Exploring Relationships between Task and Ego Orientation, Free Throws, and Eye Tracking: an Application of Tobii Pro Glasses 2

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Abstract

Sports are a major part of the everyday lives of people living in the United States. Categorizing sports into any type of ball sport, especially basketball, raises the amount of attention given from athletes. A major part of basketball is free throws, which could ultimately win or lose the game for a team. With the significance of basketball, and free throws, the aim of the present study was to analyze the visual strategies prior to a basketball free throw compared to answers from a Task and Ego Orientation in Sport Questionnaire. We analyzed 42 Fort Lewis College students (25±7 years), 10 expert men, 9 expert women, 10 novice men, and 13 novice women, all with a freshman to senior academic standing. Each participant completed 3 pre-participation surveys and 2 post-participation surveys containing information about mindfulness, task and ego orientation, and competitive state anxiety. Along with the surveys each participant also completed 10 free throw shots from the standard basketball free throw line. During each throw the movement of the eyeballs were recorded by the Tobii Pro Glasses 2. Results indicated two statistically significant correlation coefficients with eye fixation frequency and task orientation ($r = .312$, $p = .05$), and eye fixation duration and task orientation ($r = .370$, $p = .019$). The conclusion of this data can be interpreted that participants who are task oriented tend to fixate their eyes more often and longer on the rim. It is important to remember that this area of research has recently come into the spotlight of many coaches and athletes. These results highlight several areas to further investigation regarding eye tracking and free throws including diverse age groups and other ball sports.

Introduction

Sports are a major part of the daily lives of United States citizens. Over eighty-two million people participate in some type of ball sport activity. Of those, twenty-six million play basketball (Woods, 2017). In basketball there is a unique part of the game, free throws. A free throw can potentially win or lose the game for a team. So, how can athletes improve their statistics at the free throw line? Eye tracking is an important step to understanding how this aspect in basketball can be successful. Vision, or eye tracking, can enhance performance both mentally and physically while shooting free throws. It is essential to make certain that the eyes and mind are performing at optimal levels (Brooks & Vickers, 2015). Therefore, it is important to examine eye tracking and free throws in basketball, while relating it to eye movements and the quiet eye, the tracker, goal orientation, while under the influence of rewards.

Current eye tracking technology allows researchers to record and analyze the movements of the eyes when following the motion of an object, reading text, or any other visual stimulus. The eye moves in order to send information to the brain. Once that information gets to the brain it gets processed. The field of view in a human is close to 135 by 220 degrees, and has three main regions consisting of the foveal, parafoveal, and peripheral (Tobii, 2015). The foveal region only accounts for one percent of the visual field, but sends 10 percent of the information that gets sent to the brain to get processed (Tobii, 2015). When humans focus on a certain point, the foveal region of the field of view is placed on the top of the object or point. When the foveal region gets focused, it allows the brain to get the best possible resolution of that object or point that is being focused on (Tobii, 2015). When shooting a free throw in basketball, every person has a spot on the hoop or rim that they focus on. This allows the eyes to focus, and gives the

brain of the shooter the best picture with the highest resolution, which could result in making the shot. Right before taking the shot, the quiet eye comes into the spotlight.The quiet eye is the final fixation on a certain location, which plays a role in getting a high-quality image to the brain for processing (Klostermann & Hossner, 2018). Eye tracking is critical to this study because it helps get an idea of where people focus their eyes when shooting a free throw.

The eye tracker that is used for the research is called the Tobii Pro Glasses 2. These glasses were invented in 2001 by three Swedish entrepreneurs, John Elvesjö, Mårten Skogö, and Henrik Eskilsson. These researchers recognized the importance captured by their eye tracking system which provided guidance in many different disciplines. Their business has since grown to over 1,000 talented Tobiians since their start-up and continue to transform industries and lives with the help of humanized technology (Tobii, 2015). This humanized technology can also be used in sports like basketball to inspect the eye tracking of athletes at the free throw line. There is evidence of supreme quality data with two cameras for each eye, minimized gaze data lost, a large percentage of tracking the population regardless of eye color or shape, and robust pupil size estimation (Tobii, 2015). The eye tracker collects data from a first-person perspective.

The first-person perspective makes it easier for researchers to observe natural gaze behavior. The natural gaze behavior is a fixated gaze on a location in the targeting environment or a shift in gaze from one environmental location to another (Brooks & Vickers, 2015). The results depend on reliable data when looking at a target in the environment, which is the rim or hoop for free throws. Along with being physically focused on the hoop, it is also important to be aware of the emotional focus, or goal orientations, of shooting a free throw.

According to the achievement goal theory (Nicholls, 1989), individuals can construe two aspects of goal orientation in sports, which are defined as task and ego orientation. Individuals who are task oriented feel most successful when their self-improvement, personal best effort, and skill mastery are accomplished (Duda & Nicholls, 1992). On the other hand, those who are ego oriented define their success when they have the best statistics and status when compared to others/opponents (Duda & Nicholls, 1992). In basketball, free throws lean more towards statistics in order to evaluate success. This makes it easier for the ego oriented individuals to get their satisfaction or dissatisfaction in numbers and being the best (Jagacinski & Strickland, 2001). Current research shows a lot of focus on eye tracking and topics relating to everyday functions.

In current studies, there are still gaps in the research to be filled. There have been studies of eye tracking in sports like: handball, golf, judo, race car driving, baseball, and figure skating (Garcia, Munoz, Grande, Almenara, & Sampedro, 2013). Although there has been some research with eye tracking and basketball, there has not been much specific to free throws (Rienhoff, Fischer, Strauss, Baker, & Schorer, 2015) with a presence of monetary reward. Since basketball is a popular sport, and free throws are such a critical part of the game, it is important to research this aspect, and help athletes succeed at the line.

Thus, the purpose of this study is to look through the lens of eye tracking and free throws, and whether it can affect or deter task and ego orientations. It is hypothesized that the greater the eye focuses on the basket the more ego oriented the participant will be, because there will be a greater determination for the reward.

Methods

Participants

Forty participants were recruited by emails and flyers from Fort Lewis College in the southwest region of Colorado. The student participants, who were separated into four different classes, differed in age, race, and years in college (freshman 19%, sophomore 19%, junior 33%, senior 29%). Class one was categorized as an expert group, which was made up of 10 student-athletes from the Division II Men's Basketball Team at FLC (age 21±2, race= White 60%, Black or African American 30%, Hispanic/Latino 10%). Class two was categorized as an expert group, which was made up of 9 student-athletes from the Division II Women's Basketball Team (age 25±7, race= White 56%, Native American 11%, Hispanic/Latino 11%, American Indian or Alaskan Native 11%, Other 11%). Class three was categorized as a novice group, which was made up of 10 male students from FLC (age 25±7, race= White 50%, Native American 20% Black or African American 10%, American Indian or Alaskan Native 20%). Class four was categorized as a novice group, which was made up of 10 female students from FLC (age 21±2, race= White 70%, Native American 23%, Hispanic/Latino 7%). The top 3 performers in each class will be put on a leaderboard. In addition, permission to conduct the study was obtained from the Institutional Review Board (IRB) at the researchers' college.

In order to complete this study the researchers followed a specific timeline. First, emails and flyers were sent out to recruit participants. Then, participants responded with a yes or no of their willingness to participate in the study. After all participants were gathered, the researchers split everyone up into the four classes as previously stated. Separate meetings were scheduled at Whalen Gymnasium to perform each task in the study, surveys and shooting free throws. Once

all participants completed the study the researchers determined the top three scorers in each class. Finally, the results were established along with conclusions that were made.

Procedures

To analyze the visual strategy of the free throw shooters they were asked to come into the Whalen Gymnasium one at a time to perform the task. Once in the gym the individual was asked to complete paperwork, which included consent documentation, demographics, and pre-participation surveys. The pre-participation surveys headlined mindfulness and task/ego orientation. The mindfulness survey, which included five questions, was set up on a six point scale (0= not at all, 3=somewhat, 6= very much). Sample questions from this survey include: I was doing something without paying attention, I was preoccupied with the future or the past, and I was finding it difficult to stay focused on what was happening.

The task/ego orientation survey was obtained from *The Journal of Educational Psychology* (Duda & Nicholls, 1992). This survey was on a five point scale (1= strongly disagree, 5= strongly agree). Sample questions from this survey include: I learn something that is fun to do, a skill I learn really feels right, and I am the best. After the completion of the paperwork, the participant was asked to put on the Tobii Pro Glasses 2 (eye glasses), which will measure eye fixation. This is when the tracking software was started by the researchers.

Then, they had three minutes to complete a warm-up of their choosing, without a basketball. Once the three minutes was fulfilled, they had two practice shots from the free throw line. Male participants received a Wilson brand men's basketball (29.5 in. circumference), while female participants received a Wilson brand women’s basketball (28.5 in. circumference). After the two shots, the student went straight into taking ten free throws in a row. One researcher

helped retrieve the ball after every shot, one researcher managed the computer software, and one researcher tallied each successful shot attempt. After ten attempted free throws, the participants took the glasses off, this is when the software was halted by the researchers.

The final step included the participant completing the post-participation survey. This survey mirrored the task/ego survey given at the pre-participation stage. The survey included thirteen questions on a five point scale (1= strongly disagree, 5= strongly agree). Some sample questions from this survey include: I am the only one who can do a skill, others can't do as well as me, and I work really hard.

Then the student participant was released. The leaderboard was updated after every participant. After all the participants completed the study the researchers determined who was in the top three of each class. If there was one participant who had the most successful attempts they were first place on the leaderboard. However, if there was a tie among the top three, the names of those students were put in a basket for a drawing. The individual or individuals, whose names were drawn by the researchers, was put onto the leaderboard.

Data Analysis

This investigation followed a descriptive quantitative methodology. The descriptive statistical analysis outputted minimums, maximums, means, and standard deviations for each of the four classes. The standard deviation values that are closer to the mean imply less variation within each participant's class. A Cronbach's Alpha test was used to measure reliability of each scale in the pre and post participation surveys. It is established that a value of .70 or higher is the most reliable set of data (Nunnally, 1978). A Pearson Correlation test was also used to examine the positive interrelationship among task orientation, mindfulness, and eye fixation in the four

classes. A correlation value of 0 will indicate that there is no association. However, a correlation value of 1 will indicate a strong positive correlation, while a correlation value of -1 will indicate a strong negative correlation (Nunally, 1978). The last statistical analysis used was the p-value. A p-value less than or equal to .05 marks an indication of strong evidence against the null hypothesis. This would result in a rejection. A p-value close to .05 is considered to be marginal, meaning the hypothesis could be accepted or rejected (Nunnally, 1978). A p-value greater than .05 implies weak evidence against the null hypothesis. This culminates to a failure in rejecting the null hypothesis All of these statistical values were computed through SPSS software program version 25.

The eye tracking glasses consist of cameras, illuminators, and algorithms. These features create a pattern of near-infrared light on the eyes. Then the cameras take high-resolution images of the student's eyes and patterns. After that, the image processing gathers the algorithms to find specific details in the student's eyes and reflection pattern. The eyes' position, and gaze points are then transferred to a heat map which will use a sophisticated 3D eye model. The Tobii eye trackers use improved versions of the traditional PCCR remote eye tracking technology. (Tobii, 2015).

Results

For the first part of the analysis the mean scores were calculated for each survey. The results were found from using three pre-participation surveys (mindfulness, TEOSQ, CSAI-2) and two post-participation surveys (TEOSQ, CSAI-2), as well as successful attempts. Throughout the entirety of the data analysis each survey was broken into classes 1-4 as well as different subcategories. Overall the results showed no significant differences between each class

and their corresponding surveys. The beginning survey of mindfulness resulted in a mean score of 2.08 for class 1, 1.67 for class 2, 2.10 for class 3, and 2.24 for class 4. The second survey was the Task and Ego Orientation in Sports Questionnaire (TEOSQ). For analysis the survey was split into task and ego orientations. The mean score class 1 came to be 4.21 for task and 3.54 for ego. Class 2 resulted in 3.98 for task and 2.61 in ego. The score for class 3 was 4.29 for task and 2.88 for ego. Class 4 was similar to class 3 with a task mean score of 4.34 and 2.82 for ego. The final pre-survey was the Competitive State Anxiety Inventory (CSAI-2). Once again, for better analysis, this survey was split into cognitive, somatic, and self-confidence. Class one produces a mean score of 1.60 for cognitive, 1.36 for somatic, and 2.93 for self-confidence. Class 2 mostly has higher mean scores with 1.85 for cognitive, 1.58 for somatic, and 2.60 for self-confidence. Class 3 revealed a similar trend with 1.68 for cognitive, 1.69 for somatic, and 2.62 for self-confidence. Class 4 however trended differently. This trend had mean scores of 1.92 for cognitive, 1.54 for somatic, and 2.61 for self-confidence. The results for mean score showed a drastic change in outcome between pre and post surveys (Table 1).

When comparing each class to one another the tendencies were similar throughout each post survey. The TEOSQ mean scores for class 1 were 2.78 for task and 3.11 for ego. Class 2 was 2.00 for ego and 3.16 for task. Class 3 displayed 1.85 for ego and 2.86 for task. Class 4 was very similar to class 3 with a mean score of 1.88 for ego and 2.92 for task. The final survey taken by the participants was the post CSAI-2. The results were consistent between each of the top two classes as well as the bottom two. Class 1 had mean scores of 1.71 for cognitive, 1.56 for somatic, and 2.86 for self-confidence. Class 2 had a mean score of 1.81 for cognitive, 1.57 for somatic, and 2.62 for self-confidence. Class 3 showed higher mean scores overall with 2.06 for

cognitive, 1.67 for somatic, and 2.22 for self-confidence. Similarly, class 4 resulted in 2.19 for cognitive, 1.77 for somatic, and 2.31 for self-confidence. The last piece of data that was analyzed from the classes was successful attempts. Class 1 had a mean shooting accuracy of 7.60 (76%). Class 2 had a mean shooting accuracy of 6.67 (67%). Class 3 had a mean shooting accuracy of 2.60 (26%). Class 4 had a mean shooting accuracy of 2.77 (28%). Another aspect of data analysis was used with the same variables for the second part of the study.

For the second part of the analysis the standard deviation scores were calculated for each survey as well as successful attempts. Table 1 below shows the dispersion between the set of values and their respective mean scores.

For the third part of the analysis Cronbach's Alpha tests were conducted in this study, and the variables were separated by survey type (pre or post survey). In the pre-survey cognitive and somatic anxiety, confidence, ego and task orientation, and mindfulness were all examined. (CSAI) (TEOSQ) . A total of eleven Cronbach's Alpha Tests were conducted. For cognitive anxiety the Cronbach's alpha value came out to be .847, which is deemed as reliable. The somatic portion of the pre-surveys Cronbach's Alpha value was .800. Confidence was another section examined in the pre-survey. The Chronbach's Alpha value for it was .865. As for ego and task, Cronbach's Alpha values came out to be .857 and .834. Another variable measured in the pre-survey was mindfulness. The mindfulness Cronbach's Alpha was determined to be .853. Along with the pre-paperwork section, participants completed a post-survey as well. Much like the pre-survey, except this one didn't analyze mindfulness. The Cronbach's Alpha value for cognitive anxiety in the post-survey was .866.The somatic anxiety post-survey Cronbach's Alpha value was .854. The post-survey confidence value came out to be .913. As for the post-survey

ego and task orientation values were determined to be .937 and .926. All of the values indicated good reliability for both the pre and post-surveys.

Overall, when comparing the statistically significant differences (One-way ANOVA) between groups, there wasn't any significant difference among groups in our interested variables. The p-value between task orientation and eye fixation frequency was .05 with an r-value of .312. As for task orientation and eye fixation duration the p-value is .019 with an r-value of .370. The closest p-value that came to be significant was the post ego survey. This value came to be .062, the value has to be less than .05 to be strictly significant. A secondary finding of successful attempts with a value of less than .001 indicated that the groups performed differently. This proves that the successful attempts were statistically significantly different among groups.

For our successful attempts results Figure 3. Represents the mean scores for each class, and the error bars represent standard error among the classes. Eye fixation duration and frequency were determined between when participants faced up to the rim, and when they released the ball. Participants first focused on the rim, and then focused on the ball. Numbers on Figure 2 represent the order in which the participant focused their eyes. The size of the circle represents the duration of the eye fixation. Based on the map from the eye tracker, it was determined that there was a greater fixation duration on the rim. ANOVA (Table 2) revealed no significant differences between eye fixation and frequency between the four classes.

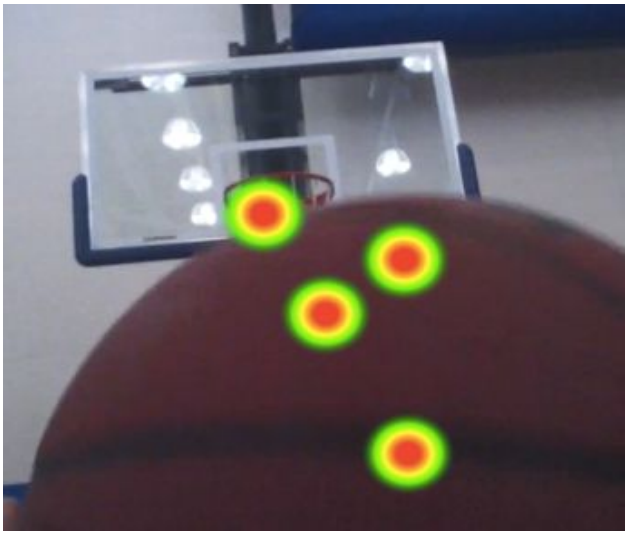

Figure 1: Heat Map of Eye Tracker

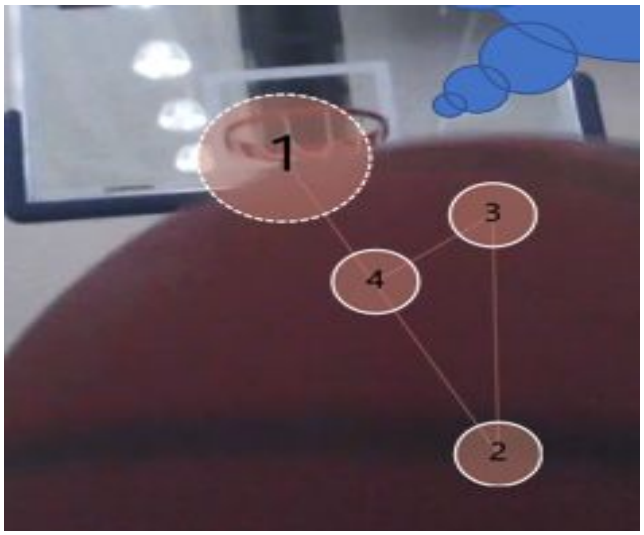

Figure 2: Map of Eye Fixation Duration

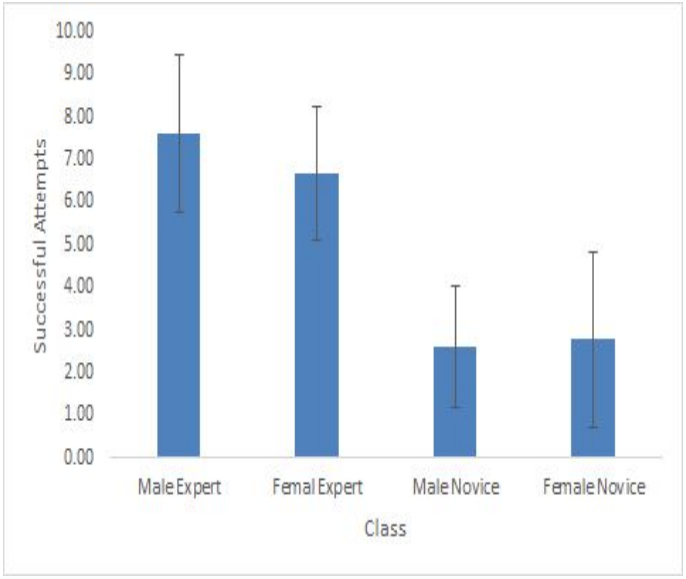

Figure 3: Mean Score of Each Class

Table 1. Descriptive statistics of all the variables for each group and total sample

		N	Mean	Std. Deviation
Task Orientation	Male Expert	10	4.21	0.50
	Female Expert	9	3.98	0.50
	Male Novice	10	4.29	0.56
	Female Novice	13	4.32	0.57
	Total	42	4.21	0.53
Ego Orientation	Male Expert	10	3.45	0.75
	Female Expert	9	2.61	0.82
	Male Novice	10	2.88	0.68
	Female Novice	13	2.82	1.07
	Total	42	2.94	0.89
Task Involvement	Male Expert	10	3.11	1.12
	Female Expert	9	3.16	1.06
	Male Novice	10	2.86	1.13
	Female Novice	13	2.92	0.97
	Total	42	3.00	1.03
Ego Involvement	Male Expert	10	2.78	1.09
	Female Expert	9	2.00	0.74
	Male Novice	10	1.85	0.70
	Female Novice	13	1.88	0.88
	Total	42	2.12	0.92
Mindfulness	Male Expert	10	2.08	1.41
	Female Expert	9	1.67	1.10
	Male Novice	10	2.10	1.39
	Female Novice	13	2.25	1.18
	Total	42	2.05	1.25
Pre-Cognitive Anxiety	Male Expert	10	1.60	0.52
	Female Expert	9	1.85	0.67
	Male Novice	10	1.68	0.47
	Female Novice	13	1.92	0.72
	Total	42	1.77	0.60
Pre-Somatic Anxiety	Male Expert	10	1.36	0.37
	Female Expert	9	1.58	0.44
	Male Novice	10	1.69	0.42
	Female Novice	13	1.54	0.55
	Total	42	1.54	0.46
Pre-Confidence	Male Expert	10	2.93	0.85
	Female Expert	9	2.60	0.61
	Male Novice	10	2.62	0.37
	Female Novice	13	2.61	0.45
	Total	42	2.69	0.58
Post-Cognitive Anxiety	Male Expert	10	1.71	0.63
	Female Expert	9	1.81	0.72
	Male Novice	10	2.06	0.48
	Female Novice	13	2.19	0.76
	Total	42	1.96	0.67
Post-Somatic Anxiety	Male Expert	10	1.56	0.45
	Female Expert	9	1.57	0.45
	Male Novice	10	1.67	0.46
	Female Novice	13	1.77	0.68
	Total	42	1.65	0.52
Post-Confidence	Male Expert	10	2.86	0.92
	Female Expert	9	2.63	0.69
	Male Novice	10	2.22	0.47
	Female Novice	13	2.31	0.81
	Total	42	2.49	0.76
Eye Fixation Frequency	Male Expert	10	5.89	3.18
	Female Expert	9	2.89	1.62
	Male Novice	10	6.00	5.01
	Female Novice	13	3.58	2.54
	Total	42	4.55	3.48
Eye Fixation Duration (Millisecon	Male Expert	10	1462.00	1165.68
	Female Expert	9	573.33	387.17
	Male Novice	10	1193.80	1203.42
	Female Novice	13	639.08	587.00
	Total	42	948.13	937.60
Successful Attempts	Male Expert	10	7.60	1.84
	Female Expert	9	6.67	1.58
	Male Novice	10	2.60	1.43
	Female Novice	13	2.77	2.05
	Total	42	4.71	2.84

Table 2. One-way ANOVA of eye tracking for each group and total sample

		Sum of Squares	df	Mean Square	F	Sig.
Task	Between Groups	3.79	3.00	1.26	1.69	0.18
	Within Groups	28.36	38.00	0.75		
	Total	32.16	41.00			
Ego	Between Groups	0.67	3.00	0.22	0.77	0.52
	Within Groups	10.97	38.00	0.29		
	Total	11.64	41.00			
TaskP	Between Groups	5.98	3.00	1.99	2.65	0.06
	Within Groups	28.55	38.00	0.75		
	Total	34.53	41.00			
EgoP	Between Groups	0.64	3.00	0.21	0.19	0.90
	Within Groups	43.14	38.00	1.14		
	Total	43.78	41.00			
Mindfulness	Between Groups	1.86	3.00	0.62	0.38	0.77
	Within Groups	61.89	38.00	1.63		
	Total	63.74	41.00			
CogPRE.CSAI	Between Groups	0.74	3.00	0.25	0.66	0.58
	Within Groups	14.20	38.00	0.37		
	Total	14.94	41.00			
SomPRE.CSAI	Between Groups	0.58	3.00	0.19	0.92	0.44
	Within Groups	7.93	38.00	0.21		
	Total	8.51	41.00			
ConfPRE.CSAI	Between Groups	0.79	3.00	0.26	0.77	0.52
	Within Groups	13.09	38.00	0.34		
	Total	13.88	41.00			
CogPOST.CSAI	Between Groups	2.66	3.00	0.89	1.59	0.21
	Within Groups	21.14	38.00	0.56		
	Total	23.80	41.00			
SomPOST.CSAI	Between Groups	1.58	3.00	0.53	1.19	0.33
	Within Groups	16.81	38.00	0.44		
	Total	18.39	41.00			
ConfPOST.CSAI	Between Groups	0.34	3.00	0.11	0.39	0.76
	Within Groups	10.91	38.00	0.29		
	Total	11.25	41.00			
E.F.Freq	Between Groups	73.21	3.00	24.40	2.20	0.10
	Within Groups	398.69	38.00	11.07		
	Total	471.90	41.00			
E.F.DURATION	Between Groups	5390469.86	3.00	1796823.29	2.24	0.10
	Within Groups	28893936.52	38.00	802609.35		
	Total	34284406.38	41.00			
Successful Attempts	Between Groups	211.46	3.00	70.49	22.49	0.00
	Within Groups	119.11	38.00	3.13		
	Total	330.57	41.00			

Discussion

Introduction

Based on the results for this study, there are several general conclusions that can be obtained about the relationships between class, mindfulness, anxiety performance, task and ego orientation, and eye tracking. The purpose of this study was to examine eye tracking and free throws, and whether it affected or deterred task and ego orientations. Major findings of this study from our descriptive statistics include: female experts showing more mindfulness compared to other classes, no cognitive or somatic anxiety was reported during the study for any class. Participants experienced slight self-confidence, and described themselves as task oriented rather than ego oriented. Because group difference was not evident by the ANOVA results, we conducted a follow up correlation analysis with the overall sample. Two statistically significant correlation coefficients with eye fixation variables were found that were between task orientation and eye fixation frequency ($r = .312$, $p = .05$), and task orientation and eye fixation duration ($r = .370$, $p = .019$). These findings can be interpreted that participants who are task oriented tend to fixate their eyes more often and longer.

Mindfulness

The first variable measured was mindfulness. Participants were asked five questions regarding their state of mind before shooting free throws. Classes one (male expert), three (male non-expert), and four (female non-expert) agreed that they were “somewhat” preoccupied with the future or past, or having a “somewhat” hard time focusing on what was currently happening. Whereas class two (female expert), their mean scores categorized them as “not at all” preoccupied with the future or past, or “not at all” having a hard time focusing on what was

happening. These findings are not consistent with those of Leeds Beckett University, where they found females to show more stress and to be more preoccupied with other things compared to their male counterparts (Kaiseler, Poolton, Backhouse, & Stanger, 2017). Participants in this study were mostly focused on the task at hand, and either not at all or somewhat preoccupied with other things which resulted in how they performed. Practicing mindfulness leads to an improvement in clinical problems which includes both cognitive and somatic anxiety (Ford, Wyckoff, & Sherlin, 2016).

CSAI-2 Pre and Post-Survey

The second variables measured regarded both cognitive and somatic anxiety, as well as self-confidence. Participants did not experience cognitive or somatic anxiety at all when completing the CSAI pre-survey. On average participants were neither nervous or concerned about the free throw challenge. Questions asked in this survey about self-confidence included: feeling at ease, feeling comfortable, or feeling jittery. The mean score for the self-confidence portion categorized them as "somewhat". Meaning on average the participants felt "somewhat" jittery, comfortable, and at ease. Although, it may be perceived that when someone doesn't experience any type of cognitive anxiety, they would have high amounts of self-confidence. This was not the case for the current study, or studies in the past. In "An Examination of Competitive Anxiety and Self-Confidence among College Varsity Athletes" their findings state that somatic anxiety has a larger influence on self-confidence (Zeng, Leung, & Liu, 2008) . Similar to another study "Competitive Anxiety, Situation Criticality, and Softball Performance" which presents results where cognitive anxiety had a negative association with self-confidence (Krane, Joyce, & Rafeld, 1994). The CSAI post-survey results were identical to the pre-survey. Participants

experienced no cognitive or somatic anxiety, which resulted in a "somewhat" response when asked about self-confidence.

Task and Ego Pre and Post-Survey

A fourth conclusion is that goal orientation was unified amongst all classes. Overwhelmingly participants described themselves as task oriented based on the TEOSQ pre survey. Established mean scores determined that participants agree that they are task oriented and disagree that they are ego oriented. These findings can result in the participants being more extrinsically motivated. This replicates the findings of Hepler (2016) which concludes that task orientation was a significant and positive finding for Division 3 basketball players. Hepler (2016) and Ntoumanis (2001) both found that task-oriented individuals participate for intrinsic reasons. This is consistent with the findings in this study. Even though there was pressure to gain recognition on the leaderboard participants were not more ego oriented, or more extrinsically motivated. The two previous studies did not list a reward or recognition which is why there was no difference in the results. After the completion of the free throws, participants filled out another TEOSQ with the same questions as the pre-survey. Each class changed their answers and class 1 and 2 were consistent with each other and class 3 and 4 were consistent with each other.

Participants from class 1 and 2 answered that they were not sure for task, and disagreed for ego. Participants from class 3 and 4 answered that they strongly disagreed for ego, and disagreed for task. This is a big change from the pre survey. These results could have changed because of the results of making it on the leaderboard or not. According to the Hepler (2016) study success can be met with a variety of external rewards and if the participant didn't make the leaderboard then there was no external reward. Hepler (2016) also states that good performances

serve to enhance one's pride or self-esteem which is also why answers could have changed for questions such as I learn something that is fun to do, or something I learn makes me want to practice more. The research from Yoo and Kim (2002) confirms that participants who experienced task orientation more frequently reported self-referenced sources of enjoyment. Although task orientation changed ego orientation stayed the same between all classes. The similar results are because participants were not affected by the leaderboard for questions such as I have the best stats, or I am the best. Yoo and Kim (2002) reiterated the consistency of our results ruling that more frequently identified social recognition and rewards as their enjoyment sources.

Eye Tracking

In terms of associating eye tracking with task and ego orientation the results were once again similar amongst all classes. The eye fixation duration and frequency were specified between when participants faced up to the rim and when they released the ball. The heat maps suggest that there are no significant differences in eye fixation and frequency between groups. The maps also suggest that a large amount of time was spent fixating on the rim. This finding is steady with previous research for half of the classes while it is inconsistent for the other half. The findings of research show that attention on the ball leads to a significant decrease in basketball free-throw shooting performance (Rienhoff, Fischer, Strauss, Baker, & Schorer, 2015). Classes 1 and 2 showed a high accuracy percentage while classes 3 and 4 showed a low accuracy percentage. This displays that while the research is correct for 50% of the study there is still a difference between skill levels even though there was consistent focus on the basket and not the ball. Another study by Rivilla-Garcia and company (2013) suggests that elite handball

goalkeepers performed a greater number of visual fixations than the amateur goalkeepers. Although Rienhoff (2015) and Rivilla-Garcia (2013) show similarities in their finding our research contraindicated most eye tracking findings.

Limitations

Limitations to this study include the eye tracker not calibrating for participants with vision impairments. This was only the case for a couple of the participants in the study. Sports teams and physical education classes used the gym throughout the day, so it was difficult to find open times to schedule people. On top of gym availability, having access to one eye tracking system also made it hard for participants to come in and complete the research project. Slight limitations to the study also included the wires and battery pack attached to the eye tracking glasses. This caused the lack of comfortability among the participants and might have caused some missed free throws. Due to the pandemic of Covid-19, this also caused some problems. Time for data collection was limited, and completing the study online, and through Zoom meetings made finishing up the research project more difficult than it would have been had there not been a pandemic.

Future Directions

Free throws play a crucial role in many basketball games. To further extend this research, there should be more research done within the game of basketball. This includes shooting a basketball from different distances and locations on the court. For example, analyzing eye movements for jump shots and three-point attempts from different locations. Future researchers should also be more gender specific in the research. Although our study separated participants into class there should be a study that only focuses on gender and not different skill levels. This

potentially could change the results especially with the variety of surveys. Another direction for this study is to test different age groups. This eye tracking system could be used as a learning tool for people who haven't been around the game of basketball. Beginners and athletes trying to better their game could learn from the experts where to focus their eyes when shooting a basketball.

Conclusion

Overall, the current study suggests that participants for all groups maintained a greater eye fixation on the rim before the shot while cultivating a task-oriented state of mind. It was hypothesized that the greater the eye focus on the basket the more ego oriented the participant will be, because there will be a greater determination for the reward. Therefore, our hypothesis is not supported. It is important to remember that this area of research has recently come into the spotlight of many coaches and athletes. This study is specific to free throws and can be extended into further opportunities within the game of basketball or other sports.

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