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RESEARCH ARTICLE

External Attention Focusing is Embodiment: Evidence from Closed Eyes during Performance

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Abstract

The investigation in this study revealed that external attention is the most significant factor in explaining the phenomenon of embodiment, which connects the mind, body, and environment. To test this hypothesis, the research sample included 21 students who participated in two tests. The first test involved drawing a straight line on a board with eyes closed. The second test required participants to kick a ball with their eyes closed during execution. In the context of external attention, participants were instructed to focus on the target, while internal attention required them to concentrate on technique and the path of body movement. The results favored external attention, indicating a clear preference for this approach. Consequently, the research question was answered, confirming that external attention is a phenomenon of embodiment in performance, with an emphasis on not retaining the skill. This finding can be applied in various fields, such as robotics and sports.

Keywords: Embodiment, External attention, Blind action, Motor control, Performance

1. Introduction

Attention plays a significant role in our general lives and particularly in the field of sports. It is a crucial factor in achieving results. Attention, in general, is divided into two types: external attention, which focuses on the performance goal, and internal attention, which focuses on the movement path or performance technique [1, 4, 6, 7, 16]. Many studies have shown that external attention is better than internal attention, but the interpretation varies according to the theoretical framework of the study. In this study, we assume that external attention is essentially a phenomenon of embodiment that connects the brain, body, and environment, which is fundamentally the goal [10, 17, 18]. Therefore, in this study, we pose the question: Are the body parts included according to external attention, or only in certain parts of the body, especially considering there are multiple skills in the field of sports and general life? Embodiment phenomena or theory relate to the idea that our cognitive processes are deeply rooted in the body's interactions with the environment. In sports, external attention focusing on external stimuli like opponents or the ball helps in synchronizing bodily movements and actions, enhancing performance by making the athlete's actions more fluid and responsive [3, 5, 8, 9, 14]. Research question: Is external attention the same as embodiment? For all parts of the body or just some parts? If it applies to all body parts, this means that external attention is the tool or the apparent face of embodiment. In other words, if the results are correct, the phenomenon of embodiment is external attention [11–13, 15, 19].

2. Method

2.1. Participants

Twenty-one students (ages 19–23) participated in this experiment. They met all volunteer screening requirements and provided informed consent, which was approved by the School of Psychology Ethics Committee at Plymouth University. Participants were compensated at a rate of £4 per half hour or received course credits. All participants reported being in

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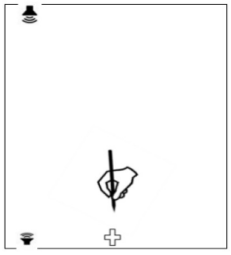

Fig. 1. Illustration of the task (graphic tablet).
Note. Participants began drawing from the landmark (+) to the top of the tablet screen upon hearing the starting sound and stopped when a sound indicated they had reached the top.

good health, with no history of disease, and were not undergoing any medical treatment that could affect motor or visuomotor functions. Two participants were excluded from the data analysis because they could not perform the task correctly (see Results). A sensitivity analysis using G*Power indicated that the final sample size of 21 provided 80% power to detect effects with $d > 0.66$. Previous research on similar within-participant manipulations has reported effect sizes within this range.

2.2. Material and apparatus

A standard PC controlled the experiment. Stimulus presentation and data recording were conducted using a custom program connected to an A4-sized Wacom Graphics Tablet running version 0.5.0.0. The tablet featured two landmarks, including a centrally placed cross at the lower end of the screen to indicate the starting point (see Fig. 1). A 1331 Hz sine wave sound lasting 100 ms, played through an external loudspeaker system, served as the auditory start and end signal for each trial. a centrally placed cross at the bottom of the screen that indicated the starting point (see Fig. 1). Each trial began and ended with a 100 ms sine wave sound at 1331 Hz, which was played through an external loudspeaker system.

2.3. Procedure and design

There are two tests one for hands and second one for foot, the first test participant did graphics tablet and second test participant did kick ball. In the first test, each participant was seated in a dimly lit room and instructed to draw straight lines on a graphics tablet (from bottom to top) with their eyes closed. There was a total of 40 trials, which took 30 minutes to complete. The trials were divided into two blocks of 20 trials each for the two different conditions (external focus, internal focus), with the order counterbalanced across participants using a Latin-square design to avoid order effects. While within-participant designs may be subject to carry-over effects, they provide more statistical power by minimizing between-participant variability. Moreover, prior research on action (with eyes open) has shown that manipulations of attentional focus are strong enough to overcome such differences. In fact, within-participant designs are standard for investigating the effects of attentional focus on motor control rather than learning. At the start of each block, participants received instructions for the specific condition. In the external focus of attention condition, participants were instructed to imagine the target while drawing a straight line towards it. They were told to concentrate on an imagined smiley face at the top of the tablet and to move the pen towards it in a straight line. Participants were asked to visualize the position of the pen relative to the target and to correct any imagined deviations from a straight trajectory toward the target. In the internal focus of attention condition, participants were directed to mentally focus on their fingers holding the pen and to imagine drawing a straight line without visualizing a target. They were encouraged to feel where their hand was on the board and to maintain a fixed straight-line trajectory. At the beginning of each trial, participants received brief reminders of the instructions for the block they were performing. Once the experimenter confirmed that participants understood the task, they were instructed to place their pen in the starting position (see Fig. 1) and close their eyes. After a few seconds, they heard a signal to start drawing. They drew until they reached the upper end of the graphics tablet, at which point they heard the signal again. Participants were asked to draw the line at a normal, unhurried speed, taking between 10 and 20 seconds. They were informed that trials would be invalid if they took less than 10 seconds or more than 20 seconds to complete the drawing. The blind drawing performance of each participant was assessed using deviance scores, which indicated the deviation from an ideal straight line between the start and end points on the graphics tablet, as shown in Fig. 1. To measure deviance, each participant's line drawing was marked at 40 equidistant points along the start-end point axis, and the average horizontal distance at each of these points between the straight line and the pen's position was recorded. Negative values indicated deviation to the left, while positive values indicated deviation to the right. A participant's overall deviance score for this task was the sum of the absolute difference scores in each bin, with horizontal deviance measured in millimeters (left: −ve, right: +ve) from the start position to the endpoint. In the second test, each participant has ten attempts to kick the ball into a goal measuring one meter from five meters.

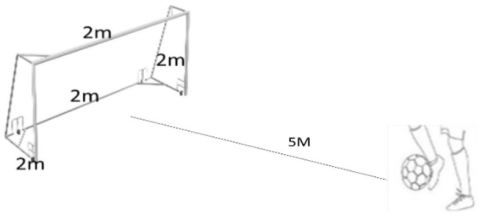

Fig. 2. Illustration of the task (kicking ball).

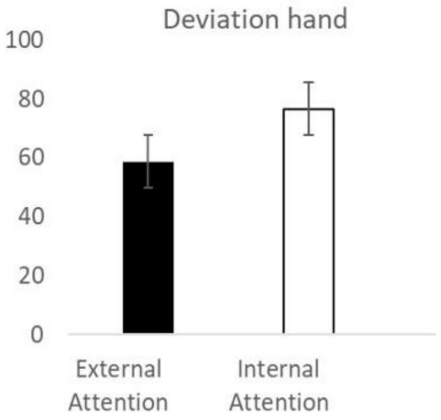

Fig. 3. Illustrates the deviation of hand.

The instructor asks the participant to close their eyes when kicking the ball. For the first ten attempts, the participant is asked to focus on the target, and for the next ten attempts, the participant is asked to focus on the performance or technique. Thus, the total number of attempts for both external attention and internal attention is twenty, as shown in Fig. 2.

3. Results

The results of the experiment on the graphic tablet for hand and kicking a ball for foot calculated external attention and internal attention-based deviation of the hand and score of kicking the ball. $t(20) = 3.1$, $p < 0.005$, $d = -0.63$, indicating highly significant results, while the results of foot (external and internal attention) was $t(20) = 1.97$, $p > 0.005$, $d = -0.63$, indicating highly significant results, while the results of the foot (external and internal attention) were $t(20) = 1.97$, $p > 0.06$, marginally significant. Also, the correlation between external attention of the foot for both tests, graphic tablet and kicking the ball, is 0.30, indicating a moderate degree, and internal attention for both tests, graphic tablet and kicking the ball, is 0.54, indicating a high degree, according to the degree of correlation (good and strong). For more details, see Figs. 3 and 4.

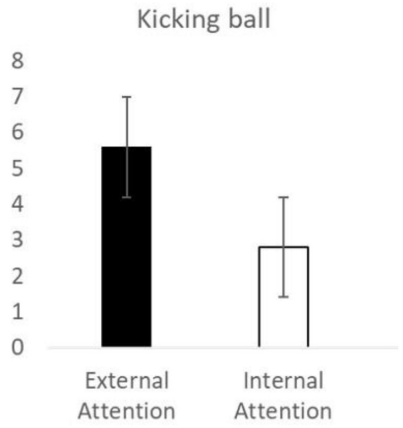

Fig. 4. Illustrates the score of kicking ball.

4. Discussion

The results revealed the vital and effective role of external attention in various parts of the body, whether the hand or foot. External attention, if not the inclusion for performance, scope, and goal, is the mechanism or tool that controls inclusion. On the other hand, according to these results, external attention has been decisively confirmed to have priority in learning, control, and achievement. This is what Gabriel [7, 16, 19] and others have indicated. Embedding in the field of robotics is the fundamental aspect of design, which simulates humans in terms of mind, body, and environment as one unit. There are several hypotheses regarding the phenomenon of embedding. One of them is that embedding is motor or mental imagery, meaning that merely imagining something is an interaction with the surrounding environment. However, according to the hypothesis we present, mental imagery is only a trigger for intention, while external attention is a trigger for will and action. Therefore, external attention is likely the hypothesis that explains the phenomenon of embedding. Based on the results, which showed the extent of deviations during performance within the variable of external attention that focuses on perceiving the target, while internal attention focuses on the hand's movement straight towards the target, the results indicated that the deviation from the straight line in internal attention is greater than in external attention. This provides a very strong indication that external attention is more embodied to performance.

In summary, external attention is the inclusion of action and can be applied in the field of sports in terms of learning, control, and training. Moreover, external attention clearly and explicitly explains the phenomenon of inclusion through the results. This has addressed the research question that external

attention is the phenomenon of inclusion in terms of will and movement.

Ethical approval

Research ethic committee has confirmed that no ethical approval is required. Also, it dose not contain data from any studies with human participant performed by the author.

Conflict of interest

The author declares that no conflict of interest.

Data availability

https://docs.google.com/spreadsheets/d/1hMdug94YUcfHu34OtsvISKlPWk-XBh_H/edit?usp=drive_link&ouid=106002427556274413594&rtpof=true&sd=true.

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