harvey et al., 2002; Hamilton, Scott, & MacDougall, 2007), whereas self-determined ST may provide more motivation to the athlete due to the fact that it is coupled with an increased feeling of competence and autonomy (Hardy, 2006). Whilst there is a large amount of literature available detailing the impact of ST on the performance in various sports disciplines, there is currently only one article reporting on the use and effect of ST in the sport of Olympic Weightlifting (Cutton & Heaton, 2014). In this case study, the authors intended to examine the assortment of ST used by an elite power lifter during training and competition. These authors found that the functions of ST as applied by the power lifter were similar as reported by Hardy, Hall and Hardy (2005), Theodorakis et al. (2008) and Tod et al. (2011), i.e. ST was used to increase effort, focus, and mental preparation, to decrease anxiety, to optimize lifting technique and to boost confidence. To better understand the task requirements of Olympic Weightlifting, the next

paragraphs provide further background details, and a more in-depth description of the performance standards in this sport discipline.

1.2 CrossFit versus Olympic Weightlifting and Standards

1.2.1 General description. CrossFit (CF) is an all-inclusive fitness program aiming to improve the athlete's general fitness level and to prepare him/her for any physical task (Glassmann, 2007). CF movements typically cover gymnastics/calisthenics, metabolic conditioning or "cardio", and Olympic Weightlifting (OW) or Powerlifting (Glassman, 2002). Gymnastics/calisthenics are bodyweight exercises requiring a high level of body control and technical skills, whereas "cardio" intends to improve the athlete's cardiorespiratory capacity or so-called stamina. OW are ballistic movements using a barbell that are based on explosive strength whereby precision, coordination, power and speed are crucial for successful execution of the movement. OW is a crucial part of the CF program, in which other lifts are also seen, e.g. Thrusters, Hang Power Cleans, Snatch Balance, Sumo Deadlift High Pull, etc. The current research study only focused on the OW movements, described in further detail below.

1.2.2 Olympic Weightlifting. There are two competition lifts, each with their own standards that determine a successful execution, e.g. the Snatch, the Clean & Jerk (Everett, 2009). Both lifts require the athlete to bring the barbell from the ground to overhead either in one single movement with a wide grip (Snatch) or in two movements with a close grip (Clean & Jerk). During an OW competition, each athlete is allowed three single lifts of a barbell at a self-chosen weight, whereby the total of the highest two lifts determines the overall weight-result (total score) within an age group (youth, junior, senior, masters) and a bodyweight category (Olympic Weightlifting, n.d.). In the current research study, both OW lifts were assessed in a competition setting, however the weight with which the barbell was loaded was based on the individual athlete's capacity rather than a self-chosen weight set. The assessment of the performance of the lift was based on pre-defined standards for OW, which are further outlined below.

1.2.3 Standards. For every lift, three different phases can be distinguished, i.e. the first pull (lift from floor), second pull (final upward explosion) and third pull (transition). Additionally, the Snatch and Clean & Jerk consist of a preparatory phase, a starting position, a receiving position and a recovery position (Everett, 2009). The specific standards and technical requirements of each lift are described below (description based on Everett (2009)).

Snatch. The Snatch is executed with a wide hand placement, specifically intended to reduce the distance the barbell must travel in its path from the platform to over the athlete's head. A correct *starting position* for the Snatch is shown in Figure 3A, i.e. a wide hand placement, the arms approximately vertical, the shoulders placed slightly in front of the bar, the bar over the balls of the feet, and an upright back angle. The bar is held with a pronated grip with the thumb trapped between the bar and the first and second finger (Figure 4, Hook grip), the feet positioned approximately under the hips and slightly rotated outward (5-15 degrees). Lastly, an upright head position with the eyes pointing straight forward must be maintained throughout the lift. The *first pull* (Supplementary data 1B) brings the barbell from the floor to the point at which the final upward explosion is initiated, typically when the barbell reaches approximately mid- to upper-thigh level. The first pull primarily requires a precise positioning, intended to optimize the positioning and acceleration of the second pull. The weight of the athlete and the barbell is centered over the front edge of the heel, while keeping the barbell as close to the legs as possible. During the first pull, the barbell is actively pushed back toward the body, while the shoulders are kept in front of the barbell. The *second pull* (Supplementary data 1C) starts at approximately mid- to upper thigh with an explosion of the hips and knees, creating the majority of the upward and vertical acceleration of the barbell. The elevation of the barbell goes hand in hand with the transition underneath the barbell. After finalizing the extension of the hips and knees in the second pull, the athlete immediately retracts the hips and knees to begin a squatting movement. This active pull under the barbell is the *third pull* (Supplementary data 1D), and it finishes with the athlete in the *receiving position* (Figure 3B; overhead squat with stabilized shoulders, extended elbows and wrists, and relaxed hands). When the athlete does not succeed to actively and immediately fix the correct receiving position, the barbell will drop in front or behind the athlete, resulting in a failed lifting attempt. Once the bar is secured and stabilized overhead, the athlete will recover from the squat to a standing position and the lift has been successfully completed.

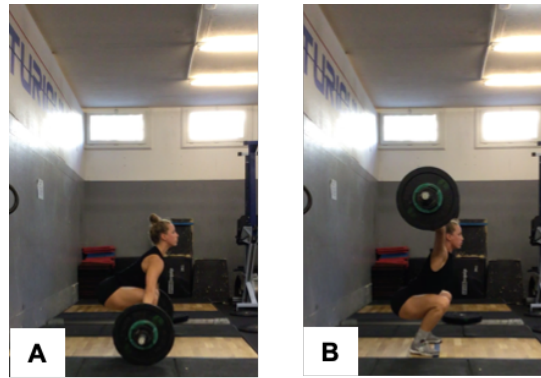


Figure 3. Start (A) and receiving position (B) of the Snatch.

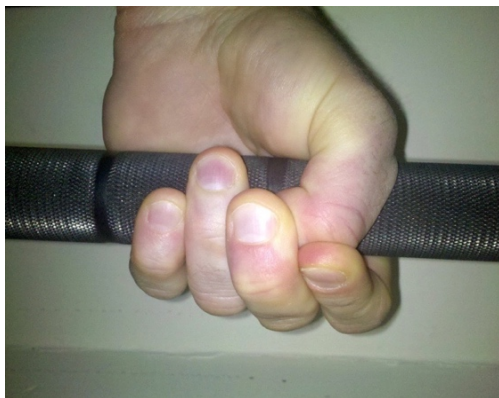


Figure 4. Hook Grip. This pronated grip with the thumb trapped between the bar and the first and second finger is used for both the Snatch and the Clean & Jerk. It provides more security than the conventional grip whereby the thumb wraps around the fingers. The hook grip also supports a more efficient lift performance and reduces the amount of hand, forearm, and elbow tension needed to maintain a grip on the bar. (Image by Baddriver - Own work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=10003711>)

Clean & Jerk. The Clean & Jerk consists of two movements, both executed with a narrow hand placement. The barbell is first lifted from the floor onto the shoulders (Clean) and then driven overhead (Jerk). The *starting position* for the Clean requires a slightly greater height of the shoulders and hips, and a more limited flare of the knees due to the narrower grip of the Clean (compared to the Snatch). The barbell touches or is in close proximity to the chins in the starting position (Figure 5A). The hook grip (Figure 4) is used in the pulling segment of the Clean, however the thumb is released as the barbell reaches its final position at the shoulders. The *first pull* (Supplementary Data 2B) brings the bar from the floor to the level of mid- to upper thigh. Whilst the explosion point is slightly lower when compared to the Snatch due to the narrow grip, the first pull is again intended to optimize the positioning and acceleration of the second pull. During the first pull, the athlete's back remains set in complete extension, the arms relaxed, fully extended and maximally rotated internally, the torso pressurized with air, the weight focused over the feet and the face directed straight ahead. The *second pull* (Supplementary Data 2C) begins with the initiation of the final hip and knee extension effort, creating the bulk of the vertical acceleration of the barbell. In essence, the mechanics of the hips and legs are identical for the Snatch and the Clean. However, during the second pull of the Clean, the barbell is in

contact with the thighs and the distance the barbell must travel to its final position on the shoulders is shorter compared to the Snatch. Elbow flexion during the second pull allows the athlete to bring the barbell into the body higher up toward the hips. The *third pull* (Supplementary Data 2D) is the point at which the athlete pulls him- or herself under the barbell to rack it on his or her shoulders, i.e. the athlete performs a squatting movement. The *receiving position* is a front squat and the successful completion of the Clean depends on the placement of the feet in the correct receiving position (Figure 5B), and even more on the stability of the torso due to the downward force of the bar. Recovery from the front squat to a standing position occurs through an upward acceleration, while maintaining an upright torso and while actively driving the elbows up.

The Jerk is the second and final phase of the Clean & Jerk, whereby the barbell is lifted from the athlete's shoulders to an overhead position (Figure 5C, 5D, respectively). The athlete initially creates force against the platform to accelerate the barbell upward and then quickly removes the pressure of his or her feet against the ground and uses the barbell's inertia to push him- or herself down underneath it. The bar is to be received with fully extended elbows and the torso vertical with a slight forward incline to allow correct overhead positioning. The three variations of the receiving position, i.e. the Split Jerk, the Power Jerk, and the Squat Jerk are shown in Figure 6.

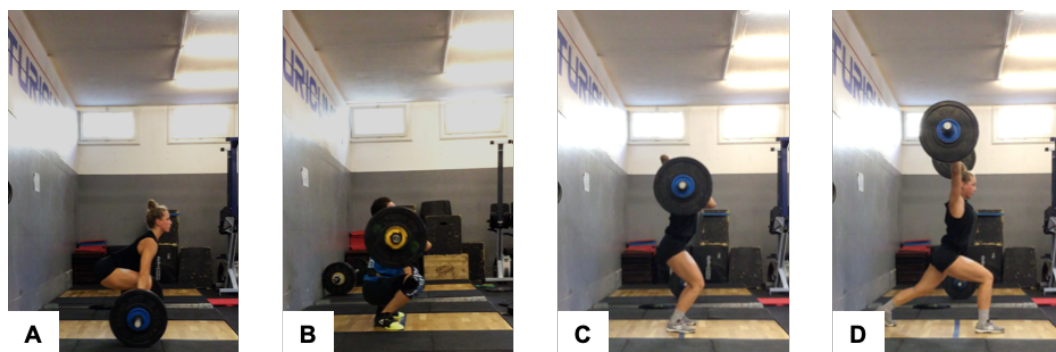


Figure 5. The different phases of the Clean & Jerk: (A) start position, (B) first pull to bring the barbell upwards, (C) second pull with hip and knee explosion, (D) third pull with hip retraction, (E) receiving position, i.e. front squat, (F) dip to create force against the platform, (G) receiving position, i.e. overhead position with slightly forward inclined trunk and full elbow extension.

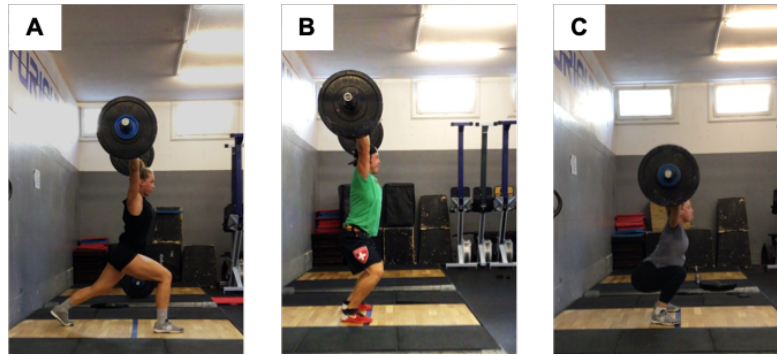


Figure 6. Variations of the receiving position for the Jerk: (A) Split Jerk, (B) Power Jerk, (C) Squat Jerk.

1.3 Aim and Research Question

In any lifting competition, either during CF or standard OW, athletes are subjected to a huge amount of pressure due to the unpredictability of a certain lift or the required weight to move in order to obtain the highest score, and thus the event-win. The complex movements of OW challenge the athletes both physically (power and precision) and mentally (Everett, 2009). Based on the strength and power requirements of OW, motivational ST would seem more appropriate for the skilled lifter. However, there is no scientific literature confirming the efficacy of motivational vs. instructional ST during the performance of OW in skilled athletes.

The aim of the current study was therefore to assess the effectiveness of self-determined goal-directed instructional and motivational ST on the performance of the Snatch and the Clean & Jerk in skilled CF athletes. The following research questions were formulated:

A) Does self-determined goal-directed ST improve the performance of the Snatch and Clean & Jerk in skilled CF athletes?

H0: there is no difference in the lift performance between No ST, motivational ST and instructional ST

B) A secondary exploration aimed at assessing whether self-determined goal-directed motivational ST is more beneficial than goal-directed instructional ST for the performance of the Snatch and Clean & Jerk in more vs. less experienced CF athletes?

H0: the impact of ST on the lift performance is the same for more and less experienced athletes

2 Methods

2.1 Participants

Fifteen CrossFit (CF) athletes were recruited to voluntarily participate in this study (mean age 26.7 (± 5.2) years, range 18-38 years; 11 men, 4 women). Athletes had on average 4.6 (± 2.1) years of CF experience, 2.9 (± 2.2) years of CF competition experience and 3.5 (± 2.3) years of Olympic Weightlifting (OW) experience. Nine athletes had 4 years or less of CF experience and were considered to be less experienced, 6 athletes had more than 4 years of CF experience and were considered to be more experienced. All but one athlete trained more than 4 hours per week, of which 8 athletes reported training more than 6 hours per week. The athletes' 1 Repetition Maximum (1RM) weight for the Snatch and Clean & Jerk ranged from 35-115kg, and 60-145kg, respectively (Table 1). All athletes provided written informed consent prior to testing (Supplementary data 2). None of the athletes took part in any other activities designed to maximize focus or performance during OW.

Table 1
Demographic data, experience and 1RM data of the athletes

	M (\pm SD)	Range
Age (years)	26.7 (± 5.2)	[18 ; 38]
CF experience (years)	4.6 (± 2.1)	[1.5 ; 9]
CF competition experience (years)	2.9 (± 2.2)	[0 ; 7]
OW experience (years)	3.5 (± 2.3)	[0 ; 8]
1RM Snatch (kg)	87.9 (± 23.7)	[35 ; 115]
1RM Clean & Jerk (kg)	112.4 (± 27.0)	[60 ; 145]
1RM Back squat (kg)	144.7 (± 38.1)	[75 ; 200]
1RM Front squat (kg)	125.1 (± 33.3)	[70 ; 170]
1RM Deadlift (kg)	176.5 (± 46.2)	[100 ; 240]
1RM Bench Press (kg)	108.5 (± 28.2)*	[50 ; 150]

Note. M = Mean. SD = Standard Deviation. CF = CrossFit. OW = Olympic Weightlifting. 1RM = 1 Repetition Maximum.

*Data missing for 2 athletes

2.2 Test Procedure

Prior to testing, athletes attended an online seminar (Supplementary Data 3) during which the aim of the study, background on ST as well as the study design were explained. For every athlete, the order of the three test conditions was randomly assigned (Urbaniak & Plous, 2013), i.e. no ST (control), goal-directed motivational ST (M-ST), or goal-directed instructional ST (I-ST), with a cross-over time interval of 3 days to maximum 1 week between test days.

Athletes were to abstain from a CF workout or competition in the 4h before testing, to eliminate the potential impact of fatigue.

2.2.1 Self-Talk assessment. Following the online seminar, athletes were asked to fill out the Automatic Self-Talk Questionnaire for Sports (ASTQS, Supplementary Data 4) to assess their habitual ST use during CF at baseline and to provide (in writing) their self-determined ST phrases for the M-ST and I-ST condition.

Athlete's habitual ST. The ASTQS is a multidimensional questionnaire that evaluates the athletes' self-reported competitions thoughts or thoughts they intentionally use while performing (Zourbanos, Hatzigeorgiadis, Chroni, Theodorakis, & Papaioannou, 2009). Statements are distributed over eight factors, four positive (psych up, confidence, anxiety control and instruction), three negative (worry, disengagement and somatic fatigue) and one neutral (irrelevant thoughts). For each of the statements, athletes had to indicate on a 5-point scale (0 = never, 1 = rarely, 2 = sometimes, 3 = often, 4 = very often) to what extent the statement applied to them.

Athlete's self-determined ST. Given that self-determined ST may provide more motivation to the athlete (Hardy, 2006), athletes were instructed to choose their own ST phrases, and inform the tester in writing about their self-determined ST phrases for each of the test conditions. They were instructed to practice the use of their self-determined motivational or instructional ST (phrases to be stated aloud) during their regular training sessions prior to the respective M-ST or I-ST test day.

2.2.2 Test set-up. All lifts were performed on an OW platform, with the standard OW barbells (15kg for women, 20kg for men), weight plates (ranging from 0.5kg to 20kg) and the preferred lifting equipment of the individual athlete (i.e. wrist support, chalk, knee support, weightlifting shoes), as long as allowed during a competition. Time cap for every lift was 1 minute once the bar was loaded and the platform was free. Each lift was video-recorded and analyzed offline

(scoring and video-analysis). All tests were performed at TuricumFit, Switzerland (TuricumFit GmbH; <https://turicum.fit/de/home>).

2.2.3 Athlete testing. For each test day (No ST, M-ST, I-ST), athletes were instructed to warm-up and perform three movements of each lift to prepare for the task. Athletes then completed three different weight sets consisting of three repetitions each for the Snatch and the Clean & Jerk, resulting in a total of nine repetitions for every lift per test condition (no ST, M-ST, I-ST; Figure 7). Weight set 1, 2, and 3 were standardized to the 1RM of each athlete (Table 1), at 75%, 85% and 95%. The three weight sets were performed in a randomized order (Urbaniak & Plous, 2013). During the M-ST and I-ST condition, athletes had to say the chosen self-determined motivational or instructional ST phrases aloud prior to every lift. During the control condition (no ST), athletes were instructed to perform the lifts as per their usual performance/strategies. No verbal encouragements or corrections were provided during any of the tests. After the completion of all lifts on the third test day, athletes gave an interview regarding their personal experience and habitual use of ST when training OW movements.

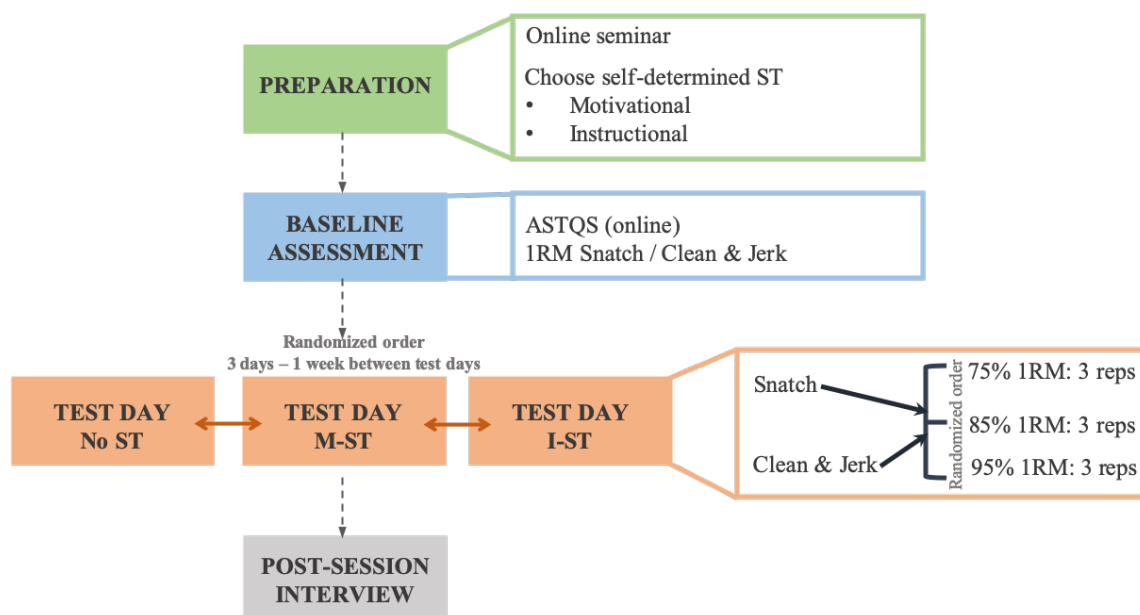


Figure 7. Schematic overview of the study, consisting of a pre-test preparation of the athletes, baseline assessment, testing for each of the conditions and post-session interview.

ST = Self-Talk. M = motivational. I = instructional. ASTQS = Automatic Self-Talk Questionnaire for Sports. 1RM = 1 repetition maximum.

2.3 Data Analysis

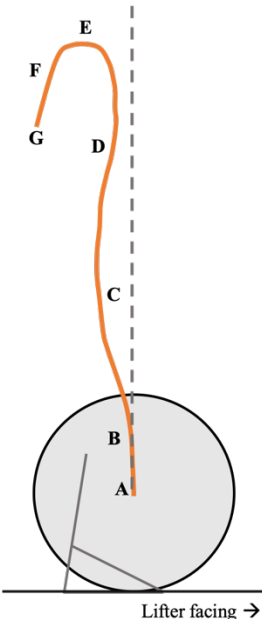
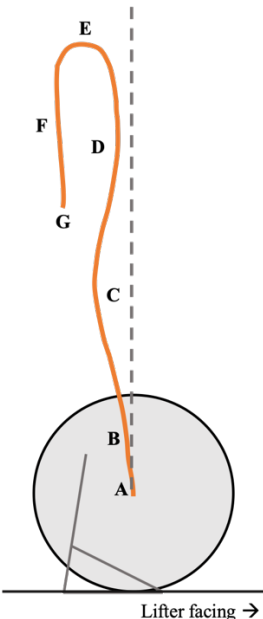
All analyses were done off-line by one observer (MND). Analyses consisted of a qualitative scoring of the lift performance, and an objective analysis of the travelled path of the barbell.

2.3.1 Qualitative Scoring. The Snatch and the Clean & Jerk were considered in terms of the start position, the three pulls, and the receiving position and recovery of the lift (Everett, 2009). The qualitative scoring was based on the video observation of every lift, whereby 2 points were awarded for a successful lift, 1 point for a lift whereby the athlete managed to complete the lift albeit technical errors in performance, and 0 points for a failed lift. Technical errors included for example poor vertical acceleration of the bar during the second pull, early initiation of the third pull, incomplete arm extension when receiving the barbell, walking or taking additional steps during recovery. Every athlete could obtain a maximum score of 18 points for the Snatch, and 18 points for the Clean & Jerk, per test condition (no ST, M-ST, I-ST).

2.3.2 Bar path analysis. Bar path tracing was performed for every successful lift (score 2 or 1) using Iron Path Pro (<http://www.theironpath.com/>). Table 2 lists the expected barbell path for the Snatch and the Clean & Jerk. After identifying the barbell path, quantitative temporal parameters including velocity and acceleration profiles, as well as the kinetic parameters such as force and work profiles of the respective lift were extracted. Start and end point of the lifts were defined based on their respective velocity profiles (Figure 8). Based on these profiles, following parameters were calculated for the Snatch and the Clean for every ST condition and every weight set: (A) duration from start position till receiving position (sec); (B) maximum velocity (m/sec); (C) maximum acceleration (m/sec²); (D) time till maximum velocity (% of lift duration); (E) force at maximum velocity (Newton); (F) work at maximum velocity (Joule). The Jerk-portion of the Clean & Jerk was not further analyzed as part of the current study. Data extraction was done using Excel© 2019 (Microsoft Office, version 16.32). For every ST condition, all extracted parameters were averaged over the three attempts per lift, per weight set and over all weight sets.

Table 2

The barbell's path when viewed from the lifter's profile.

Relevant steps	Snatch	Clean
A. Starting point: the center of the barbell		
B. Backward sweep of the bar during the initial lift from the floor		
C. Farthest backward point during the pull at approximately mid- to upper thigh		
D. Slight forward curve during the third pull		
E. Maximal elevation of the bar		
F. Final squatting under the bar into bottom position		
G. Final position of the bar as it's received and stabilized in the bottom of the squat		

Note. According to Everett, 2009 (P. 121, 149)

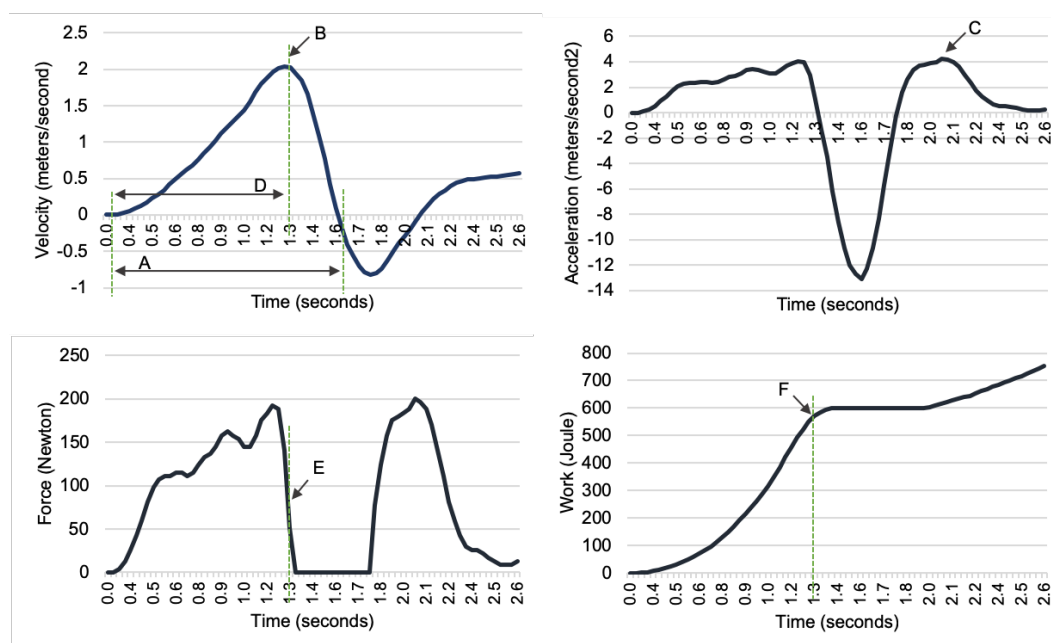


Figure 8. Example of data extraction obtained from the bar-path tracing of the Snatch: (A) duration from start position till receiving position (sec); (B) maximum velocity (m/sec); (C) maximum acceleration (m2/sec); (D) time till maximum velocity (% of lift duration); (E) force at maximum velocity (Newton); (F) work at maximum velocity (Joule).

2.4 Statistical Analysis

The information collected at baseline was analyzed using descriptive statistics. Normality of the dependent variables (qualitative scores 0-18; and 6 lift parameters based on the video-analyses as shown in Figure 8) was verified using the Kolmogorov-Smirnov test for Normality (Smirnov, 1948). The number of failed, semi-successful and successful lifts was considered an additional dependent variable.

The effect of test condition, i.e. the independent variable (No ST, M-ST, I-ST) was assessed using a repeated measures analysis (sum scores, objective data from bar-path analyses), consisting of a repeated measures ANOVA (Gueorguieva & Krystal, 2004) for normally distributed data or a Friedman test (Siegel & Castellan, 1988) in case of not normally distributed data. Post-hoc analyses were done in case of a significant repeated measures analysis, using either a paired t-test or the Wilcoxon signed-rank test (depending on data distribution).

For the secondary data exploration, difference scores between conditions were calculated (No ST minus M-ST and No ST minus I-ST) and compared between the less and more experienced CF athletes. These dependent variables (difference scores) were compared between the 2 groups using the non-parametric Mann-Whitney *U* tests.

All statistics were done using Social Science Statistics (2018) , with the level of significance set at .05 (<https://www.socscistatistics.com/tests/>). Due to the small sample size, a post-hoc Bonferroni correction, in case of a significant repeated measures analysis, was not applied.

3 Results

This section starts with the description of the athlete's habitual ST, and their self-determined ST as chosen for the I-ST and M-ST conditions. Next, the results obtained from the comparison of the lift performance between the different ST conditions (primary research question) are reported. Finally, the results for the secondary exploration is provided, i.e. the difference in the impact of ST between less and more skilled athletes.

3.1 Athlete's Self-Talk

Results for the Automatic Self-Talk Questionnaire for Sports (ASTQS) at baseline, and the self-determined ST phrases as used for the motivational ST (M-ST) and instructional ST (I-ST) conditions can be found below.

3.1.1 ASTQS (habitual use of ST). Athletes mostly reported using positive ST (categories “psych up”, “confidence”, anxiety control”, and “instruction”). Within the positive categories, highest scores were obtained for “instruction” phrases, followed by phrases related to “anxiety control”, and “confidence”. In other words, athletes reported a more frequent habitual use of goal-directed instructional ST. “Psych up” related phrases had lowest scores, i.e. were least applied according to the athlete's self-reported habitual use. Athletes reported fewer use of negative ST (categories “worry”, “disengagement”, “somatic fatigue”). When using negative ST, athletes most frequently reported thoughts related to “somatic fatigue”. Habitual use of neutral ST scored the lowest. Full details can be found in Table 3.

Interestingly, a comparison of the spontaneous ST as reported by less experienced CF athletes (≤ 4 years CF experience, $n = 9$) to more experienced CF athletes (> 4 years CF experience, $n = 6$), showed higher scores or a more frequent habitual use of both positive and negative ST and a less frequent habitual use of irrelevant thoughts in the more experienced group of CF athletes. Additionally, the more experienced CF athletes also reported highest scores for the use of ST phrases related to “instruction” (i.e. goal-directed instructional ST) and to “anxiety control” (i.e. self-regulating ST).

3.1.2 Self-determined ST (ST used for the M-ST and I-ST). The athletes generally chose the same type of self-determined motivational ST phrases for both lifts, whereas they chose different goal-directed instructional ST phrases for the Snatch and the Clean & Jerk. The motivational phrases that were most commonly selected for the M-ST condition were to psych

themselves up or to boost their confidence, i.e. [come on], [you can do this], or variations thereof. With respect to the instructional ST, the self-determined phrases that were selected by the athletes focused on the different phases of the lift, ranging from the start position, to the first, second and third pull. For the Snatch, the self-determined phrases were for example [big chest] (start position), [keep your knees out] (first pull), [high elbows] (second pull), or [aggressive catch] (third pull/receiving position). The Clean was characterized by similar phrasing, yet athletes used a stronger focus on [push the floor away] or [drive through your feet] (second pull), [fast under the bar] (third pull) for the Clean, and [upright dip] (first pull) or [fast lock out] (third pull/receiving position) for the Jerk. There was no apparent difference in the choice of self-determined ST phrases between the less experienced ($n = 9$) and more experienced ($n = 6$) CF athletes. All athletes verbalized their self-determined ST aloud prior to each lift during the M-ST and I-ST condition.

Table 3

Results for the 8 sub-scales of the Automatic Self-Talk Questionnaire for Sports (ASTQS) as reported at Baseline

	Total group ($n = 15$)	Less experienced group ($n = 9$)	Experienced group ($n = 6$)
Psych-up (0-4)	1.84 (0.81)	1.77 (1.26)	2.13 (0.64)
Confidence (0-4)	1.90 (0.82)	1.81 (1.35)	2.04 (0.43)
Anxiety control (0-4)	1.99 (0.83)	1.92 (1.12)	2.27 (0.53)
Instruction (0-4)	2.29 (0.76)	1.32 (1.12)	2.67 (0.56)
Worry (0-4)	1.22 (0.74)	1.11 (1.09)	1.36 (0.75)
Disengagement (0-4)	1.11 (0.57)	1.42 (0.92)	1.27 (0.62)
Somatic fatigue (0-4)	1.53 (0.54)	1.36 (1.12)	1.77 (0.43)
Irrelevant thoughts (0-4)	1.07 (0.80)	1.52 (1.11)	0.63 (0.72)

Note. The ASTQS ordinal scoring (0: never; 1: rarely; 2: sometimes; 3: often; 4: very often) for the individual items was averaged per participant and per sub-scale. Mean (standard deviation) are reported for each of the 8 sub-scales (4 positive, 3 negative, and 1 neutral). The less experienced group consists of athletes with 4 years or less of CF experience ($n = 9$); the experienced group consists of athletes with more than 4 years of CF experience ($n = 6$). CF = CrossFit.

3.2 The lift performance

For every ST condition (No ST, M-ST, I-ST), a total of 45 lifts were performed for every weight (lift at 75, 85, 95% of 1RM) for both the Snatch and the Clean & Jerk. This resulted in a total of 405 videos for each lift. Due to technical failure of the video equipment, 9 lifts were not recorded and hence could not be scored or analyzed (1.1% missing data). Sum scores for all weight sets (range 0-18 per lift), as well as per weight set (range 0-6 per lift) were calculated and used for the statistical comparison between test conditions. Additionally, the total number of failed lifts vs. lifts performed with technical errors (semi-successful) vs. successful lifts was also visually compared between the ST conditions.

3.2.1 Qualitative Scoring. The total number of failed lifts for the Snatch and for the Clean & Jerk can be found in Figure 9. The comparison of the performance between the ST conditions is described for both lifts separately in the paragraphs below.

Snatch. Comparison of the sum scores (range 0-18) between the different test conditions (No ST, M-ST, I-ST) showed no significant differences ($p > .05$; Table 4).

Visual inspection of the number of failed lifts vs. lifts performed with technical errors vs. successful lifts also yielded further interesting results (Figure 10). The number of failed lifts reduced with ST, whereby the reduction was more apparent for I-ST. Furthermore, using M-ST increased the number lifts performed with technical errors, and reduced the number of successfully performed lifts. Conversely, I-ST increased the number of successfully performed lifts.

Clean & Jerk. The sum scores (range 0-18) did not differ significantly between the different test conditions (No ST, M-ST, I-ST; $p > .05$; Table 4).

Further visual inspection of the number of failed lifts vs. lifts performed with technical errors vs. successful lifts showed a decrease in the number of failed lifts when using ST, whereby the reduction in failed lifts was larger for the I-ST condition (Figure 10). The number of lifts performed with technical errors increased in the M-ST condition, whereas the number of successful lifts decreased. In the I-ST condition, the number of successfully performed lifts increased compared to No ST.

Table 4

Mean (standard deviation) for the qualitative scores of every lift (range 0-18), with statistical comparison between the ST conditions based on the Repeated Measures Analysis of Variance

	Snatch			Clean & Jerk		
	(n = 15)	F	p	(n = 15)	F	p
No ST	13.5 (3.09)	1.01	.38	14.9 (2.92)	0.43	.65
M-ST	13.3 (3.09)			14.8 (3.26)		
I-ST	14.4 (2.53)			15.3 (2.81)		

Note. F = F-statistic based on the Repeated Measures of Analysis of Variance. p = concurrent p-value. ST = self-talk. M = motivational. I = instructional.

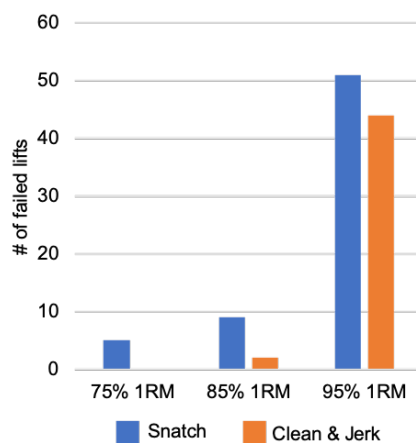


Figure 9. Total number of failed lifts for the Snatch (blue) and the Clean & Jerk (orange) for the different weight sets (75%, 85%, 95% 1RM). More fails were seen at higher weights for the Snatch. The Clean & Jerk was mostly failed at 95% 1RM. 1RM = 1 repetition maximum.

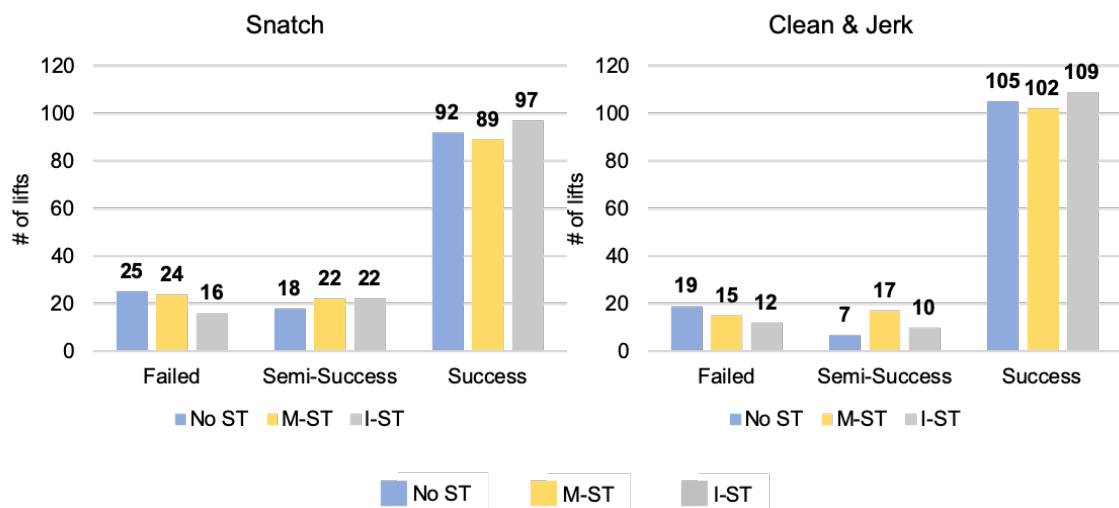


Figure 10. Number of failed lifts, semi-successful (lifts performed with technical errors), and successful lifts for the Snatch and the Clean & Jerk for each of the ST conditions.

ST = self-talk. M = motivational. I = instructional

3.2.2 Bar Path Analysis. Bar path analysis was performed for every (semi)-successful lift (score 1 or 2), i.e. a total number of 340 Snatch bar paths and 350 Clean bar paths were analyzed. For each lift (Snatch, Clean & Jerk), group means and standard deviations of the temporal and kinetic parameters were calculated across weight sets and compared between the ST conditions (Table 5). The Jerk-portion of the Clean & Jerk was not analyzed as part of the current study. All analyzed data was normally distributed, as confirmed by the Kolmogorov-Smirnoff test (all $p > .05$).

Snatch. Comparison between the ST conditions of the Snatch (Table 4), showed no significant differences for any of the parameters of the Snatch performance (Figure 12). Further analysis comparing the performance for every weight set (75%, 85%, 95% 1RM) also did not show any significant effect of ST-condition on any of the lift parameters (Supplementary Data 6A).

Clean & Jerk. Comparison between the ST conditions of the Clean (Table 4), showed no significant differences for any of the parameters of the Clean performance (Figure 14). Further comparison of the parameters for every weight set showed did show some significant differences between the ST conditions (Supplementary Data 6B). Maximum acceleration was significantly different between ST conditions at 85% 1RM ($F = 4.51$, $p < .05$), force at maximum velocity was significantly different at 85% ($F = 3.68$, $p < .05$) and 95% 1RM ($F = 3.94$, $p < .05$). Post-hoc paired t-tests showed a significantly lower maximum acceleration and force at maximum velocity at 85% 1RM during the M-ST condition compared to No ST (max. acceleration: $t = -1.97$, $p < .05$; force at max. velocity: $t = 3.28$, $p < .01$) and I-ST (max. acceleration: $t = 2.69$, $p < .01$). Finally, at 95% 1RM, the force at maximum velocity was also significantly lower using M-ST compared to No ST ($t = -2.33$, $p < .05$) and compared to I-ST ($t = 2.85$, $p < .05$).

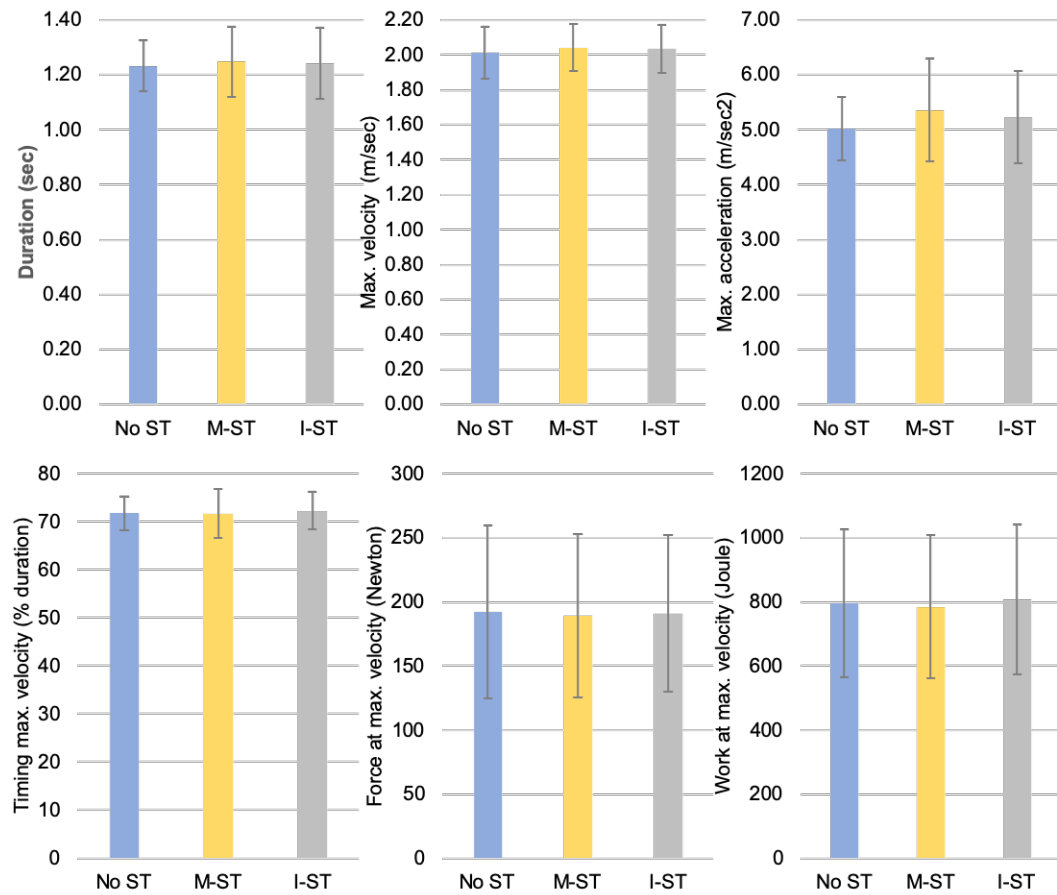


Figure 12. Mean and standard deviation for the temporal and kinetic parameters of the Snatch per ST condition. No significant differences were found for any of the parameters between the different test conditions. ST = self-talk. M = motivational. I = instructional.

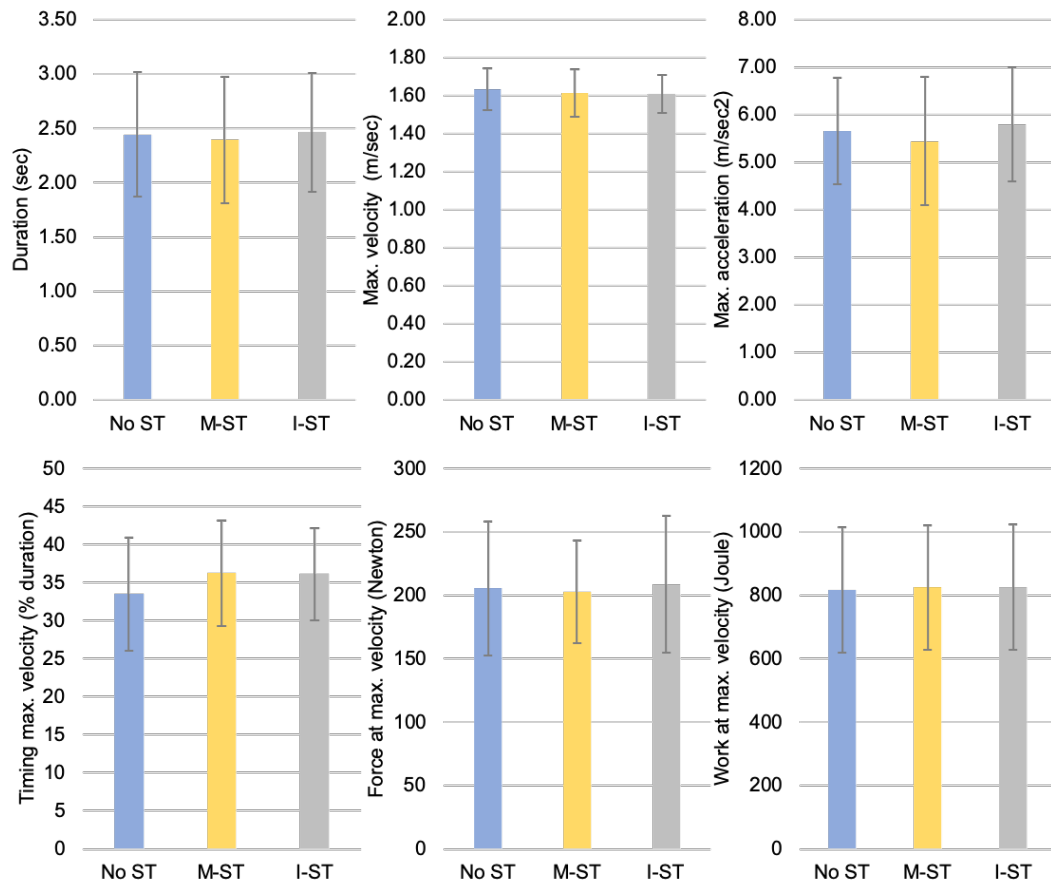


Figure 14. Mean and Standard deviation for the extracted parameters of the Clean per ST condition. No significant differences were found for any of the parameters between the different test conditions. ST = self-talk. M = motivational. I = instructional.

Table 5

Mean (standard deviation) of the temporal and kinetic parameters for every lift, with statistical comparison between the ST conditions based on the Repeated Measures Analysis of Variance

	Snatch			Clean & Jerk [▽]		
	(n = 15)	F	p	(n = 15)	F	p
Duration (sec)						
No ST	1.23 (0.09)	0.21	.81	2.44 (0.57)	0.22	.80
M-ST	1.25 (0.13)			2.39 (0.58)		
I-ST	1.24 (0.13)			2.47 (0.55)		
Max. velocity (m/sec)						
No ST	2.01 (0.15)	0.57	.57	1.64 (0.11)	0.70	.51
M-ST	2.04 (0.14)			1.62 (0.12)		
I-ST	2.03 (0.14)			1.61 (0.10)		
Max. acceleration (m/sec ²)						
No ST	5.03 (0.58)	1.99	.15	5.66 (1.12)	1.42	.26
M-ST	5.36 (0.94)			5.45 (1.34)		
I-ST	5.24 (0.84)			5.80 (1.20)		
Time to max. velocity (% duration)						
No ST	71.8 (3.5)	0.24	.79	33.5 (7.4)	2.23	.13
M-ST	71.8 (5.0)			36.2 (6.9)		
I-ST	72.4 (3.9)			36.16 (6.0)		
Force at max. velocity (N)						
No ST	192 (68)	0.06	.94	205 (53)	0.23	.80
M-ST	190 (64)			203 (41)		
I-ST	191 (61)			209 (54)		
Work at max. velocity (J)						
No ST	797 (231)	2.79	.08	818 (198)	0.61	.55
M-ST	786 (225)			825 (197)		
I-ST	808 (233)			826 (197)		

Note. [▽] data extracted from Clean only. *F* = F-statistic based on the Repeated Measures of Analysis of Variance. *p* = concurrent p-value. ST = self-talk. M = motivational. I = Instructional. Max. = maximum. sec = seconds. m = meter. N = Newton. J = Joule. % = percentage.

* Significant difference between the No ST, M-ST and I-ST condition (p<.05).

3.3 Impact of Experience Level

Whilst all athletes were recruited based on their experience and skills with respect to CF, a secondary data exploration was done to compare the performance of athletes with 4 years or less of CF experience ($n = 9$) to those with more than 4 years of CF experience ($n = 6$). The sections below first provide the results for the qualitative scoring, followed by the results for the temporal and kinetic parameters obtained from the bar path analysis.

3.3.1 Qualitative Scoring. Visual comparison of the total number of failed lifts for both the Snatch and the Clean & Jerk, showed that the more experienced CF athletes had fewer fails, irrespective of the ST condition (Figure 15). When performing the Snatch, both groups of athletes had a reduction of the number of failed lifts when using I-ST. M-ST also reduced the number of fails in the more experienced CF athletes, whereas M-ST increased the number of fails for the less experienced group. Using ST also seemed beneficial for the less experienced CF athletes to reduce the number of fails, whereby the biggest impact was seen for I-ST. More experienced CF athletes only failed their Clean & Jerk at 95% 1RM, whereby ST did not impact on the number of fails.

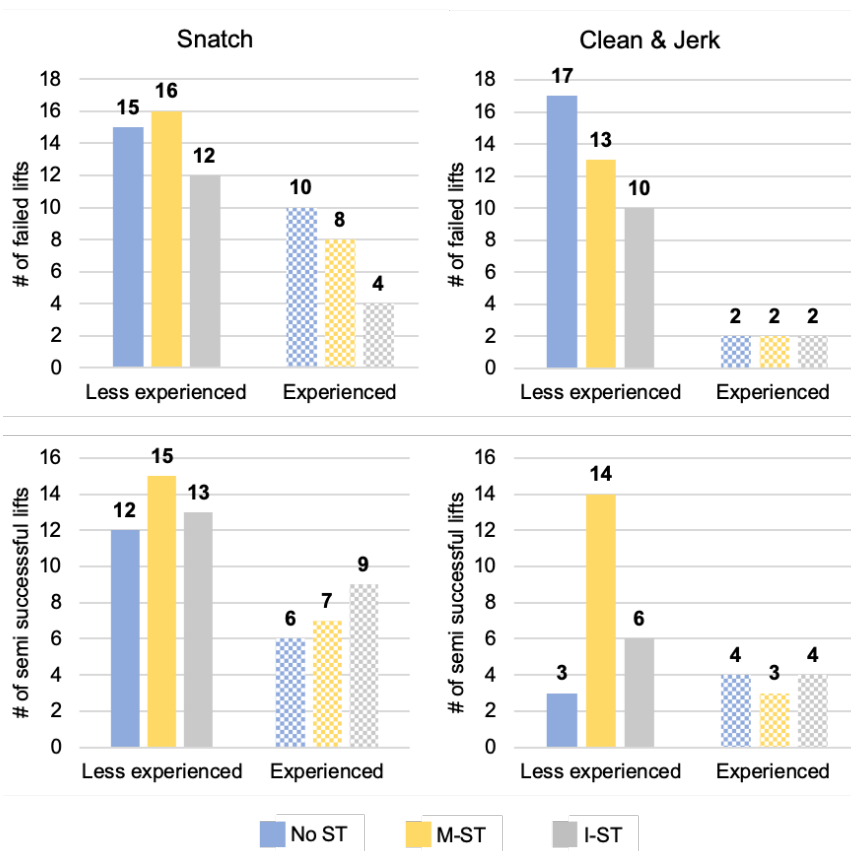


Figure 15. Number of total failed lifts for the Snatch and the Clean & Jerk per ST conditions for the less experienced (≤ 4 years of experience) and more experienced (> 4 years of experience) CF athletes. No ST (blue), M-ST (yellow) and I-ST (grey). ST = Self-Talk. M = motivational. I = instructional.

3.3.2 Bar Path Analysis. Visual inspection of the difference scores comparing both ST condition to the No ST conditions (No ST minus M-ST; No ST minus I-ST) of the Snatch and Clean & Jerk showed highly mixed results for the different parameters (Figure 16, 17). Difference scores were compared between the groups of less experienced ($n = 9$) and more experienced ($n = 6$) CF athletes.

Snatch. During the Snatch, the direction and magnitude of effect of *M-ST* vs. *No ST* (Figure 16, orange bars) was different between the less and more experienced athletes for movement duration, timing of max. velocity and force at max. velocity. Less experienced athletes became slower using M-ST compared to No ST, whereas the more experienced athletes were not affected. More experienced CF athletes reached their max. velocity earlier and used more force at max. velocity when using M-ST compared to No ST, whereas the opposite was seen for the less experienced CF athletes when comparing No vs. M-ST. In both athlete groups, max. velocity and max. acceleration increased and work at max. velocity decreased when using M-ST compared to No ST. However, difference scores were not significantly different between both groups of athletes ($p > .05$).

When inspecting the impact of *I-ST* vs. *No ST* (Figure 16, green bars), the same patterns emerged, whereby the difference between both athlete groups was significant for force at max. velocity ($U = 12$, $p < .05$). More experienced CF athletes had a significant increase in force at max. velocity when using I-ST compared to less experienced athletes. Both groups showed an increase in work at max. velocity when using I-ST compared to No ST. I-ST also had a beneficial effect on movement duration, i.e. reduction, in the more experienced group, whereas this parameter increased in less experienced CF athletes using I-ST. Apart from force at max. velocity, the difference scores were not significantly different between both groups ($p > .05$).

Clean & Jerk. During the Clean, the direction and magnitude of the effect of *M-ST* vs. *No ST* (Figure 17, orange bars) was different for all parameters. Less experienced athletes using M-ST while performing the Clean had a clear reduction in max. velocity, max. acceleration and force at max. velocity, whereas the opposite effect was seen for more experienced athletes. Additionally, the more experienced athletes using M-ST performed the Clean with a shorter movement duration, a delayed max. velocity and increased force and work at max. velocity. These effects were not seen in the less experienced group when comparing No ST and M-ST. Statistical comparison showed that more experienced athletes had a significantly higher increase in max. velocity when using M-ST compared to less experienced athletes ($U = 6$, $p < .01$).

Comparing the difference scores for *No ST* vs. *I-ST* (Figure 17, green bars), showed a similar direction and magnitude of effect as for the M-ST in both groups of athletes. Less experienced athletes had a significantly higher increase in max. velocity and delayed timing of max. velocity compared to more experienced athletes (max. velocity: $U = 2.5$, $p < .01$; timing: $U = 12$, $p < .05$).

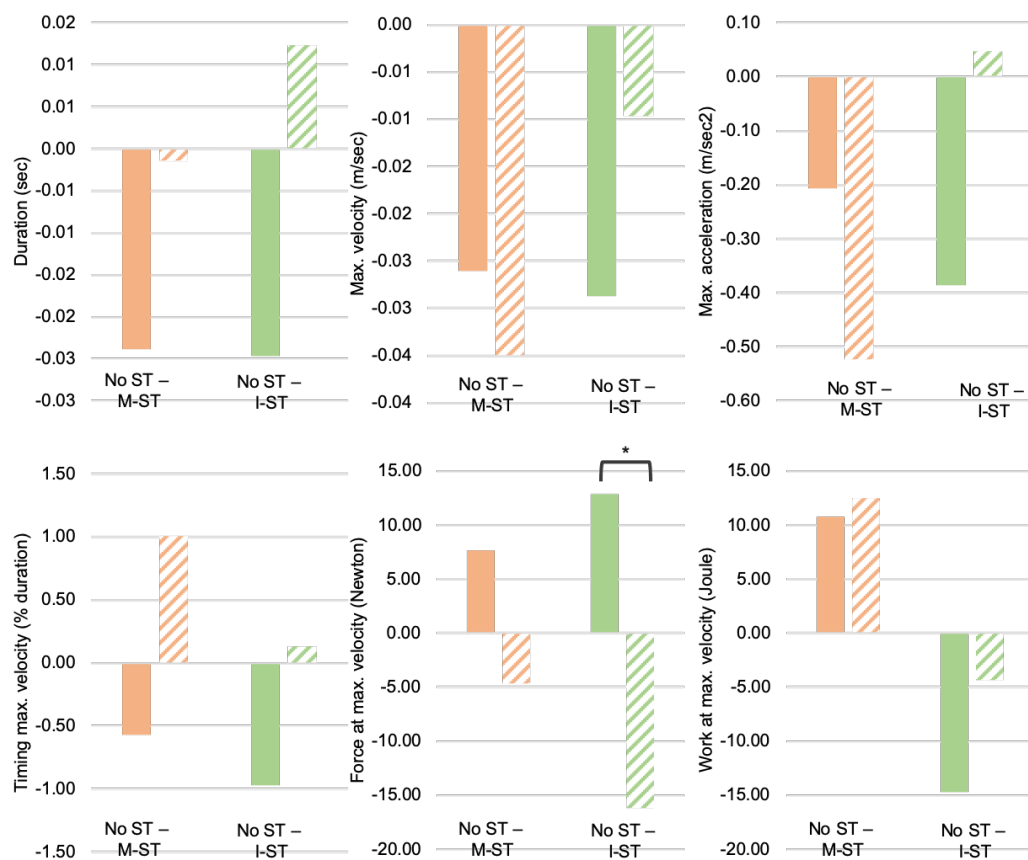


Figure 16. Difference scores in the Snatch performance for the No ST vs. the M-ST (orange) and the No ST vs. the I-ST (green) condition for the less experienced (≤ 4 years of experience; full color) and more experienced (> 4 years of experience; pattern color) CF athletes. ST = Self-Talk. M = motivational. I = instructional. * $p < .05$ (Mann-Whitney U test).

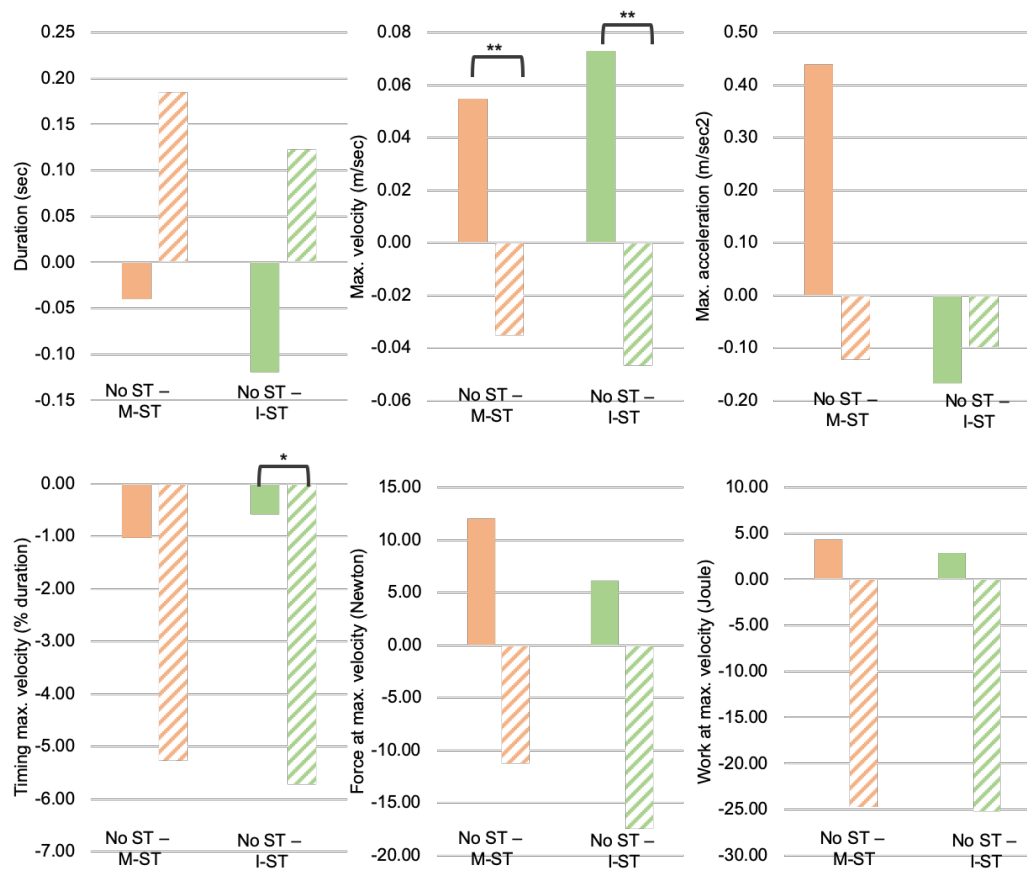


Figure 17. Difference scores in the Clean performance for the No ST vs. the M-ST (orange) and the No ST vs. the I-ST (green) condition for the less experienced (≤ 4 years of experience; full color) and more experienced (> 4 years of experience; pattern color) CF athletes. ST = Self-Talk. M = motivational. I = instructional. * $p < .05$, ** $p < .01$ (Mann-Whitney U test).

4 Discussion

The current study examined the impact of self-determined goal-directed ST on the performance of the Snatch and the Clean & Jerk in skilled CF athletes, each lift to be performed at 75%, 85% and 95% of their 1 repetition maximum (1RM) for every test condition. Athletes were given three attempts per weight set, whereby the order of the sets was randomized for every athlete. The test conditions, allocated in a randomized order, comprised No ST, motivational ST (M-ST), and instructional ST (I-ST). For the M-ST and I-ST, athletes vocalized the self-determined ST phrases aloud prior to each lift. The performance for both lifts was scored qualitatively (fail, pass with technical errors, pass) and quantitatively (temporal and kinetic parameters using bar path analysis). In the sections below, we will first discuss the athlete's habitual use of ST and their self-determined ST phrases selected for the M-ST and I-ST conditions. Next we will discuss the performance of the Snatch and the Clean & Jerk, and the impact of ST.

Study participants reported a more frequent habitual use of positive vs. negative ST, as determined with the Automatic Self-Talk Questionnaire for Sports (ASTQS). Neutral ST phrases were not part of the athlete's habitual use. Positive ST most commonly involved goal-directed instructional or motivational phrases, as well as self-regulating phrases to control anxiety. Negative ST typically included phrases related to perceived physical strain (somatic fatigue), though very few athletes reported the habitual use of negative ST. This is in line with Hardy et al. (2005), who previously reported that athletes mostly choose positive ST, compared to neutral or negative ST. Participation in the current study required athletes to specifically choose goal-directed, positive motivational and instructional ST phrases, to be used during the M-ST and I-ST condition respectively. The beneficial impact of positive ST to enhance competitive focus, and hence performance has been demonstrated previously (Carr 2006, Harvey et al., 2002; Hatzigeorgiadis et al., 2011). Moreover, allowing the athletes to choose their own preferred ST phrases is said to further increase motivation (Hardy, 2006). For the current study, athletes choose encouraging phrases for both lifts for the M-ST condition. Conversely, for the I-ST condition, athletes used specific instructional phrases related to the different technical requirements of each lift. All athletes were instructed to practice the relevant ST phrases prior to their test day in order to maximize familiarization and hence reduce the cognitive resources needed during the test session. It has been shown that newly learnt ST or ST that has not been practiced can drain an athlete's cognitive processing abilities and hence does not have a beneficial effect on performance (Hatzigeorgiadis et al. 2011).

To investigate the effect of ST on the lift performance, each lift was scored as, passed, passed with technical errors, or failed (score 0 - 2). Additionally, tracing of the barbell path was used to extract objective temporal and kinetic parameters related to the lift performance (Snatch and Clean-portion of the Clean & Jerk). Temporal parameters included movement duration from start to receiving position in squat, maximum velocity and acceleration, as well timing of the maximum velocity (i.e. the transition point from second to third pull); kinetic parameters included generated force and work at the transition point of maximum velocity. For both the lifts, increasing the barbell load resulted in more failed attempts, i.e. 33% fails for the Snatch and 37% fails for the Clean & Jerk at 95% 1RM, as well as more technical errors – especially during the Clean & Jerk.

Comparing the obtained scores for each lift did not show any significant impact of the test condition (No ST, M-ST, I-ST). However, further inspection showed that I-ST reduced the number of failed lifts (Snatch and Clean & Jerk). M-ST on the other hand increased the number of lifts performed with technical errors, especially for the Clean & Jerk. This negative impact of M-ST was even more apparent in less experienced CF athletes (Figure 15). Results for the comparison of temporal and kinetic parameters between the test conditions also showed no impact of M-ST or I-ST on the performance of the Snatch, and a limited effect of M-ST on the acceleration and force at maximum velocity for the Clean performed at 85% 1RM (Supplementary Data 4). Current study results do not support previous studies reporting beneficial impact of M-ST with respect to effort and performance of different tasks, ranging from e.g. an endurance cycling task (Blanchfield, Hardy & De Morree, 2014; Barwood, Corbett, Wagstaff, McVeigh & Thelwell, 2015), to a breaststroke leg or arm drill in swimming (Hatzigeorgiadis, 2006) or a vertical jump task (Tod, Thatcher, McGuigan & Thatcher, 2009). The majority of studies has been done using recreationally active men or women, however the positive effects of ST have also been confirmed in skilled or competitive athletes (Hatzigeorgiadis et al., 2009; Hardy et al., 2014; Wallace et al., 2016; Walter, Nikoleizig & Alfermann, 2017). Additionally, there is a body of literature supporting the hypothesis that I-ST improves the accuracy of motor skills, and that M-ST improves strength and endurance (Tod et al., 2011; Hatzigeorgiadis et al., 2011). However, in the current study group of skilled CF athletes, I-ST seemed more beneficial to avoid failure of the lift for both the Snatch and the Clean & Jerk. Conversely, M-ST even appeared to have a detrimental effect on the quality of performance as shown by an increase in lifts that were executed with technical errors. Tod et al. (2011) furthermore hypothesized that the effects of ST on performance depend on the skill

level of the athlete (Tod et al., 2011). Indeed, it has been shown that skilled athletes benefit more from M-ST, irrespective of the actual task requirements (Beilock et al., 2002; Zourbanos et al., 2013; Hardy et al., 2014). These conclusions could not be supported by the current findings in the group of skilled CF athletes, i.e. I-ST reduced the number of failed lift attempts for all athletes, irrespective of the level of experience (Figure 15).

The lack of results and the contradictions with existing literature must be discussed in view of multiple factors. A first factor relates to the inherent requirements of OW, i.e. the Snatch and Clean & Jerk both require a tight combination of technical skills, speed, balance, coordination and strength. Based on literature, I-ST would be beneficial to improve the technical aspects, whereas M-ST would be more appropriate to manage the weight that must be moved from ground to overhead. It thus appears that ST must have a unique and combined motivational and instructional function in order to have a positive impact on the lift performance in OW. Indeed, from the post-session interviews that were conducted with all athletes after the control condition (No ST), those with more OW experience indicated that the use of a combination of both functions is absolutely crucial to successfully perform the required lift. M-ST serves to psych up and mentally prepare for the weight [Let's go] when approaching the bar, I-ST is crucial to ensure focus, stability and proper technical execution when grabbing the barbell ["High elbows"]. These post-session interviews also revealed that the more experienced athletes already used a combination of both ST phrases in the control condition (No ST), which could help explain the lack of results when instructing these athletes to use either M-ST or I-ST only. Self-determined ST that is in line with the athlete's previous experience of being successful, will lead to a consistent experience of ST (Van Raalte et al. 2016). This means that when the CF athlete feels that he or she can be successful in the lift (e.g. in case of lower load, or more experience) and he or she uses the ST [you can do this] or [fast elbows], the CF athlete is more likely to truly encourage him/herself and to continue to work hard to successfully make that lift. On the other hand, using the same ST phrases while not feeling able to make the lift (e.g. too heavy, lack of experience), can lead to an inconsistent ST experience (Van Raalte et al., 2016), which impacts on the athlete's experiences and affect/cognition/motivation. This raises a second discussion point, i.e. the experience and skill-level of the current study cohort with respect to OW. Whilst all athletes had a vast amount of CF experience, they had fewer expertise in the art of OW. If the skill level indeed plays a role in the impact of ST, instructional phrases would be expected to be more beneficial. Current study results did show a reduction of the number of fails when using I-ST. From the post-session interview, it also became apparent that

those athletes with fewer years of experience preferred the use of motivational phrases in their trainings. The ASTQS confirmed this, i.e. less experienced athletes generally reported a less frequent habitual use of ST compared to more skilled athletes. Moreover, less experienced athletes reported a more frequent use of motivational phrases (“psych up” and “confidence”) or irrelevant thoughts. Hence, they were more familiar with this type of ST compared to I-ST. More skilled athletes on the other hand reported a more frequent use of instructional phrases. A final factor relates to the familiarization and practice of the self-determined ST during training and competition prior to the test sessions. In the current study, athletes were instructed to practice the use of the self-determined phrases in the days leading up to the test session, however this was not strictly monitored. Moreover, test sessions were scheduled with an interval of 3 days to maximum 1 week, limiting the familiarization possibilities which could have contributed to a reduced impact of ST (Walter et al., 2017). Insufficient practice could have resulted in a depletion of the athlete’s cognitive resources during the M-ST and I-ST test session, and hence using the ST no longer has any beneficial effects on the athlete’s performance (Hatzigeorgiadis et al. 2011).

Limitations and future directions. Whilst being the first study to investigate the effect of goal-directed ST on the performance of OW in a cohort of skilled CF athletes, current results also warrant some critical reflections. First, all athletes were recruited based on their skill level with respect to CF movements, however not all athletes were equally skilled in OW movements. Consequently, current study results cannot be extrapolated to competitive lifters. Additionally, irrespective of the condition (No ST, M-ST, I-ST), all athletes showed an increasing number of failed lifts when performing at higher weights. In fact, more than 30% of the athletes failed their lift at 95% of 1RM. Whilst not unexpected, fewer data were available for the subsequent analyses. Third, the cross-over design allowed for testing of three test conditions (No ST, M-ST, I-ST) in a randomized order with a relatively small sample size, however athletes might not have sufficiently familiarized with the different ST phrases despite instructions. A longer wash-out period between conditions, and closer follow up of the athletes could be beneficial for a proper familiarization with the self-determined ST. Additionally, it would have been more optimal to do the assessment of the athlete’s performance in the No ST condition at baseline, and only randomize the M-ST and I-ST in a cross-over design. Future studies would benefit from inclusion of elite OW athletes, using a larger sample size to split the athletes into two groups, i.e. M-ST and I-ST based on their habitual use of ST, with a baseline assessment (No ST) prior to the ST test sessions. A closer monitoring and intense practice of the self-determined

ST could further help to maximize familiarization and efficacy of application of ST prior to a lift attempt. An in-depth interview with competitive, elite OW athlete would also allow to gain a better understanding of the type of ST phrases, or combination thereof, most commonly used for the Snatch and the Clean & Jerk. Fourth, the unknown order of the weight sets, due to the randomization, could have had an unwanted negative impact on the mental preparation of the athlete (context and previous experiences). Increasing the load on the barbell for every lift, rather than a randomized order of weight sets, with smaller weight increments and more rest between lifts would re-create test circumstances that are closer to the reality of an OW competition. Lastly, a more advanced analyses of each of the pulls, including spatial parameters of the bar path trajectory and kinematics of the athlete could provide additional insights with respect to the impact of self-determined and goal-directed ST on the lift performance.

5 Conclusion

The current study could not demonstrate a statistically significant effects of ST on the performance of the Snatch and the Clean & Jerk. However, inspection of the data did show that instructional ST reduced the number of failed lift attempts, whereas motivational ST seemed to have a negative impact on the performance, especially in less experienced CF athletes. Considering that the present study is among the first to investigate the impact of self-determined, goal-directed ST on the lift performance, current results provide valuable preliminary information. Further studies are required to determine the optimal type of ST for OW and thus to define strategies that could assist coaches and athletes to optimize performance in this sport discipline.

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doi:10.1123/tsp.27.2.171

Supplementary data

Supplementary Data 1: The different phases of the Snatch

Supplementary Data 2: The different phases of the Clean & Jerk

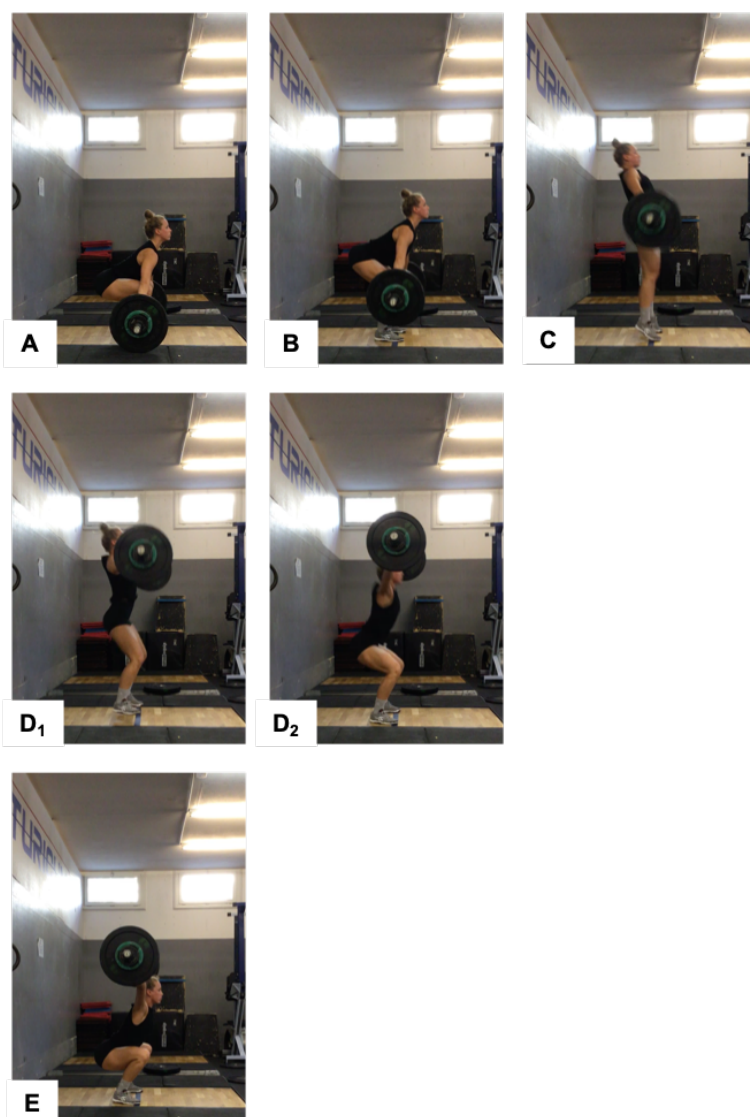
Supplementary Data 3: Informed Consent. This form was signed in hard copy by all athletes prior to the start of the study.

Supplementary Data 4: Presentation to explain the aim of the study, background on goal-directed motivational and instructional ST, and the study design. This information was provided as an online seminar.

Supplementary Data 5: The Automatic Self-Talk Questionnaire for Sports (ASTQS). All athletes filled out the ASTQS at baseline using an online Google questionnaire.

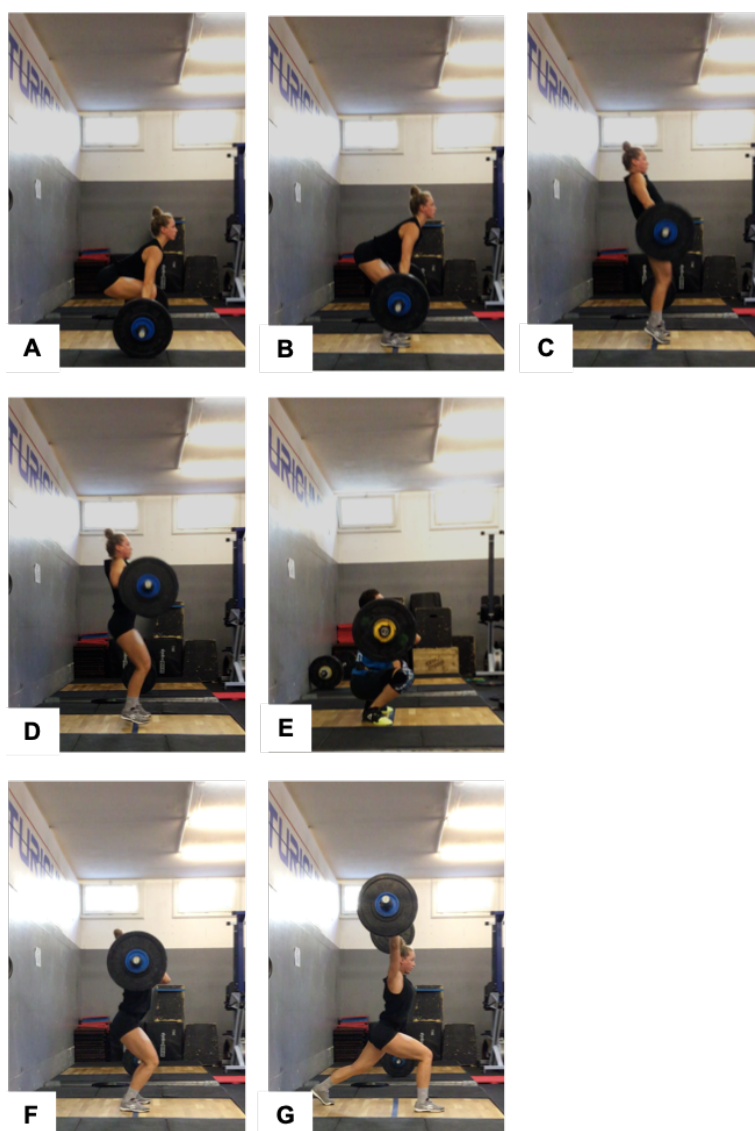
Supplementary Data 6: Temporal and kinetic parameters for every weight set and every ST-condition: (A) Snatch, (B) Clean.

Supplementary Data 1



The different phases of the Snatch: (A) start position, (B) first pull to bring the barbell upwards, (C) second pull with hip and knee explosion, (D₁) third pull with start of hip retraction, (D₂) third pull with transition under the bar, and (E) receiving position, i.e. overhead squat.

Supplementary Data 2



The different phases of the Clean & Jerk: (A) start position, (B) first pull to bring the barbell upwards, (C) second pull with hip and knee explosion, (D) third pull with hip retraction, (E) receiving position, i.e. front squat, (F) dip to create force against the platform, (G) receiving position, i.e. overhead position with slightly forward inclined trunk and full elbow extension.

Supplementary Data 3

Masterarbeit

Malick N'Diaye

The impact of goal-directed motivational versus instructional self-talk on the lift performance of skilled weightlifters

TeilnehmerInnen – Einverständniserklärung



Sehr geehrte(r) TeilnehmerIn,

vielen Dank für Ihre Bereitschaft, an den verschiedenen Tests teilzunehmen, die Teil der Studie zur Untersuchung der Auswirkung von Selbstgesprächen auf die Leistung des Gewichthebens sind.

Alle erhobenen Daten werden anonymisiert und nur für den speziellen Zweck dieser Studie verwendet. Bitte führen Sie alle Tests mit maximaler Bemühung durch, wobei Sie das erforderliche Selbstgespräch verwenden und die Standardanforderungen der Hebe-Übungen einhalten.

Vor den Testphasen haben sie bereits:

- die Präsentation studiert
- den Basisfragebogen ausgefüllt
- den Selbstgesprächsfragebogen ausgefüllt
- ihr/e bevorzugte/n motivationale/n- und instruktive/n Selbstgesprächs-Satz/Sätze ausgewählt

Sie wurden vor der Testphase darüber informiert, welche Art des Selbstgesprächs getestet werden soll, und haben das entsprechende Selbstgespräch während Ihrer regulären Trainingseinheiten geübt.

The impact of goal-directed motivational versus instructional self-talk on the lift performance of skilled weightlifters

Testdesign:

TESTTAG 1			TESTTAG 2			TESTTAG 3		
Kein Selbstgespräch vor jedem Lift			Motivationales Selbstgespräch vor jedem Lift			Instruktives Selbstgespräch vor jedem Lift		
Lifts			1. Snatch			3x3 Wiederholungen		
			2. Clean & Jerk			@75%, 85% und 95% vom 1 Repetitions Maximum (1RM)		

Die Reihenfolge Ihrer Testbedingungen wird vorgängig festgelegt und dir am Testtag mitgeteilt.

Ich wurde gründlich über die geplante Studie und die Testphase informiert, an der ich teilnehmen werde. Ich verstehe die Risiken, die mit den erforderlichen Aufgaben (Lifts) verbunden sind. Ich habe keine weiteren Fragen und nehme freiwillig an dieser Studie teil. Ich kann mich ohne Begründung jederzeit aus der Studie/Testphase zurückziehen.

Name, Vorname

Unterschrift TeilnehmerIn

Ort, Datum

Unterschrift Prüfer

Supplementary Data 4

Instruktion zum Thema Self-Talk

Masterarbeit von Malick N'Diaye

Universität Fribourg



„The impact of goal-directed motivational versus instructional self-talk on the lift performance of skilled weightlifters“

Was ist Self-Talk (ST)?



Gedanken haben einen grossen Einfluss auf unser Befinden, Emotionen und die Performance.



ST oder Selbstgespräche sind Aussagen, welche Athleten sich selbst sagen (laut oder leise), wobei die Athleten selbst das beabsichtigte Ziel der Aussage sind.

- Aussagen sind spontan und automatisch, oder
- ziel-orientiert und bewusst/absichtlich



POSITIVE ST

8 positive ST Gebote sind:

1. Sei ein Optimist, kein Pessimist
2. Bleibe realistisch und objektiv
3. Fokussiere das hier und jetzt, nicht die Vergangenheit oder Zukunft
4. Bewerte Probleme als eine Herausforderung anstatt eine Bedrohung
5. Betrachte Erfolge als nachvollziehbar und Misserfolge als überwindbar
6. Fokussiere den Prozess nicht das Produkt
7. Konzentriere dich auf Dinge die kontrollierbar sind
8. Trenne deine Performance von deinen Selbstwertgefühlen

Typen von Self-Talk:

Instruktiver ST (I-ST)

fokussiert auf eine Technik oder eine spezifische Fertigkeit zur Konzentrationssteigerung

Zum Beispiel: „high elbows“

Motivationaler ST (M-ST)

fokussiert auf das positive Befinden eines Athleten zur Vertrauenssteigerung.

Zum Beispiel: „you can do this“

ST als Instruktion

Beispiele Englisch

- Big chest, keep your eyes forward
- Stand up tall
- High elbows
- Press the floor away
- Aggressive Catch
- Accelerate through the roof
- Always press the bar upwards
- Set your feet solid
- Long pull
- Push your head through the window
- Stay tight
- Keep the bar close

SKILL & TECHNIK FOKUS

ST als Instruktion

Beispiele Deutsch

- Stolze Brust, Augen nach vorne
- Mach dich lang, Steh auf stolz
- Hohe Ellenbogen
- Drück den Boden weg
- Aggressive Catch-Position
- Beschleunige bis durchs Dach
- Hör nie auf die Stange nach oben zu drücken
- Setz die Füße konsequent und solide
- Langer Zug
- Drück den Kopf zwischen die Arme
- Spannung im ganzen Körper
- Halt die Stange nahe am Körper

SKILL & TECHNIK FOKUS

ST als Motivation

Beispiele Englisch

- Come on, you can do this
- Come on, this is light weight
- You want this lift
- Make yourself proud
- You have done this before
- Stay focussed and go for it
- It doesn't matter what everyone else is doing
- Each lift at a time
- Start acting like you want it
- Drive / Effort
- This is it / Time to shine
- This is do or die time

WOLL BEFINDEN & VETRAUEN FOKUS

ST als Motivation

Beispiele Deutsch

- Komm schon, du kannst das
- Komm schon, das ist leicht
- Du wisst es / Du wisst diesen Lift
- Mach dich stolz
- Du hast das schon mal getan/gehoben/geliftet
- Bleib fokussiert und gib alles
- Es ist egal was andere machen
- Eins nach dem anderen
- Zeig das du es willst
- Vollgas
- Es gilt ernst / Zeit um zu scheinen
- Alles oder nichts

WOLL BEFINDEN & VETRAUEN FOKUS

Hypothese*:

Instruktiver ST (I-ST)

SKILL & TECHNIK FOKUS

Vorteil für präzise und ergebnisorientierte motorische Fertigkeiten

Motivationaler ST (M-ST)

VERTRAUEN FOKUS

Vorteil für motorische Fertigkeiten welche Kraft und Ausdauer verlangen

*Theodorakis et al. (2000) The Sport Psychologist, 14(3), 253-271

Beispiel-Studie mit erfahrenen Sportlern*:

Wer:

40 erfahrene Fussballspieler

Was:

Ziel-Schuss-Übungen mit dem dominanten und nichtdominanten Fuss

Self-Talk:

motivationale und instruktive Selbstgespräche (ST)

Fragestellung:

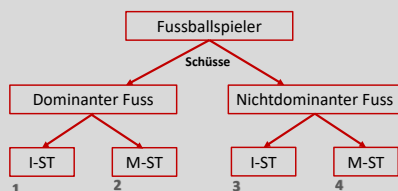
Relative Effektivität von instruktiver und motivationaler Selbstgespräche bei Ziel-Genauigkeit vom dominanten und nichtdominanten Fuss

*Hardy et al. (2014). Journal of Applied Sport Psychology, 27(2), 132-139

Beispiel-Studie mit erfahrenen Sportlern*:

Experiment:

4 Bedingungen mit jeweils 12 Schüssen auf das Goal



I-ST: Instruktiver ST
M-ST: Motivationaler ST

Resultat:

Höhere Genauigkeit beim dominanten Fuss in Kombination mit M-ST

Keinen prägnanten Unterschied im Vergleich der Selbstgespräche des nichtdominanten Fusses.

*Hardy et al. (2014). Journal of Applied Sport Psychology, 27(2), 132-139

Wie ist der Wissensstand zum Thema ST



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- I-ST improves accuracy of motor skills
 - M-ST improves strength and endurance
- BUT**
- Effects of ST depend on the skill level of the athlete
 - Novice athletes benefit more from I-ST
 - Skilled athletes might benefit more from M-ST
 - Self-chosen ST improves the athlete's motivation

Wie ist der Wissensstand zum Thema ST



- IST improves accuracy of motor skills
- MST improves strength and endurance
- Effects of ST depend on the skill level of the athlete
 - Novice athletes benefit more from I-ST
 - Skilled athletes might benefit more from MST
- Self-chosen ST improves the athlete's motivation

Es fehlen Studien zur Verwendung und Wirkung von Selbstgesprächen (ST) im olympischen Gewichtheben

Fragestellung der Masterarbeit...

Welchen Einfluss hat die ziel-orientierte Anwendung von motivationaler Selbstgespräche im Vergleich mit instruktiver Selbstgespräche bei der Ausführung von Olympischen Gewichthebe-Übungen erfahrener CrossFit-/Weightlifting-Athleten?



Wie wird getestet?

Wer:
CrossFit- /Weightlifting-Athleten


Was:
3 Testtage
2 Lifts: Snatch und Clean & Jerk
9 Versuche
Pro Lift: 3 Versuche pro Gewicht
(75, 85 & 95% vom 1RM)
→Jeder Lift wird per Video festgehalten und nachträglich ausgewertet

Self-Talk:
Keine, motivationale oder instruktive Selbstgespräche vor jedem Lift

Selbstgespräche:
Wähle ein/en instruktives/n und motivationales/n ST Statement/Satz aus.*

*Siehe die Liste mit den Beispielen, oder kreiere selbst

Testtag:
Dir wird vor dem Test eine ST-Art zugeteilt, welche vorgängig geübt und angewendet werden soll.

 **Ziel ist es jeden Lift erfolgreich zu absolvieren!**

Was von dir erwartet wird?

NACH DIESER PRÄSENTATION

1. Fülle den Online Fragebogen aus
 - Baseline Fragebogen über die allgemeinen Infos zum Athlet
 - Self-Talk Fragebogen (ASTQS)
2. Lies dir die Listen der ST-Arten genau durch
3. Wähle 2-3 Sätze/Stichworte in jeder Kategorie, welche du dir in der Praxis vorstellen könntest

VOR DEM TESTTAG

Wende die gewählte ST Art 3-4 Tage vor dem Testtag in der Praxis an (Es wird dir noch mitgeteilt welche ST-Art du an welchem Testtag verwenden sollst)

TESTTAG

1. Wende den gewählten ST vor jedem Snatch- und Clean & Jerk-Versuch an.
2. Video Interview

VIELEN DANK THANK YOU

Bei Fragen oder Unklarheiten, kontaktiere

malick.n85@gmail.com

+41 76 326 8810

Supplementary Data 5

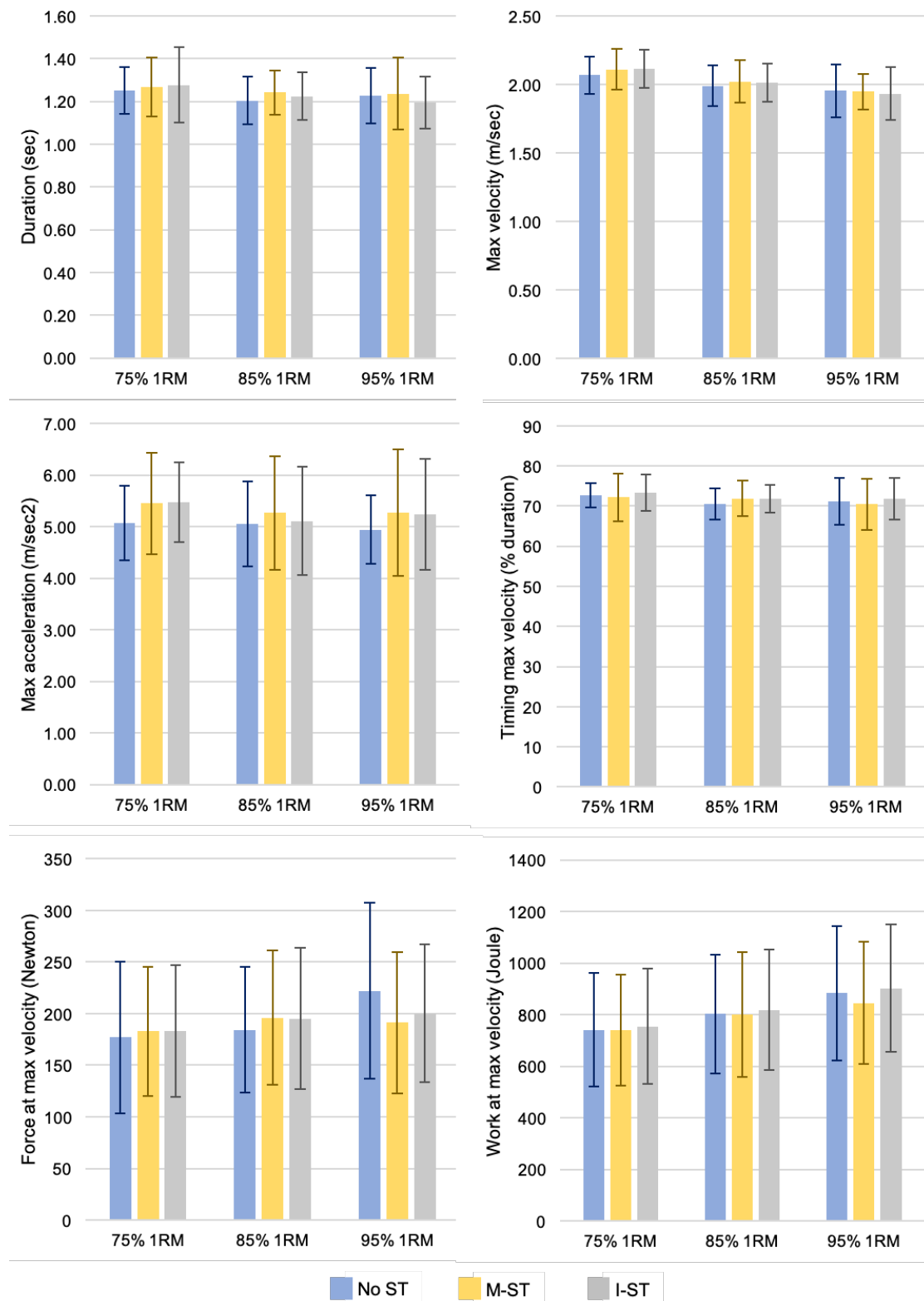
Automatic Self-Talk Questionnaire for Sports

Zourbanos, N., Hatzigeorgiadis, A., Chroni, S., Theodorakis, Y., & Papaioannou, A. (2009). Automatic Self-Talk Questionnaire for Sports (ASTQS): Development and preliminary validation of a measure identifying the structure of athletes' self-talk. *The Sport Psychologist*, 23(2), 233-251.

Faktor	Item	Englisch Original	Deutsche Adaptation
Psych-up	1	Let's go	Let's go
	2	Power	Power
	3	Give 100%	Gib 100%
	4	Do your best	Gib dein Bestes
	5	Strong	Stark
Angstkontrolle	6	Relax	Relax
	7	Don't get upset	Reg dich nicht auf
	8	Calm down	Beruhige dich
	9	No stress	Kein Stress
Selbstvertrauen	10	I believe in me	Ich glaube an mich
	11	I am very well prepared	Ich bin sehr gut vorbereitet
	12	I feel strong	Ich fühle mich stark
	13	I can make it	Ich kann es
	14	I believe in my abilities	Ich glaube an meine Fähigkeiten
Aufmerksamkeitsinstruktion	15	Concentrate on your goal	Konzentrier dich auf dein Ziel
	16	Focus on what you need to do now	Fokus auf das, was du zu tun hast
	17	Concentrate on your game	Konzentrier dich auf deine Aufgabe
	18	Focus on your technique	Fokus auf die Technik
	19	Concentrate	Konzentration
Befürchtungen	20	I am going to lose	Ich werde verlieren
	21	I'm wrong again	Ich bin wieder falsch
	22	I am not as good as the others	Ich bin nicht so gut wie die anderen
	23	I am not going to reach my goal	Ich werde meine Ziele nicht erreichen
	24	I cannot concentrate	Ich kann mich nicht konzentrieren
	25	I am not going to make it	Ich werde es nicht schaffen
	26	What will others think of my poor performance	Was werden andere über meine schlechte Leistung denken
Rückzug / Vermeidung	27	I want to stop	Ich will aufhören
	28	I want to get out of here	Ich will weg von hier
	29	I think I'll stop trying	Ich glaube, ich höre auf es zu versuchen
	30	I can't keep going	Ich kann nicht mehr
	31	I am fed-up	Ich habe die Nase voll
Somatische Müdigkeit	32	My body is not in a good condition	Mein Körper ist in keiner guten Verfassung
	33	I am tired	Ich bin müde
	34	Today I 'suck'	Heute bin ich echt scheisse
	35	My legs/arms are shaking from tiredness	Meine Beine/Arme zittern vor Müdigkeit
	36	My body doesn't help me today	Mein Körper hilft mir heute nicht
Irrelevante Gedanken	37	I am thirsty	Ich habe Durst
	38	What will I do later tonight	Was werde ich heute Abend machen
	39	I am hungry	Ich bin hungrig
	40	I want to take a shower	Ich möchte duschen

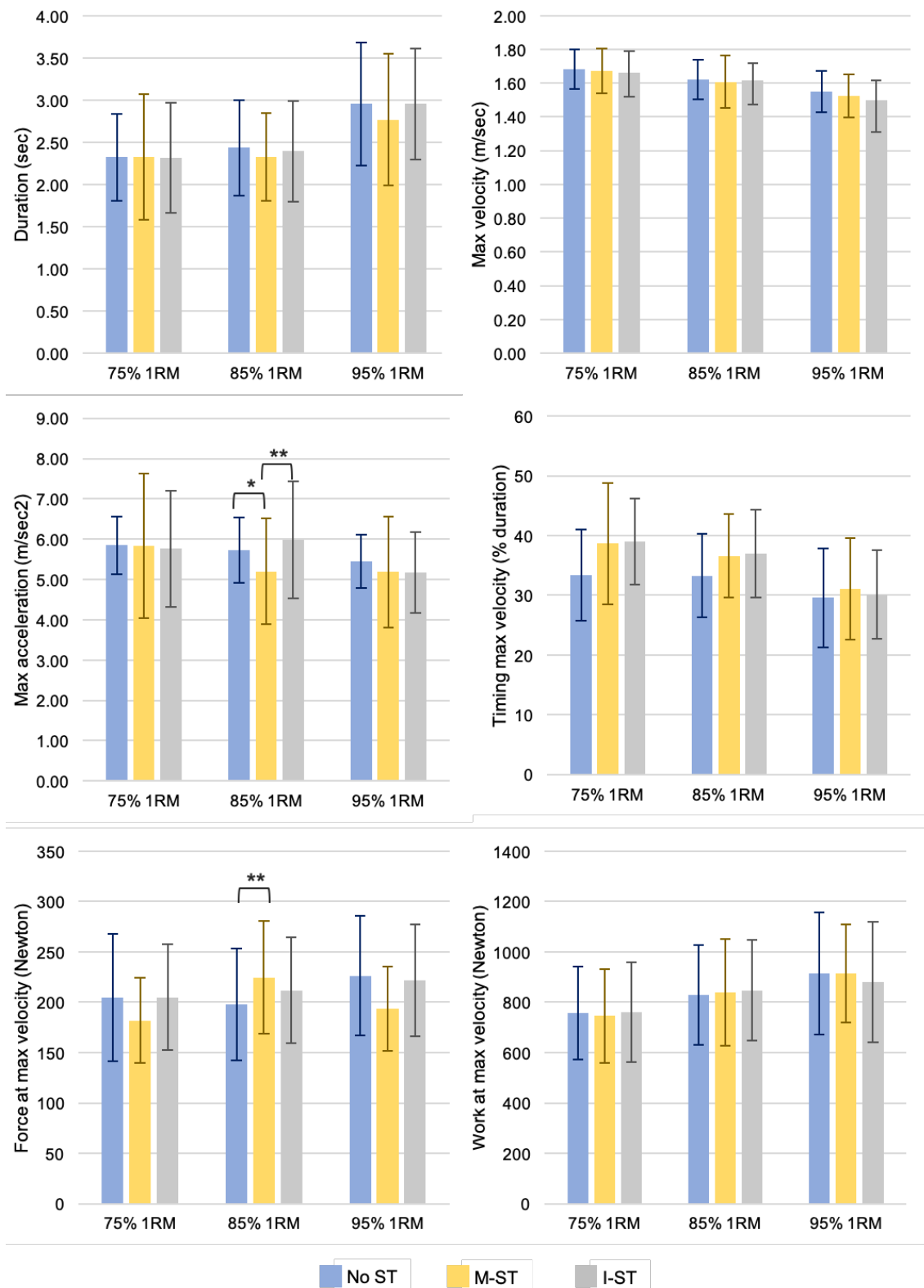
Bemerkung. Einleitungstext: Bitte beurteile das Auftreten der folgenden Gedanken im Kontext von Wettkämpfen. Führe dir dazu deine letzten Wettkämpfe vor Augen und schätze die Häufigkeit des Auftretens der vorgegebenen Gedanken ein. Antworten werden auf einer 5-Punkte Likert Skala beurteilt (0 = nie, 1 = selten, 2 = manchmal, 3 = häufig, 4 = sehr häufig)

Supplementary Data 6: (A) Snatch



Mean and standard deviation for the temporal and kinetic parameters of the Snatch per weight set (75%, 85%, 95% 1RM) and per ST condition. No significant differences were found for any of the parameters between the different test conditions. 1RM = 1 repetition maximum. ST = self-talk. M = motivational. I = instructional.

Supplementary Data 6: (B) Clean



Mean and Standard deviation for the extracted parameters of the Clean per weight set (75%, 85%, 95% 1RM) and per ST condition. Post-hoc significant results for the 85% indicated a significantly lower maximum acceleration of the barbell and higher force at max. velocity when using motivational ST compared to No ST or instructional ST (paired t-test). * $p < .05$; ** $p < .001$. 1RM = 1 repetition maximum. ST = self-talk. M = motivational. I = instructional.

Acknowledgement

Einen grossen Dank gilt ganz speziell meiner Verlobten E. Jaspers, für die Geduld und Liebe, welche Sie mir über all die Monate unterstützend gegeben hatte. Sie war eine grosse Stütze während dieser emotionalen Achterbahn nach so vielen Jahren ausserhalb jeglicher Vorlesungssäle. One Love.

Zudem möchte ich mich ganz herzlich bei allen Teilnehmern und meinen sehr motivierten und unterstützenden Betreuern bedanken. The work is done, let's look for something new.

Aim higher – get stronger.

Coach Malick