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The Effects of Deception on Maximal Strength, Goals, and Physical Self-Efficacy

Timothy J. Piper[1], Steven J. Radlo[1], Kylie J. Gerhardt[1], Darice S. Brooks[2] & Jessica A. Schnaiter[3]

[1]Department of Kinesiology, Western Illinois University, USA, [2]Department of Kinesiology, Michigan State University, USA, [3]School of Applied Health and Educational Psychology, Oklahoma State University, USA.

Corresponding Author: tj-piper@wiu.edu

ABSTRACT

Deceptive feedback involves offering altered performance results to athletes with the intention of eliciting greater physical output. The use of feedback and feedforward mechanisms used to predict a performance endpoint is referred to as teleoanticipation. Having a perceptual idea of an upcoming load helps to generate the appropriate force necessary (feed forward) to successfully reach the goal endpoint of the lift. The interpretation of physiological and psychological effects of stimuli is the basis for current and future performances. Self-efficacy, which is situational self-confidence (ability to make a specific type of lift), was also investigated in this study to see if loading misinformation would have an influence. The purpose of the present study was to investigate the effects of loading misinformation, of varying percentages, on maximal strength, physical self-efficacy, and strength goals through the lens of teleoanticipation. Recreational lifters (n=17) were tested for one repetition maximum (1RM) leg press scores, future goal weights (G), and physical self-efficacy (SE), over the course of two orientation sessions and five separate test sessions. A baseline of 1RM strength was established during the first test control session (TC). Deceptive feedback was given on the subsequent three sessions and consisted of loads that were 5% (T+5), 10% (T+10) or 15% (T+15) above the loads reported to participants during each session. The full extent of deception was revealed on the final session of testing with truthful feedback (TF). There were significant differences between the trials for 1RM measures; TC was significantly different from the T+5, T+10, and TF. Results for G revealed significance for all trials compared to TC but no differences were found in self-esteem. This data suggests that deception may enhance 1 RM measures, negatively impact goal setting, but not affect physical self-efficacy.

INTRODUCTION

Strength coaches constantly search for ways to improve maximum strength performance in their athletes. Athletes strive to meet training and competition goals based upon prior performance and subconscious feedback during activities. Teleoanticipation, the anticipation of an end goal or endpoint, uses feedback and feedforward mechanisms to explain the physiological and psychological effects of stimuli on performance (Ulmer, 1996). In strength exercises the knowledge of the load being lifted represents an endpoint of performance. Alteration or deception of loads could modify an athletes' expectations of the exercise endpoint before, during, and after performance (Williams et al., 2014). Manipulation of exercise load is a method of investigating both the theory of teleoanticipation as well as maximal strength potential, goal setting, and physical self-efficacy.

Before beginning any task, our nervous system uses a wide variety of feedback involved in the task and then a strategy or template for how the task should be completed is utilized, which is the essence of teleoanticipation (Ulmer, 1996). The amount of force required to press a desired amount of weight is pre-set, but if the weight amount is heavier or lighter

than what is expected, in-task regulation using feedforward and feedback resources is affected (Williams et al., 2014). Detection of barbell load and imbalance requires interpreting feedback for improved performance, such as when lifting an unevenly loaded barbell, results in adjustments of force output allowing for a coordinated performance (Piper et al., 2012).

Deceptive feedback applied to cycling has yielded mixed results with false positive and false negative deceptive feedback resulting in no significant effect on completion time and average power (Wilson et al., 2012) but increased higher power output in experienced cyclists (Micklewright et al., 2010). Investigating deceptive feedback upon nine experienced cyclists Stone, Thomas, Wilkinson, Jones, St Clair-Gibson, Thompson (2012) found greater performance due to deceptive feedback. This study revealed that cyclists were able to complete a 4000-meter time trial faster when they were told their baseline trials was 102% of power output from baseline. The conclusion of the study was that the cyclists were performing with some form of metabolic reserve even during maximal trials. If there is some form of reserve during strength training exercises the ability to train at higher than expected levels could lead to greater training effects.

Like cycling studies, some resistance training studies have explored pacing of repetitions, which requires use of feedback associated with the concept of teleoanticipation, have revealed mixed results. Halperin et al. (2014a; 2014b) found that adult male and female subjects used pacing strategies and attempts to reserve strength for final repetitions in a set whereas Reid et al. (2017) found adolescent females did not while using the same study protocol. Using high repetition protocols exploring teleoanticipation and the application of known and unknown loads Beaudoin et al. (2018) found that total repetitions completed with known and unknown loads performed by recreationally trained males and females did not result in significant results. In strength and cycling, research indicates that maturity, experience, the ability to effectively use feedback, and application of near-maximal force may alter how subjects exhibit force output during deceptive or unknown situations.

For athletes involved in competitive sports where absolute strength is crucial, such as in weightlifting and powerlifting, loads during competition are increased in small increments, i.e. 2.2 pounds (1 kilogram) for weightlifting or 5.5 pounds (2.5 kilograms) for powerlifting. One potential limitation to measuring maximal strength may be the individuals' belief regarding their maximum strength level. It has been found that false positive feedback, in which the load was greater than subjects believed results in greater strength measures (Wells et al., 1993) with no negative effect on self-efficacy (Ness & Patton, 1979) and increases central nervous system stimulation, greater rate of force production, muscle activation, and power output when performing the exercise with an unknown load compared with a known load (Hernández-Davó et al., 2015).

Goal setting is a motivational technique that helps provide athletes with a pathway to attain success. It can be used as a feedback mechanism to indicate success or failure, and can aid in task persistence when taking on activities once not thought of as being possible or when experiencing temporary setbacks in goal attainment.

Goal setting has been shown to have a causal effect on predicting performance. Garland et al. (1988) showed that individual task goals influenced sit-up performance through their influence on self-efficacy. Additionally, Lerner and Locke (1995) showed that goal level on performance was mediated by personal goals and self-efficacy. A number of variables seem to interact between goal setting and sport performance. These include self-efficacy, self-satisfaction, ability, and goal commitment (Theodorakis, 1996). Furthermore, in the business world, it appears that self-efficacy acts as a mediator variable for goal setting and performance (Appelbaum & Hare, 1996).

Self-efficacy and goal setting play a major factor in strength training and competition. Bandura's self-efficacy theory (Bandura, 1977) states that humans are more likely to participate in activities they believe they can perform successfully, and past performances are the most powerful source for efficacy information (Samson, 2011). Athletes who believe that have had success in former trials are more likely to apply increased effort and set more difficult goals for themselves, this is a very important piece for understanding why "false positive feedback" trials may be more successful than "false negative feedback" experiments (Escarti & Guzman, 1999).

Physical self-efficacy in men and women with low perceived ability has been shown lead to conservative perception of physical limitations. While generally a good indicator of baseline strength

potential, low self-efficacy results in low physical performance due to both physical as well as mental limitations (Meeuwsen, 1991; Wells et al., 1993). These researchers found that when subjects were lifting more than they believed, they outperformed their counterparts, who were lifting less than they believed, indicating that self-efficacy plays a role in maximum strength performance. Based upon the potential interplay of the combined factors in the literature, the purpose of the present study was to investigate the effects of loading misinformation, of varying percentages, on maximal strength, physical self-efficacy, and strength goals through the lens of teleoanticipation.

METHODS

Experimental Approach to the Problem

Although previous research has investigated the effects of deceptive feedback on various types of activities, the prior studies have not determined the effects of deceptive feedback upon self-efficacy or to what different percentages of deception are efficacious for improving strength performance. No prior research has assessed how deceptive feedback effects goal setting for future sessions, and thus is warranted for examination. The present study was designed to test whether providing deceptive feedback would enhance leg press force production, self-efficacy, as well as goal setting for future testing sessions. Specifically, would providing the subjects with feedback of 5%, 10%, and 15% below the actual load being lifted produce greater strength performance and would revealing the deception and all previous scores result in higher post-test scores. These percentages were derived from prior anecdotal experience and based upon the percentages used in prior research. The maximum deception in prior research for the incline machine in 48 college males, (Ness and Patton, 1979) and the 1RM free weight bench press in 36 experienced males (Fitzsimmons, Landers, Thomas, and van der Mars, 1991) did not exceed 8-10%, thus, 15% was chosen to determine if there was a ceiling effect of advantageous deceptive feedback. Hirsch (1974) determined that the maximum voluntary contraction of muscle represents approximately 30% of the maximal tensile strength of the tendons, leading to the determination that using 15% of overload was within allowable risk without approaching, or possibly surpassing, safe levels of force production during testing.

All subjects experienced two orientation sessions, a pre-test, three randomized deceptive feedback conditions, and post-test, for a total of seven sessions. The design was a within-subjects repeated measures sampling. The dependent variables tested were the amount of weight lifted for each of the conditions, scores on a subset of the Physical Self-Efficacy Scale, and weight for the goal strength survey. The independent variables were the five testing conditions (pre, post, and three feedback conditions). Significant main effects for strength, physical self-efficacy, and goal setting for the five testing conditions were assessed.

Subjects

This study was approved by the Institutional Review Board (IRB) and subjects were informed of the benefits and risks of the investigation prior to signing an institutionally approved informed consent document to participate in the study. Four female and 13 male college students between the ages of 18 and 25 (mean + SD, age: 20.06 +1.83 years, height: 173.28+8.28 centimeters, weight: 73.33 +13.00 kilograms, volunteered to participate for this research study and completed the institutionally approved informed consent prior to participation. All subjects were recreational strength trainees with at least 6 months experience (21.61+9.84 months), free of any ankle, knee, hip, or low back tendon injuries at the time of and at least six months prior to testing and had no prior ligament injuries to the same joints and signed informed consents. To disguise the purpose of the study, subjects were told that the research was examining the effects of daily variability of strength upon self-efficacy and maximum strength rather than deceptive feedback. A full debriefing explaining the exact methods of the study was completed prior to final testing session.

Subject Safety

Due to the nature of the research, subjects were given deceptive feedback and using loads at or above maximum voluntary contractions, the the safety of the subject was maintained by using two spotters at all times.

Apparatus

A Universal brand leg press machine (Universal Gym Equipment, model-Gladiator, Cedar Rapids, IA) was used to test maximal lower body strength. The seat position was adjusted for each subject so that the knee joint angle reached 90° during all testing as

measured by a Baseline goniometer (model 12-1000, Fabrication Enterprises Inc. of White Plains, NY). To maintain secrecy of the deceptive manipulations throughout the study the subjects were informed that the study was simply investigating visual feedback upon strength performance, self-efficacy, and goal setting. The weight stack was concealed behind a partition attached to the leg press machine, allowing for adjustments to the weight without observation from any subjects. The offered explanation given for the concealment of the weight stack was that it helped avoid any of the subjects witnessing the loads being lifted, which could have led to altered perceptions of strength, load, or impact upon self-efficacy.

Measures

Maximal performance output on a Universal leg press machine was measured at each session in the form of the 1 repetition maximum (1 RM) lift. Subjects sat in the leg press machine while having their lower back, hips, and buttocks in contact with the pads of the seat and back rest. Subjects then positioned their feet flat, hip-width apart on the lower leg press pedals. When instructed, subjects pressed the pedals forward until they reached full knee extension. Loads were increased incrementally, ranging between 20 pounds when lifts looked very easy down to five pounds once the subject appeared to be approaching their 1RM, until the subject was unable to complete a full repetition.

The Perceived Physical Ability (PPA) subscale of the Physical Self-Efficacy Scale (PSES; Ryckman et al., 1982), a 10 item five-point Likert scale, was used to assess subjects' general physical self-efficacy during the study. The 10 items of the PPA has a Chronbach's alpha of .76 suggesting that this factor was a reliable assessment of general self-efficacy. Validity of the PPA was weaker, Chronbach's alpha reaching a maximum of .52 (McAuley & Gill, 1983). To assess the impact of deceptive feedback on goal setting subjects were asked to set a goal for future tests immediately after the completion of the final repetition of each testing session.

All subjects went through a total of seven testing sessions, each separated by three days to allow for full recovery. According to recent research related to repeated strength, sprint, and jump training, 72 hours of recovery is sufficient to resolve any performance decrements related to soreness and fatigue (Thomas, Brownstein, Dent, Parker, Goodall, and Howatson, 2018). To decrease chance of injury, each subject performed three to five minutes of dynamic warm-up and aerobic work followed by three to five submaximal sets of leg press, starting at approximately 25% of self-reported 1RM estimations, followed by increasing loads of approximately 5-20% per set up to approximately 85% of the estimated 1RM, to ensure sufficient warm-up prior to any maximal testing. After the warm-up sets, subjects began attempts at the 1RM lift. Each subject was given three to six minutes of rest between each 1 RM attempt. After reaching the 1RM for each day of testing, the subjects immediately completed the physical self-efficacy questionnaire and set a goal weight for future sessions.

There was no feedback to the subjects during the initial two orientation sessions, and these sessions were used to establish an approximation of the 1RM. After the orientation sessions, data collection began, with the first day of data collection being the 1RM test control session (TC). During subsequent testing sessions subjects were tested for maximal strength at which time the manipulations took place. The deceptive feedback manipulations for the test sessions were designed so subjects lifted 5% (T+5), 10% (T+10), and 15% (T+15) above the weight they were told was on the weight stack, and the feedback manipulations were randomized for each subject. On deceptive feedback days every load reported to subjects was adjusted by the given percentage so that each set attempted on that particular session were adjusted to reflect the same percentage of deceptive feedback. To help illustrate the loading, and reported loading for a testing session that involved deception, table 1 depicts the loads and reported loads for a hypothetical subject who obtained a 1RM of 185 kilos during TC.

During each testing session involving deceptive feedback loads were preceded with a simple statement to the subjects; "Your 1RM established is "X" pounds. The load on the machine is currently "Y" pounds. Lift". In each deceptive feedback session, the "Y" load was the misinformation load reported to the subject. There was no form of encouragement, coaching, or other feedback given to the subjects throughout any of the sessions.

Debriefing of Subjects Prior to Final Testing Session

After all subjects had successfully completed the first four testing sessions, (TC, T+5, T+10, T+15) each subject was debriefed regarding the true nature of the study. Previous 1RM scores for TC, T+5, T+10, and T+15 were accurately revealed to the subjects

Table 1. Example loading, and deceptive load reporting, for a hypothetical subject.

Attempts for a given session under scenario of 10% of deception (T+10) based upon a 185k 1RM	Attempt 1	Attempt 2	Attempt 3	Attempt 4	Attempt 5
Actual Load	170	180	185	190	195
Load Reported to Subject	155	162	165	170	175

and they were allowed to ask questions regarding the deceptive practices. The only time subjects received honest feedback was during TC and the final test session of truthful feedback (TF) which basically acted as a post-test session because all participants were fully aware of the entire study purpose and their truthful individual results. Only on a few occasions did subjects indicate that they thought that the loads seemed heavier than expected. On such occasions that subjects questioned the accuracy of loads they were told a prepared script, in a casual manner, that "strength levels, and perceptions of effort, varies from day-to-day". Anecdotally, no subjects pursued the matter any further but did say things to the effect that they "felt weak", were having an "off day", or similar comments.

Statistical Analyses

All data from these strength tests were analyzed using IBM SPSS version 24 and utilized a p-value of 0.05 for significance. Separate within-subjects measures analysis of variance (ANOVA) were conducted for each of the three measures (strength, self-efficacy, and goals). The five trial (TC, T+5, T+10, T+15, and TF) acted as the repeated measures. Tukey's Honestly Significant Difference (HSD) was used as the post-hoc test to detect differences between mean scores of the trial blocks.

RESULTS

Strength Performance Scores

Analysis of the strength measurement revealed a difference between trials, $F(4,64) = 5.25$, $p < 0.001$. TC (190.37 + 53.48 kg) was significantly different from T+5 (197.72 + 49.67 kg, T+10 (197.31 + 51.39 kg), and TF (200.12 + 53.12 kg). T+15 (192.91 + 51.71 kg) was not significantly different form any other trials, (see Figure 1, Strength Score Means).

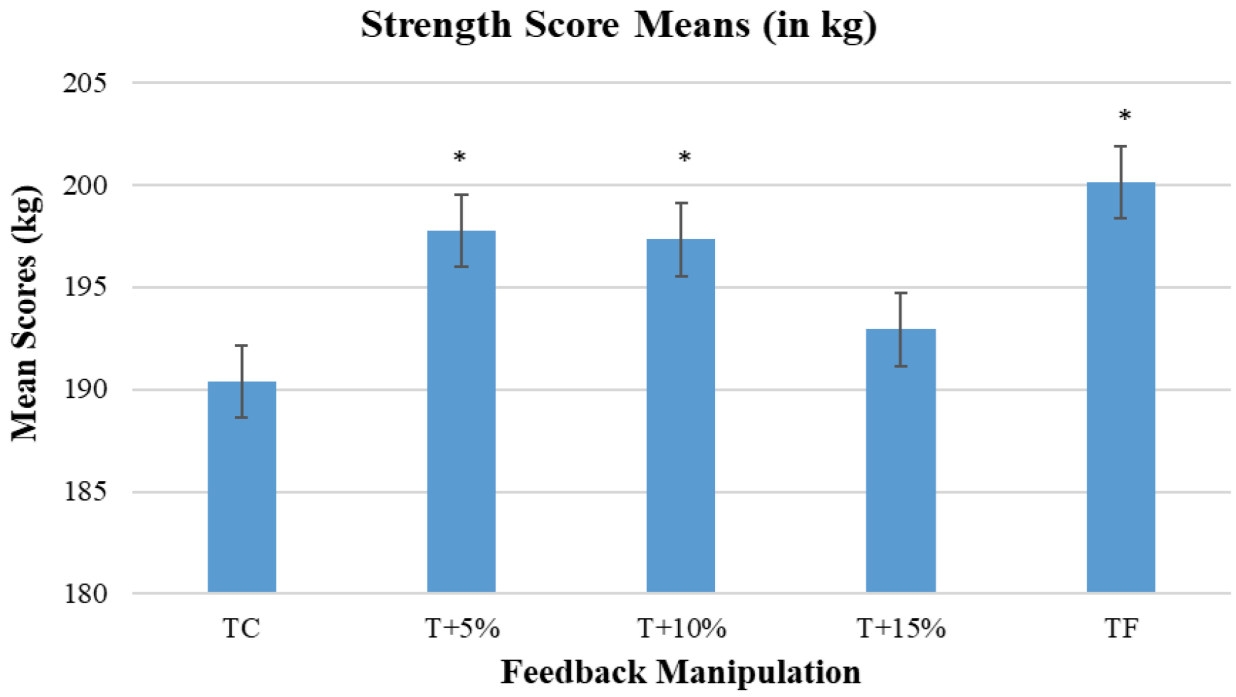

Figure 1. Average Strength Mean Scores (in kilograms)
Note. This figure demonstrates the effects of deceptive feedback on maximum leg press strength. Data are presented as mean + SEM. *Significantly ($p < 0.001$) different from TC.

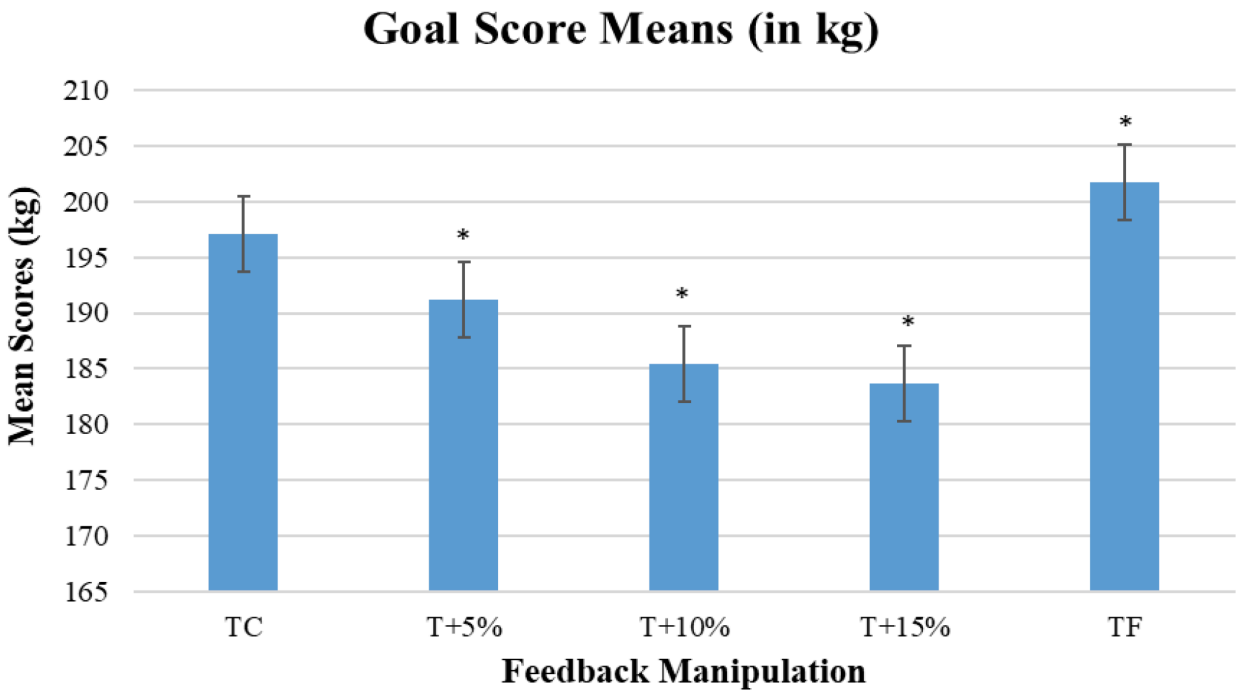

Figure 2. Average Goal Score Means (in kilograms)
Note. This figure demonstrates the effects of deceptive feedback on leg press goal scores. Data are presented as mean + SEM. *Significantly ($p < 0.001$) different from TC.

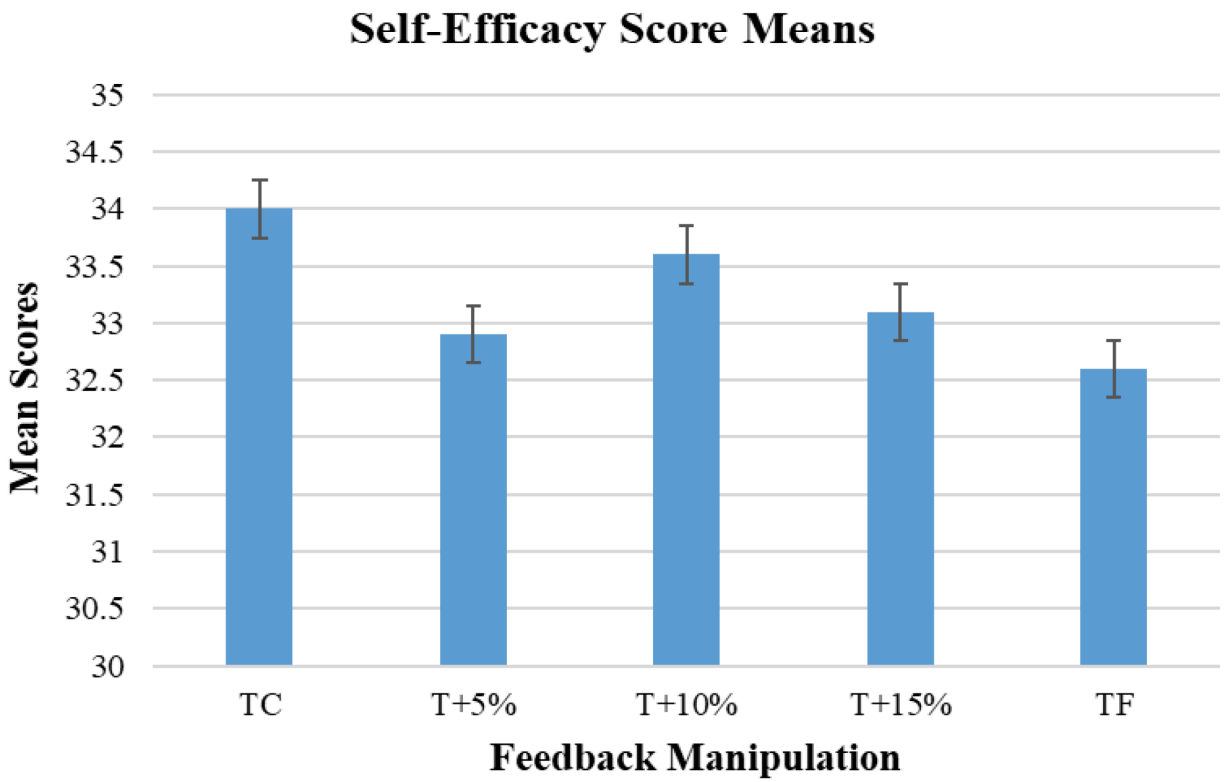

Figure 3. Average Self-Efficacy Mean Scores
Note. This figure demonstrates the effects of deceptive feedback on self-efficacy. Data are presented as mean + SEM. No significant differences from TC.

Goal Scores

Analysis of the goal measurement revealed a difference between the goal measures, $F(4,64) = 17.35$, $p < 0.001$. TC (197.05 + 53.93 kg) was significantly different from T+5 (191.19 + 48.44 kg), T+10 (185.43 + 48.53 kg), T+15 (183.71 + 49.40 kg), TF (201.72 + 51.39 kg) (see Figure 2, Goal Score Means). It should be noted that based upon the strength measures during deceptive feedback session T+5 lifters would have believed that their performance was an improvement. On the contrary, during T+10 and T+15 the perceived strength scores would be perceived as decreases in strength when actually both of these sessions actually produced greater strength scores than TC. It may be assumed that T+5 could lead to greater goal scores but in actuality all goal scores lowered at every level of deception.

Physical Self-Efficacy Scores

No significant differences for self-efficacy measures were revealed between any trials, $F(4,64) = 1.33$, $p>0.05$, TC (34.4 + 0.07), T+5 (32.9 + 0.06), T+10 (33.6 + 0.07), T+15 (33.1 + 0.069), TF (32.6 + 0.07) (see Figure 3, Self-efficacy scores).

DISCUSSION

The purpose of the present study was to investigate the effects of loading misinformation, of varying percentages, on maximal strength, physical self-efficacy, and strength goals through the lens of teleoanticipation. The first research hypothesis was that as deceptive feedback was given to subjects their strength scores would increase as subjects attempted to reach their prior score in TC. This hypothesis was supported for two of the three sessions, with significant findings in T=5 and T+10. The second research hypothesis was that as perceived strength scores were lower than TC the goal scores would decrease. This hypothesis was supported for each manipulated session. The final research hypothesis was that as perceived strength scores were lower than TC the physical self-efficacy scores would decrease. This final hypothesis was not supported in any of the testing sessions.

1RM Strength Scores

Previous studies have revealed that when subjects perceive they are performing poorly, they increase force output or modify their level of effort (Morton, 2009; Pires & Hammond, 2012). Data revealed that deceptive feedback resulted in greater maximum strength scores of the leg press. In contrast, subjects receiving negatively manipulated feedback did not experience a change in performance (Thomas & Renfree, 2010) or decreased performance when the task was perceived to be unachievable (Mauger et al., 2009). Manipulations of T+5 and T+10 resulted in almost identical strength measures, 3.5% above TC, indicating that only minor deception is necessary to elicit significant increases in strength. While the T+15 trial was not significant compared to TC, it still resulted in 1.5% greater strength measures than TC. Teleoanticipation of a known, previously accomplished strength score, may account for the greater strength performance during deceptive test sessions. As subjects attempted maximal loads, they used prior performance endpoints and neural feedback to determine if they could achieve previous levels of performance.

The sensitivity and upper limit of undetectable deceptive feedback with positive performance results in cyclists was a two percent increase in specified power output was required (Stone et al., 2012). This percentage was the smallest worthwhile change in performance for a timed distance trial. Anecdotally, while suspicions of deception were not a part of the research design some subjects reported that they were suspicious of some sort of error or deception, primarily after T+10 and T+15. In agreement with prior strength training studies it appears that upper limit to useful deception, without detection by subjects, appears to be five percent (Micklewright et al., 2010; Wilson et al., 2012).

During the T+10 subjects did perform significantly better than the TC session believed that they had failed to reach their pre-test maximal test load. During the T+15 session the reported scores would have been very low, for instance a 400-pound leg press would have been reported as 340 pounds, which would lead to a belief that they were performing very poorly could explain the decreased effort (Mauger et al., 2009), explaining why the T+15 scores were not significantly different from the control test sessions and were actually below the T+5 and T+10 sessions. During this final test session, TF, subjects were debriefed about the true nature of the study, and learned of the true prior results for each testing sessions. Upon learning of the true nature of the study prior to the final session, TF, all subjects once again showed significantly greater strength scores and surpassed the TC by 5%. due to the realization that their previously believed strength endpoint was

actually much higher than TC and thus, gave them greater confidence to attempt numbers that were on average over 20 pounds the perceived endpoint set in the control session.

Goal Scores

All of the goal scores were significantly different from TC, with T+5, T+10, and T+15 being lower, whereas TF was higher than TC. While the goals set after T+5 were slightly higher than the TC scores, after the deceptive feedback was given for T+10 and T+15 trials subjects reported goal scores that were lower than the TC strength scores. This indicates that as manipulations became greater, subjects began to decrease subsequent lifting goals, each lower than those set after TC. This would lead us to believe that manipulations of 5% or greater could be detrimental to goal setting resulting in lower performance levels. Upon debriefing subjects could ask questions about the deceptive practices of the study and after all questions were answered subjects then completed the final test session (TF) with accurate feedback. This belief that there were errors in the loads support teleoanticipation models of endpoint detection. When subjects receive positive feedback or perceive the feedback as better than performance, this type of feedback seems to have a motivating influence on performance times and exercise intensity (Mauger et al., 2009). Upon learning of the true nature of the study prior to TF all subjects not only outperformed their previous 1RM but also after testing was complete, set goals significantly higher than TC. This indicates that the deception not only increased performance but also increased the subject's perception of what they were capable of performing, essentially aiding in setting a new perceived strength endpoint.

Physical Self-efficacy Scores

While there was a trend toward lower self-efficacy as measured by the PPA subscale (Ryckman et al., 1982), deceptive feedback did not adversely affect physical self-efficacy even though some of the 1RM scores reported to them during the deceptive trials were below the 1RM scores during TC. This may indicate that while subjects believed they were not performing well during deceptive test sessions it did not result in them feeling weak or unable to exhibit high strength measures during the leg press exercise. It may also indicate that the PPA subscale, a measure of general physical ability, is not specific to strength and therefore may not be the best measure of strength self-efficacy.

Strength goals are linked to prior successful performances and the interaction between a lifters prior strength scores impacts how high they might set future goals. When viewed side-by-side the impact of deceptive feedback on goals becomes clear (see figure 4, Deception comparison chart). By using the mean data from reported 1RM leg press scores the average feedback scores are shown in the middle column of table four, along with the respective goal scores after each session. It becomes clear that the goal scores after the control session were above the 1RM scores but, once deceptive feedback was given, which was below the prior 1RM control score, goal scores were lowered to levels at or below the original 1RM. After subjects were debriefed on the true nature of the study, and given all accurate information for each test sessions, they became aware that they were actually capable of strength scores above their prior belief. Once lifters see their higher than expected performances, while under deceptive feedback manipulations, they actually scored slightly better than all previous 1RM scores

Table 2. Deception Comparison Effectds on Strength, Goals, and Self-Efficcy, for the 1 RM Leg Press

Feedback Protocol	1RM Leg Press Scores	Mean deceptive feedback	Goal Scores	Self-efficacy Scores
Control Session (TC)	190.37 kg	190.37 kg	197.05 kg	34.4
5% deceptive feedback (T+5)	197.72 kg	187.83 kg	191.19 kg	32.9
10% deceptive feedback (T+10)	197.31 kg	187.44 kg	185.43 kg	33.6
15% deceptive feedback (T+15)	192.91 kg	183.26 kg	183.71 kg	33.1
Truthful feedback session (TF)	200.12 kg	200.12	201.72 kg	32.6

but, within 2-3 kilos of their known 1 RM scores from prior test sessions, supporting the concept of teleonticipation influence on strength performance.

While the data clearly demonstrates some statistically significant findings in favor of deceptive feedback there are some potential negative consequences to the misinformation received by subjects. One obvious concern could be a decrease in the level of trust and confidence in a coach or trainer who offers false feedback. The recording of goal scores and self-efficacy in the present study, especially based upon the TF session, was partially intended to indirectly explore the impact of deception. Results indicated no impact upon self-efficacy, goal scores actually were significantly different from the control session. This may indicate that there is no personal impact when deception is revealed, and consequences of the deception were actually not detrimental. While the exact impact upon trust between the lifter and coach has not been explored related to lifting or strength tasks it would be interesting to explore in future research.

Also of interest is the seemingly conflicting data that shows no clear connection of self-efficacy to goal scores. It would make logical sense that as perceptions of strength diminished, due to the false feedback, that physical self-efficacy would lower in parallel to strength goals. One possible explanation for this discrepancy may lie in the nature of the physical self-efficacy scale (PSES; Ryckman et al., 1982,) which is not specific to strength but rather addresses overall physical self-efficacy.

PRACTICAL APPLICATIONS

Deception of athletic performance during practice, such as altering the pace time of a trial run without the athlete's knowledge, may alter the way the athlete thinks before, during, and after their performance. When athletes reach plateaus in training or competition, some coaches may intentionally increase training intensities, unbeknownst to the athletes, with the goal of eliciting greater performances than the athlete expects to achieve. If the coach or trainer then reveals the deception it may result in the athlete gaining confidence and then setting higher goals for future workouts or competitions.

These data suggest that while deception during training may significantly increase 1RM measures without any significant effect on physical self-efficacy, goal setting may reflect decreasing self-expectations. It appears that the 5% deceptive feedback manipulation had the greatest effect on 1RM scores with the least negative impact on 1 RM goals. Based upon the current study the high level of performance, in spite of lower goals, reinforces previous literature that states that the complex nature of performance is only partially explained by self-efficacy (Feltz et al. 2008, Moritz et al. 2000). Further research is needed to more fully understand the motivational factors that allowed participants to perform so well, in spite of no change in self-efficacy while in conjunction with lower goal setting scores.

The greater the percent of deceptive feedback given to the subject, the lower the goals for future performances. For practical purposes, small manipulations may be warranted if an athlete appears to have hit a plateau in training even if their expectations of performance do not match their physical potential. Deceptions of 10 % or more show no measurable advantages over 5% of deception. Also, deception with loads that surpass 5% are shown to not only be unnecessary for strength performance enhancement but could also lead to an increased risk of injury. While it has been shown that the muscle-tendon strength far exceeds 15% overloads (Hirsch, 1974). Interestingly, once an individual who has undergone deceptive manipulation learns of the deception and actual performance, they may not only outperform their previous measures but also set even higher goals for subsequent trials. A potential negative consequence of any form of misinformation or deceptive feedback could be a loss of trust between the coach and athlete. To avoid any loss of trust or confidence between the coach and athletes the intent of the deception should be fully disclosed and explained to athletes so they can understand the purpose. If applied properly, ethically, and with the intent of eliminating perceived strength plateaus, it appears that false positive feedback may be an effective psychological method for enhancing maximal strength performance.

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