Impact of gaze shift pattern on athletic performance

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Introduction

- Gaze shifts are essential in sports to identify and interpret visual information more efficiently, leading to better decision-making.
- Gaze shift is heavily employed in volleyball for effective blocking of the ball.
- During blocking, when the ball is being passed from the setter to the spiker, the blocker switches gaze from the ball to the player [1].
- Previous studies have shown that gaze behavior crucial for good volleyball performance, but specific gaze shift patterns for success are unclear [1] [2] [3].

Objective

- **Hypothesis** - a longer gaze duration for the ball compared to that for the spiker will increase the likelihood of the ball being blocked.
- The results from this study could be used to develop quiet eye training for volleyball players to enhance sports performance [4].
- Quiet eye refers to the final fixation or gaze on a specific target immediately before executing a movement [4].

Methods

- Participants - Ten college-level female volleyball players with no history of motor or neurological issues

Figure 1: Data collection device – Tobii pro glasses 2.

Figure 2: Gaze trajectory – Event #1: Ⅰ is the start of the trajectory, Event #2: Ⅱ and Ⅲ show the gaze switch from the ball to the player and Event #3: Ⅳ is the end of the trajectory.

- Formulae used to calculate player gaze and ball gaze ratios based on *Figure 2* trajectory:

  1. Whole trajectory (μs)= event #3 time – event #1 time
  2. Gaze at ball (μs) = event #2 time – event #1 time
  3. Gaze at ball ratio (%) = (gaze at ball/whole trajectory) * 100
  4. Gaze at player ratio (%) = 100 – gaze at ball ratio

- The response of the participant wearing the tracker following the entire trajectory was recorded as 1 (success at ball blocking) or 0 (failure at ball blocking).
- T-tests with a 95% confidence interval were used to analyze the data.
- Significance is represented by asterisks (*=p<0.05, **=p<0.01, ***=p<0.001).

Results

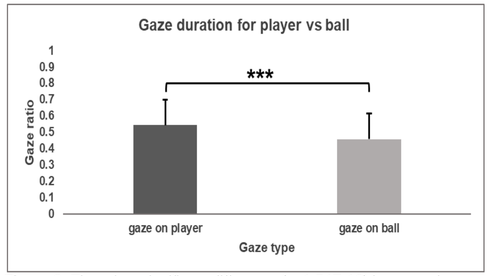

Figure 3: There is a significant difference (p=1.54E-10) between the gaze duration for the players (0.54±0.16) and the gaze duration for the ball (0.46±0.16).

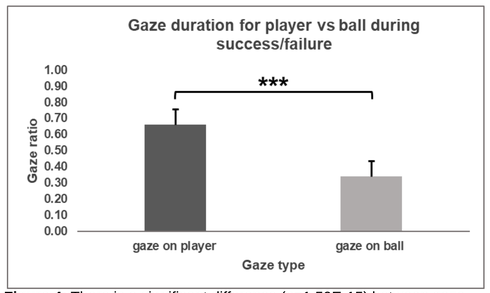

Figure 4: There is a significant difference (p=1.59E-15) between gaze duration for the players (0.66±0.095) versus that for the ball (0.34±0.095) during the events of successful and unsuccessful blocking of the ball.

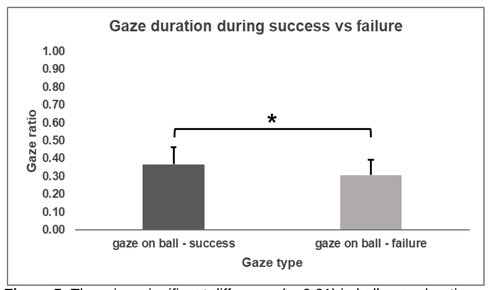

Figure 5: There is a significant difference (p=0.01) in ball gaze duration for successes (0.37±0.09) and failures (0.31±0.08) at ball blocking.

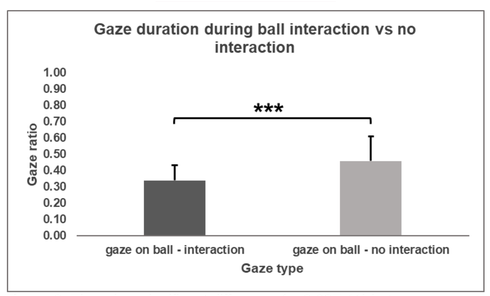

Figure 6: There is a significant difference (p=3.68E-11) between gaze durations on the ball during participant interaction with the ball (0.34±0.095) versus during no ball interaction (0.46±0.15) regardless of blocking success or failure.

Results

- Players look at the ball 46% of the time and at the player 54% of the time. *(Figure 3)*
- When the players are interacting with the ball (blocking successes + failures), the players look at the player 66% of the time and at the ball 34% of the time. *(Figure 4)*
- The players looked at the ball 37% of the time during blocking success compared to 31% during blocking failure. *(Figure 5)*
- The players looked at the ball 34% of the time when they interacted with the ball compared to 46% when they had no interaction, irrespective of blocking success or failure. *(Figure 6)*

Conclusion and Future Direction

- The hypothesis is supported by the results, in that longer gaze time for ball increases the likelihood of the ball being blocked.
- The results show that overall, blockers tend to look at the players for longer duration than the ball - for all the trajectories and for the trajectories where they interacted with the ball.
- However, for all the trajectories the difference in gaze duration between player and ball is minimal (8%), whereas that for the trajectories where they interact with the ball is 32% indicating longer gaze duration on the player when they anticipate interaction.
- Blockers also tend to have a longer gaze duration on players when they anticipate interaction with the ball compared to when there is no ball interaction.
- Based on the above statements, quiet eye training could be used to ensure that volleyball athletes develop longer gaze durations for the ball compared to the player.
- Further studies need to be conducted to get more successes/failures data to better understand the gaze behavior of athletes during the play.
- Specific blocking trajectories also need to be studied to get more conclusive gaze behavior information during blocking.

References

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