Original Research

Poor Quality of Instruction Leads to Poor Motor Performance Regardless of Internal or External Focus of Attention

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ABSTRACT

International Journal of Exercise Science 9(2): 214-222, 2016. The view that external focus of attention provides beneficial performance outcomes when compared to an internal focus of attention has been consistently supported in the movement performance literature. While *type* of focus has been well investigated, the current study examined the influence of *quality* of instruction as a variation of the type of focus. Specifically, the purpose of the study investigated how performance-enhancing instructions would differ from performance-neutral instructions on an agility performance. An agility L-run was used to measure performance in the four counterbalanced conditions: Internal-Performance Neutral (INT-PN), Internal-Performance Enhancing (INT-PE), External-Performance Neutral (EXT-PN) and External-Performance Enhancing (EXT-PE). These conditions were designed to provide insight into the influence of quality of instruction on performance. The mean times for both EXT-PN (6.76 s) and INT-PN (6.86 s) conditions were significantly slower than the EXT-PE (6.59 s) and INT-PE (6.65 s) conditions, respectively. Additionally, no differences were observed between the EXT-PE and INT-PE conditions. These results demonstrate the negative impact that poor quality of instruction can have on performance.

KEY WORDS: Motor learning, sport Performance, coaching communication

INTRODUCTION

In sport and exercise settings, instruction is commonly given to help learners enhance performance. A factor to consider when selecting the most meaningful instruction includes how instruction may focus a learner's attention. In general, attention can be focused on either internal or external factors. An internal focus of attention is characterized by the learner focusing on specific body parts or the components of movements of those body parts that contribute to performance. In contrast, an external focus of attention is characterized by paying attention to the outcome of the movement as it relates to the external environment (15). Using a variety of performance conditions, numerous studies have assessed performance differences between internal and external focus of attention (6, 9, 18, 19, 20, 21). Results from these studies have consistently reported superior performance when learners focus on external rather than internal factors.

A better movement performance under conditions of external focus of attention has been explained through the Common Coding Theory (CCT) and the Constrained-Action Hypothesis (CAH). The common Coding Theory suggests that most optimal movements are autonomic processes that have been learned and programmed through an integration of both afferent and efferent processes. The CAH is essentially a derivative of the CCT and holds that more effective motor action occurs as the cognitive load of the performance diminishes. As such, more optimal performance occurs when instruction is designed to reinforce the specific autonomous components of the actions, responses or movements. Instructions that direct a focus of attention on external factors do not alter cognitive components of movement while an internal focus may (5, 11, 16). Thus, instructions that prompt an internal focus of attention are believed to interfere with the efficiency and effectiveness of a movement, by adding an additional cognitive load that interferes with the automaticity of the performance (17, 18, 20).

Although evidence supports that an external focus can enhance movement performance in comparison to an internal focus, other factors contribute to the degree that a focus affects performance. For instance, the complexity of the task as well as the learner's skill level in performing the task may influence the amount to which a given focus of attention will affect performance (7, 8).

One factor that may contribute to movement performance is the type focusing instruction given. When subjects were instructed to focus on different external factors of a putting task, different outcomes on performance were observed (12). While no differences were observed in the two single focus conditions (target and club swing) a performance difference was observed in the combined condition. These results appear to be in contrast to the expected outcomes based on the CAH whereby a focus on external factors of any kind should yield an improvement in performance.

Another example of how instructional quality can affect performance was provided by Wulf et al. (21) who observed that participants achieved a higher vertical jump when instructed to "focus on the rungs" (external focus) of the VertecTM apparatus than when instructed to "focus on their fingertips" (internal focus). In this instance the instruction that is apparently meaningless, "focus on their fingertips" may be confounding because it is unrelated to vertical jumping (8). Thus, the differences in jumping performance may have been due to the degree of meaningfulness of the instructions instead of differences related to an external or an internal focus of attention. Based on these findings it is apparent that quality of instruction is an important factor in whether a focus will enhance, inhibit or have neutral impact on performance.

The impact of quality of instruction can also be observed in a study by Porter et al. (9) in which subjects completed an agility "L" run. Subjects displayed faster running times when they were instructed to "focus on pushing off the ground as forcefully as possible" (external focus) compared to when instructed to "focus on planting your foot as firmly as possible" (internal focus). Although both sets of instructions were intended to facilitate the performance of the agility run, it is possible that the language of

the instructions for the internal focus condition may have negatively impacted movement performance. Whereby "planting your foot" may have been perceived to mean that their foot should be made stationary or non-moving. This compares to the dynamic interpretation of "pushing-off". These differences in interpretation may provide an alternative explanation for the observed changes in performance (8). The reported negative effects on performance of the internal focus may not be the result of the added cognitive costs. Instead the reduction in performance may be due the negative action suggested by the instruction.
From this review, it can be implied that the differences in movement performance following instruction may be the result of factors other than directing an internal or external focus of attention per se. Other instructional factors contributing to altering performance may include the context, word choice, and meaningfulness of the instruction in regards to the movement task; i.e. quality of instruction.

The purpose of this study was to investigate whether poor quality of instruction in relation to focus of attention could negatively impact movement performance. Instructional quality was offered in two divergent dimensions, performance–enhancing and performance-neutral, in the two directions of focus, external and internal. We hypothesized that movement performance can be negatively impacted by poor quality of instruction regardless of the intended focus of attention type (external or internal). Through such an investigation we hope to provide practitioners with a more robust understanding of how to influence performance through appropriate instruction.

METHODS

Participants
The university institutional review board approved all experimental procedures prior to data collection. The study utilized two different assessments with two separate groups of participants. The first group completed multiple trials of an agility L-run after being given five different types of instructions on separate days. The second group was surveyed on their opinion as to the "performance-enhancing quality" of the language of the five different instructional conditions.

Members of the survey group consisted of undergraduate Physical Education students (N=45) who were highly knowledgeable of the different aspects of fitness and human performance however, none were members in any form of organized athletics and had not recently participated in any agility training.

Members of the agility run group (N=11) consisted of physically active undergraduate Physical Education students (n=6 males, n=5 females; Mean age 23.3 years, s = 5.2 years) who were recruited through a voluntary signup sheet to participate in this study. Participants were not currently involved in any form of organized athletics and had not recently participated in any agility training. Additionally, all participants confirmed they had not previously taken part in the specific speed and agility task to be used in this study. As their previous experience was limited, participants were considered novices for agility performance. All subjects reviewed and signed a consent form after the experimental protocol and the risks and benefits were explained.

The task used was the agility "L" run and consisted of two 5-meter sections connected at a right angle with a left turn to make an "L" shape (Figure 1). Previous studies have confirmed the validity and reliability of this test as being an accurate measure of agility (2, 3, 13). This test was selected because of its' previous use in focus of attention research (9). In addition, its low level of complexity made it possible to observe the impact of instructional quality on performance in non-skilled participants. Movement time was measured using a Farmtek Inc. wireless electric timing system (Polaris timing console and two pairs of electronic eyes). To capture total run time for each trial the electronic eyes were located at the start/finish line. Movement time (seconds) was measured from the moment the subjects broke the infrared beam at the start line until they broke the finish line beam. Movement times were directly uploaded into a spreadsheet for data analysis.

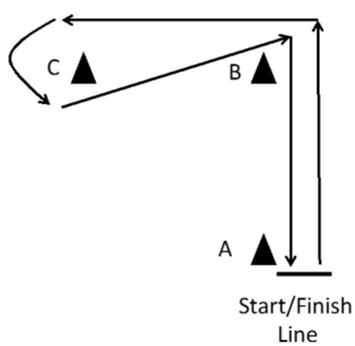

Figure 1. Agility "L" Test. Participant begins at the start line beside cone A. Run toward cone B, pivot around cone toward cone C. Run around cone C and then run back toward cone B. Pivot around Cone B and run past cone A (finish line).

Five different agility "L" run instructions were created for each of the 5 conditions: a control condition and 4 experimental conditions. The instructions given for the control condition were intended only to provide specific instruction on how to complete the task. The experimental conditions included the "control" instructions, as well as additional specific instructions to reflect the intention of each condition. Validity for the instructions relied on previous study by Porter et. al. (9) whom used the same control and EXT-PE conditions. To gain face validity of the additional 3 conditions in relation to the control and EXT-PE a survey was given to a separate group of participants to rate the perceived quality of each instructional condition.

The instruction for the Control (CON) condition was not intended to affect performance. Additional instructions were designed to produce an internal focus (INT) or an external focus (EXT) with the quality of instruction manipulated to have either a performance enhancing (PE) or performance neutral (PN) influence: External Focus Performance Enhancing (EXT-PE), External Focus Performance Neutral (EXT-PN), Internal Focus Performance Enhancing (INT-PE) and Internal Focus Performance Neutral (INT-PN). Instructions for the control (CON) condition were "Run through the course as quickly as you can with maximum effort". In addition to the control instructions the four focusing instructions were also given. The EXT-PE instructions were "Focus on running towards each cone as fast as possible while pushing off the ground as powerfully as possible throughout the course". The EXT-PN instructions were "Focus on running the shortest path while minimizing air resistance throughout the course". The INT-PE instructions were "Focus on contracting your leg muscles as forcefully and rapidly as possible throughout the course". Finally, the INT-PN instructions were to "Focus on keeping your head as relaxed as possible throughout the course".

The running participants were randomly assigned to one of four counterbalanced trial orders to control for any order effects. All trials in the control condition were completed on day one to prevent any influence from the other experimental conditions.

Protocol

On each testing day the participants arrived at the gymnasium and completed a standardized warm up procedure that included short bouts of jogging and stretching. After the warm up and a brief 10-minute rest period, participants were shown a diagram of the course (Figure 1). Then the principle investigator read the instructions for the condition to be performed that day. To confirm that the instructions were heard the participants were asked to repeat the instructions to the investigator. The process of hearing and verbally repeating the instructions was done until the subject could state the instructions accurately. Once the instructions were accurately repeated the subject would then line up to start the trial. Five trials were performed for each instructional condition, which included a 5-minute rest between each trial. Movement times (in seconds) for the agility run were recorded for five trials in each of the five conditions of instruction. Five trials were performed for each condition to be consistent with previous literature (Porter, 2010) to demonstrate that performance in each condition was consistent across trials. Trials were performed in the same location at approximately the same time with at least 48 hours between each of the different experimental conditions to minimize fatigue as a confounding factor.

Participants in the survey group were asked to read each of the five sets of instructions and to rank them from one to five in terms of overall helpfulness. Specifically, they were asked to "evaluate the ability of the instructions to enhance performance on an agility "L" run".

Statistical Analysis

These values were analyzed using a two-way 5 (instruction) x 5 (trial) repeated measures (within subjects) analysis of variance (ANOVA) with IBM SPSS Statistics software version 20. Mauchly's test of sphericity was used to document that the assumption of sphericity was not violated. Paired t-tests with a Bonferroni adjustment were used to locate the source of difference where a significant *F* was observed. The responses for the quality of instruction from the survey group were ordered in terms of the mean rank given for each by the 45 participants.

RESULTS

The rank order for the quality of instruction, by the survey group, from greatest (score of 1) ability to enhance performance to poorest (score of 5) ability to enhance performance: EXT-PE (Mean = 2.0) < CON (Mean = 2.3) < EXT-PN (Mean = 3.0) < INT-PE (Mean = 3.8) < INT-PN (Mean = 3.9); indicating that instructions that were designed to produce an external focus were ranked as better able to enhance performance (quality) versus those designed to produce an internal focus. In addition, the PE instructions also were consistently ranked as being better quality for enhancing performance than the PN instructions.

Results of Mauchly's test of sphericity revealed that the assumption of sphericity was not violated (p > 0.05), a two-way 5 (instruction) x 5 (trial) repeated measures analysis of variance (ANOVA) was then used to analyze the data. Significant differences were observed for instruction main effect ($F_{(4,\ 40)}$ = 5.304, p=0.002) , indicating differences in performance between instruction conditions (Figure 2). To identify which instructional conditions differed, pairwise multiple t-tests with a Bonferroni correction revealed that, as expected from previous literature (11, 16), the INT-PN condition was significantly slower than the EXT-PE condition (p = 0.028). Interestingly, the EXT-PN condition was also significantly slower than the EXT-PE condition (p = 0.015) and in a similar manner the INT-PN condition was significantly slower than the INT-PE condition (p = 0.005). Contrary to previous research (5, 11, 16), no significant differences were observed between the EXT-PE and INT-PE conditions. As expected, no significant differences were observed for the within group comparisons for the main effect of trial ($F_{(4,\ 40)}$ = 1.737, p=0.207) indicating consistent performance for the subjects within each condition. The interaction between instruction and trial was also non-significant ($F_{(16, 160)}$ = 1.081, p=0.380) indicating that the influence of instructions on performance was consistent across trials.

Means scores (time) for the instructional conditions from fastest to slowest were as follows (see Figure 2): EXT-PE (Mean = 6.59 s, SEM = 0.241), INT-PE (Mean = 6.65 s, SEM = 0.235), CON (6.69s SEM = 0.263), EXT-PN (Mean = 6.76, SEM = 0.253), and INT-PN (Mean = 6.86, SEM = 0.780).

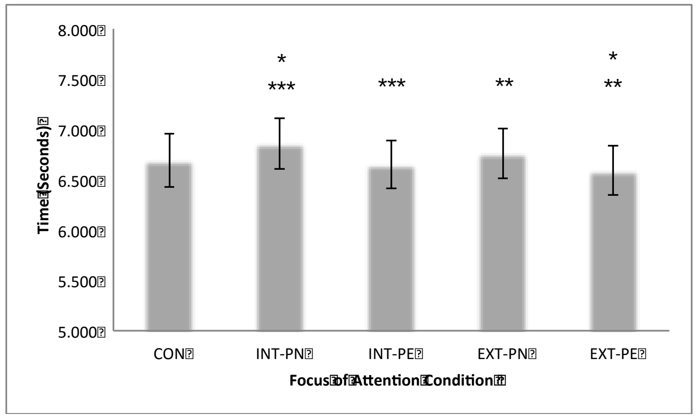

Figure 2. Mean and Standard Error of the Mean under Control, Internal-Erroneous (INT-E), Internal-Performance (INT-P), External-Erroneous (EXT-E), External-Performance (EXT-P) Conditions. Significant differences found: * p = 0.028 INT- PN vs EXT-PE; ** p = 0.015 EXT-PN vs EXT-PE; *** p = 0.005 INT-PN vs INT-PE.

DISCUSSION

The CCT and CAH contend that as the cognitive load during performance of a movement increases, the effectiveness of the movement will decline (11, 16). In this view, focusing on internal factors of a performance can produce an additional cognitive load for the subject while performing the task, an internal focus has been shown to result in a poorer movement performance (6, 9, 16, 18, 19). The results from this study however, do not completely support this concept. In general, poor quality instructions resulted in poorer performance regardless of the direction of focus, while no differences were observed between instructions with different directions of focus but with equal quality of instruction.

These results indicate that the quality of the language used in the instructions is an important component of whether the direction of focus will enhance or hinder performance. A relatively large group of knowledgeable subjects independently ranked the instructions in terms of their ability to produce a focus that should enhance performance. Based on the responses they believed that the EXT-PE and INT-PE instructions might positively influence running performance in comparison to the EXT-PN and INT-PN instructions, respectively. Thus the PE instructions were consistently viewed as being of higher quality in terms of their ability to positively influence performance. Interestingly, they also believed that the EXT-PE and EXT-PN instructions offered a better quality of instruction than the INT-PE and INT-PN. This last belief may be due to the fact that the students had previous knowledge of the focus of attention effect from a course in motor behavior. If the same survey was given to students lacking knowledge about this concept it would be hypothesized that they would instead choose both the EXT-PE and INT-PE instructions as the most helpful because they more clearly identify the task objectives. The actual impact these instructions had on the running performances in this experiment was similar to these ratings, although it did not match exactly the ratings of perceived quality. The fastest run times were associated with the performance-enhancing instruction for both conditions (EXT-PE & INT-PE) while the slowest times were associated with the performance-neutralizing instruction for both conditions (EXT-PN and INT-PN). Recognizing that the fastest run times occurred under both EXT and INT performance-enhancing conditions and the slowest run times occurred under both EXT and INT performance-neutralizing conditions it is apparent that the quality of instruction may be more important as the direction of focus.

The observed difference that occurred in the run times between the EXT-PE and INT-PN conditions would be expected because as explained by CAH, an internal focus of attention may cause an additional cognitive load and contribute to a reduced run time. This would not however, explain the significant difference in performance between the EXT-PE and EXT-PN conditions where no additional cognitive load exists. Similarly, instructions that were perceived to be performance-neutral and that induced a focus on an internal factor (INT-PN) resulted in a poorer performance than instructions that were perceived to be enhancing yet still induced an internal focus (INT-PE). These observations provide evidence that performance-neutralizing instruction will negatively impact performance regardless of the direction of focus.

Our findings are consistent with the view held by Hodges and Franks (4) who posit that explicit directions are more effective at enhancing performance than vague instructions. When instructions are aligned with the movement goal more optimal performances result (8) while instructions that are confounding or not aligned with the learner’s views result in a decrease in performance (1, 14).

At the elite level Porter, Wu, and Partridge (10) found that track and field coaches provide instructions that encouraged an internal focus of attention and the athletes themselves also utilized an internal focus during competition. Interestingly, Wulf et al. (21) also noted that a significant change in the wording of instructions might have a significant impact on the performance of those skills. These insights provide practical evidence that the content and context of instruction is as important as the focus of attention they promote.

Teachers and coaches can apply these findings by taking into consideration both focus of attention and quality of instructional cues to facilitate individual performances. For example, when instructing soccer kicking it is common practice for coaches to say something in the vein of "kick the ball as hard as you can". This externally focused instruction could be enhanced with a more performance-oriented quality, such as "kick the center of the ball with as much force as you can" as this will inevitably enhance the quality of the ball contact and hence movement performance. Furthermore, for the novice kicker an internal focus of attention instruction could also be beneficial if the coach ensures a performance-oriented quality of instruction. Instructions such as "swing your leg in a smooth path towards the center of the ball". By using more performance-based instruction teachers and coaches can provide more meaningful and appropriate information to enhance individual performance. In particular, when assisting learners with skill acquisition, it may be important to maximize instructional offerings. Such considerations could include the learner's skill level, context of the task, usefulness of terms, comprehension level of leaner, and clarity of instruction. Future research in this area could be centered on specific sports or athletes as well as their skill level while learning new sports skills. Such insights may provide broader understandings of how wording and phrasing may be used by educators and coaches to enhance performance in both learning and competitive situations.

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