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An Analysis of Performance-Based Perception in Competitive Baseball Players

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Abstract

The correlation between performance hitting a baseball and perceived ball size has been described in previous work (Witt & Proffitt, 2005). The article in question used recreational softball players to demonstrate that greater performance led to a perceived change in softball size, but discussed a desire to replicate their experiment with competitive professionals. Using athletes from a semi-collegiate baseball team during their summer season, we were able to find a correlation that although weaker, continues to propagate the relationship found in previous studies. The finding of a weaker relationship also sheds new insight into why elite athletes may fare better at this task than their amateur counterparts.

Key Words: action-specific perception, performance-based perception, semi-collegiate athletes

An Analysis of Performance-Based Perception in Competitive Baseball Players

Perception, specifically visual perception, is important because what we process visually is often what we use first to comprehend the situation around us. Common phrases such as "Seeing is believing" come from experience; we tend to believe what we see to be solid and concrete. However, from illusions and other cognitive manipulations, we know that perception is malleable. Recognizing the different ways in which one can alter perception allows us to better understand why changes in perception occur. Several different factors affect how we visually perceive stimuli, and action-specific perception is one theory that will be the focus of this experiment. Performance-based, or action-specific perception, is the concept that people perceive their surroundings based on their ability to interact with them (Witt, 2011). Simply put, if the object of one's perception is used or is to be used in a meaningful way, this usage can alter the user's perception of the object. A significant piece of evidence for the theory of action-specific perception comes from the work of Witt and Proffitt (2005) which found that recreational softball players who hit better in games are more likely to physically perceive the ball itself as being bigger.

The study in question was designed to observe a difference in perceived softball size based on players' performances. Forty-seven softball players consented to take part in the experiment. Participants were offered a free sports drink and asked if they would like to participate in a 1-minute psychological experiment. First, participants were asked to choose the size of a softball (10 cm) from eight, black, differently-sized circles shown on a sheet of white paper. These black circles were arranged unsystematically and ranged in size from 9 cm to 11.8 cm. After choosing a size, participants were asked how they had performed, with criteria including their numbers of hits, walks, and times they reached base on an error. Participants also disclosed whether their team won or lost as well as their age and sex. The statistics provided were used to calculate each participant's batting average, and it was found that batting average had a strong, positive correlation with perceived ball size.

This performance-based perception applies to other sports as well, having been demonstrated in other athletic disciplines. Two variations of the Witt study found that 1) golfers who performed better on the course perceived the hole as bigger (Witt, Linkenauger, Bakdash & Proffitt, 2008) and 2) the size of a dartboard target was perceived as bigger for people who took fewer darts to strike it (Wesp, Cichello, Gracia, & Davis, 2004). The common thread in each of these earlier examples was the use of participants who are amateurs; there were no stipulations based on athletic skill, experience, or anything of the sort. Anyone who chose to sign up for the softball league could have been a participant in the original experiment, meaning there was no way to control for skill level among the athletes.

In the article written by Witt and Proffitt (2005), they express a desire to continue observing this phenomenon with competitive baseball players. Professional or semi-professional athletes have several advantages over the average recreational player. One such advantage is that elite volleyball players were able to complete complex perceptual and cognitive tasks faster than the average person (Alves et al., 2013). Eighty-seven athletes from the Center for Development of Volleyball in Rio de Janeiro and sixty-seven non-athlete controls from the surrounding universities were included in the Alves study. The participants were asked to take a "cognitive battery" of six tests on a computer which measured executive control, memory, and visuospatial processing. After compiling the results, it was found that the volleyball players were faster at the executive control and visuospatial processing tasks than the non-athletes while maintaining the same level of accuracy.

Another distinction elite athletes have is a bevy of experience that the average person cannot match. In the case of baseball, even a collegiate athlete sees thousands of pitches in just one season, from early February into June and sometimes throughout the summer. With this information at hand, there comes a question of how experienced athletes would fare at performance-based perception tasks. Is the effect of performance on perceived ball size more pronounced, or would the use of elite athletes mitigate the changes seen in amateurs due to increased experience? Perception has also been shown to be a byproduct of effort, and it's this fact that serves as the basis for our hypothesized answer to this question.

The manipulation of perception through increasing effort has been demonstrated in previous research. (Bhalla & Proffitt, 1999) (Witt, Proffitt & Epstein, 2004). Participants who wore a heavy backpack were more likely to overestimate the steepness of a hill (Bhalla & Proffitt, 1999), indicating that these people's perception was affected by their fatigue level. Another study found that after increasing the effort involved with either walking or throwing a certain distance, those people who had to exert more effort perceived a greater distance to be achieved (Witt, Proffitt & Epstein, 2004).

In Bhalla and Proffitt's experiment, one hundred and thirty students at the University of Virginia took part in one of two conditions. Forty students in the computer condition were asked to report judgments on the slopes of two virtually-represented hills while wearing a heavy backpack. The virtual hills were meant to mimic actual hills on the university's campus. The other ninety students in the physical condition were approached while walking by the areas of these same actual hills and asked if they would like to participate in the experiment. All participant's judgments included a verbal component and a visual component, wherein they were asked to set a disc at the correct angle using a protractor with eight ranges to choose from (5, 10, 15, 20, 25, 30, 50 and 70 degrees). It was found that the participants in the "heavy backpack" condition reported the hills to have a more extreme slope than those in the "unhindered" condition.

Three more experiments were run as part of the same study with different modifications. The first modification examined the effects of fatigue and consisted of forty participants who had previously declared that they ran for exercise at least three times a week. The forty participants started at one of the two hills, gave their slope estimates, then ran a customized route of their own choosing to the other hill, with the only stipulation being that they should be exhausted by the time they reached the other hill. Participants tended to give steeper estimates after having exhausted themselves, demonstrating the effect of fatigue on perception.

The second modification looked to explore how general fitness was related to perceived geographical slant. Seventy-four participants were used, twenty-four of whom were on the University of Virginia track team, and fifty of whom were not involved on an athletic team. Varsity athletes were used to provide a sub-section of above-average fitness that the average population may not have accounted for and examines the effect of experience once more. Participants took part in four fitness tests with fitness calculations centered around heart rate. The seventy-four participants were asked to judge the slope of four hills on the University of Virginia campus in the same manner as described in the first two tests. It was found that all participants overestimated the slopes of the hills, but that the degree of overestimation was inversely related to the fitness level of participants. The track athletes gave more accurate guesses than the average-fitness, regular population.

The third modification was run differently to assist the population it wanted to observe. It was hypothesized that elderly people with "reduced physiological potential" would overestimate hill slope in the same way people with lower fitness levels did. Thirty-two volunteers between the ages of sixty and eighty-seven took part in the fourth experiment. Eight hill slopes outside of two assisted living homes where the study took place were used. The participants were asked to estimate the slopes of the hills in the same way as used in the previous three version of the test. The results of this fourth experiment supported its hypothesis that the elderly participants overestimated the sizes of the hills at about the same level as the non-athlete participants in Modification 2.

The main conclusion from these four experiments was that in each case, one set of the group was manipulated to have “reduced psychological potential”; the reduced group had one of four impairments (one for each version): more resistance, more exhaustion, worse average fitness, or old age. In each of the four parts of this study, the reduced potential group overestimated the slope of the hills to the most significant degree. What these four variations tell us is that an increase in the effort associated with making perceptions tends to exaggerate those perceptions to a greater degree. It would stand to reason that the opposite could be true as well: less effort used could result in more accurate perceptions overall.

With Bhalla and Proffitt’s work in mind, our hypothesis revolves around the idea of effort in perception: Elite baseball players will experience the same changes in perception that the average person would. Elite or professional athletes are still exerting the energy necessary to succeed, and thus it is this effort that will determine the changes in perception the players experience. If this hypothesis is correct, the athletes in this current study will find the same relationship as was found in Witt’s study of softball players, which indicates a similar strong relationship between batting average and perceived baseball size.

Method

Participants

Sixteen collegiate baseball players competing in the Madison Mallards organization were tasked with answering a series of questions posed by a researcher immediately after an August batting practice. It is important to note that the Mallards are a semi-collegiate baseball organization, meaning their players consist of college athletes from across the nation in a summer league for increased exposure and additional at-bats, among other things. The participants were all male, and their ages ranged between 19 and 22 years old. Each of the sixteen players had, at the time, been with the Mallards for at least two weeks, and all had been playing baseball and seeing pitches since late March. One participant had to have their data removed after receiving information about the study from another player before they were able to take their turn.

Materials

The players chose one of eight black circles, adjusted only by size, laid out on a large strip of paper taped to a folding table in front of them. The strip was assembled first by printing the eight circles on two standard, 8.5 x 11 sheets of paper (Figure 1). The two sheets were cut in half horizontally to create four identical half-sheets with two circles each. These half-sheets were then pieced together at the narrow sides to create one long strip with eight circles in a straight line from end to end. The circles on the sheet had diameters ranging from 2.44” to 3.42” (6.20 to 8.69 cm) and were arranged left to right in a random, non-ascending order. The centers of each circle were alternated up and down to make determining relative size more difficult, so players would have to judge each circle holistically.

Procedure

A table was set up in front of the home team's dugout during afternoon batting practice before an evening game. An announcement was made to the entire team that a researcher was looking for participants for an academic study immediately after they had finished hitting. Although no incentive was given to participate, the location of the study table was enough to convince the players to take part in the experiment after they had completed their practice. Participants took batting practice in groups of three, which meant some participants were forced to wait to complete the study while others completed it. Precautions and warnings were made to ensure no player watched another perform the task beforehand, except in the case of one individual whose data was removed from the collection.

Each participant was greeted when they arrived at the table with a scripted statement from the researcher. The statement began with an introduction and started by asking for several qualitative responses on the participant's experience with the baseball team. The most pertinent of these was an indication of how the player felt they had performed during the most recent batting practice, on a scale from 1 to 5, with 1 being they felt they had performed poorly and 5 being they felt they had performed very well. Participants were then asked to look at the eight black circles and choose the one they felt most accurately represented the size of a baseball. After the circle choice, patients were debriefed on the purpose of the study and told that they could ask further questions through e-mail correspondence. The data collected was compiled in a table (Figures 2 & 3) for easier calculation. After the results were determined, the experimental data was coded so that no result of the study could be traced back to a certain player. The appropriate calculations were completed to determine significance.

Once all the perception data was collected, results were cross-referenced with game statistics taken over the course of the season. The two sets of data, batting average and perceived ball size, were used together to find a correlation coefficient and equivalent p-value.

Results

Out of sixteen participants, seven were able to correctly determine that the fifth circle, with a diameter of 2.86” (7.26 cm), was the one pertaining to the minimum size of a regulation baseball. The average of all sixteen estimates was approximately 2.82”, 2.86” was the most common answer, followed by 2.72”, with four guesses, and 3”, with two. The most extreme guess made was the circle with a diameter of 3.14”, which also means every participant was within two ball sizes of the correct answer. This is unique from the previous research done in that the semi-professional players had a more narrowed sense of what size was correct.

As was the case in the research from Witt & Proffitt (2005), the primary purpose of this study was to observe the relationship between perceived ball size and batting average. Batting average has been previously determined to be a good indicator for general hitting performance, and this measure provided strong results in previous studies. A scatter plot of the relationship between these two variables can be found in Figure 4. In the current study, there was a moderately strong, positive correlation found between batting average and perceived ball size $r(16) = .4651$, $p = .069$. However, since $p > .05$, the relationship between these two variables was not deemed to be significant.

Discussion

The results listed are inconsistent with our hypothesis. The prediction was that the baseball players in this study would fall under a similar pattern to the softball players tested over a decade ago, and this prediction ended up being incorrect. Despite the lack of significance, there are several positives that can be taken from the experiment. The correlation between batting average and perceived ball size is still present, and it provides further evidence that superior performance leads to changes in stimulus perception. In this case, even with a non-significant result, the returns in elite baseball players can be similarly telling.

Comparisons to the softball study come naturally, but the results of this study also provide additional insight to the works on the effort in perception (Bhalla & Proffitt, 1999) and cognitive ability of athletes (Alves et al., 2013). The smaller range of estimates from these ballplayers shows that increased effort may serve to improve results among elite athletes. Another possible explanation is a literal interpretation of effortlessness, where these players may be exerting themselves less than the average person would in the same situation, thus explaining the narrowed results. The differing results between elite baseball players and amateur softball players also speaks to the contrast between professional and recreational athletes. Volleyball players were found to have quicker reaction times in cognitive testing (Alves et al., 2013), and the increased ability to distinguish baseball size among the Mallards players helps corroborate the idea that above-average athletes have an increased mental capacity pertaining to their discipline. The research herein works in harmony with previous findings, but the issue lies in the fact that the study we set out to replicate ended with major differences.

The current study was organized as a replication of Witt and Proffitt's study (2005) using a different population. In 2005, a significant relationship was found between batting average and perceived ball size among recreational softball players. Though this piece was designed to repeat the original procedure, there were several instances where improvement could be made to ensure the accuracy of these results.

The first limitation of this study to point out is a potential lack of fit between the independent and dependent variables. The relationship being tested leaned heavily on the use of statistics to measure performance. As compared to self-reporting, game statistics are objective and thus more likely to be accurate. However, the statistics still are not perfect if they do not match the variable they are trying to convey. A potential mistake made was that the batting averages recorded were taken over the course of an entire summer season. The Witt & Proffitt study calculated batting averages from just one or two games, which gives a more recent timeframe in which to capture performance. A happy medium would have been to collect averages from the last ten games played but, unfortunately, in a semi-professional league that sort of information was not easily accessible.

Along with the data collection issue, there were also occasional procedural limitations which may have skewed the results. One substantial oversight was the overestimation of privacy for the participants in performing the task at hand. An extreme example of this issue was seen when one participant's data had to be thrown out when they received information about the study beforehand. Time allotted for participants to complete the study may be another factor that could be analyzed. The Mallards team has a routine for how they go about their pre-game workouts, which led to an inadequate time-frame for completing this additional task. Some players from the team may have felt rushed during the study, and several may have felt that they were unable to participate altogether. Though new issues may arise in the form of standardization and consistency, this study with semi-professional teams may fare better over the course of two or three days as opposed to just the one. Multiple periods for players to take part may provide more comfort for the participants, as well as the opportunity to include larger numbers of athletes.

The final and possibly most significant shortcoming of the present study was an unsatisfactory number of participants. Only about one-third of the number of participants used in Witt & Proffitt's study were tested, and although the correlation was greater than for the softball players, the results were still found as not significant because of the sample size. Future versions of this study may benefit from including pitcher-only type players from the Mallards, or even using multiple semi-collegiate teams. However, it is beneficial that despite the day's negatives, the data collected sheds some valuable insight on certain aspects of action-specific perception.

The effect of action-specific perception on these semi-professional players was less pronounced than the one found in previous studies on amateur athletes. There are a number of implications that can be reasoned from this information, and the results speak to the experience and effort these elite athletes provide. With the number of repetitions a seasoned baseball player performs, they achieve a level of increased focus and ability that only comes with experience. It makes sense that these players, who have seen a baseball every day for months, would also have a narrower idea of what does and does not constitute as a baseball. For the sixteen participants who took part, the effort needed to discern the most accurate size was considerably lower than for most people, placing new importance on the value of practice. Further investigation should be done to validate the findings at hand, but what was found here provides an interesting addition to the role of the mind in athletics.

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Figure Captions

Figure 1. Two sheets of eight, differently-sized black circles that were cut in half and fastened together to create one horizontal line of eight circles.

Figure 2. Qualitative rating scales and ball size estimate (in inches) collected from individuals on the day of participation.

Figure 3. Game statistics, and ball size estimate (in centimeters) collected from statistician after the day of participation.

Figure 4. Graphical representation of batting average (horizontal axis) and perceived ball size (vertical axis), along with line of best fit shown to model correlation.

Figure 1.

Print-Out of Differently-Sized Circles

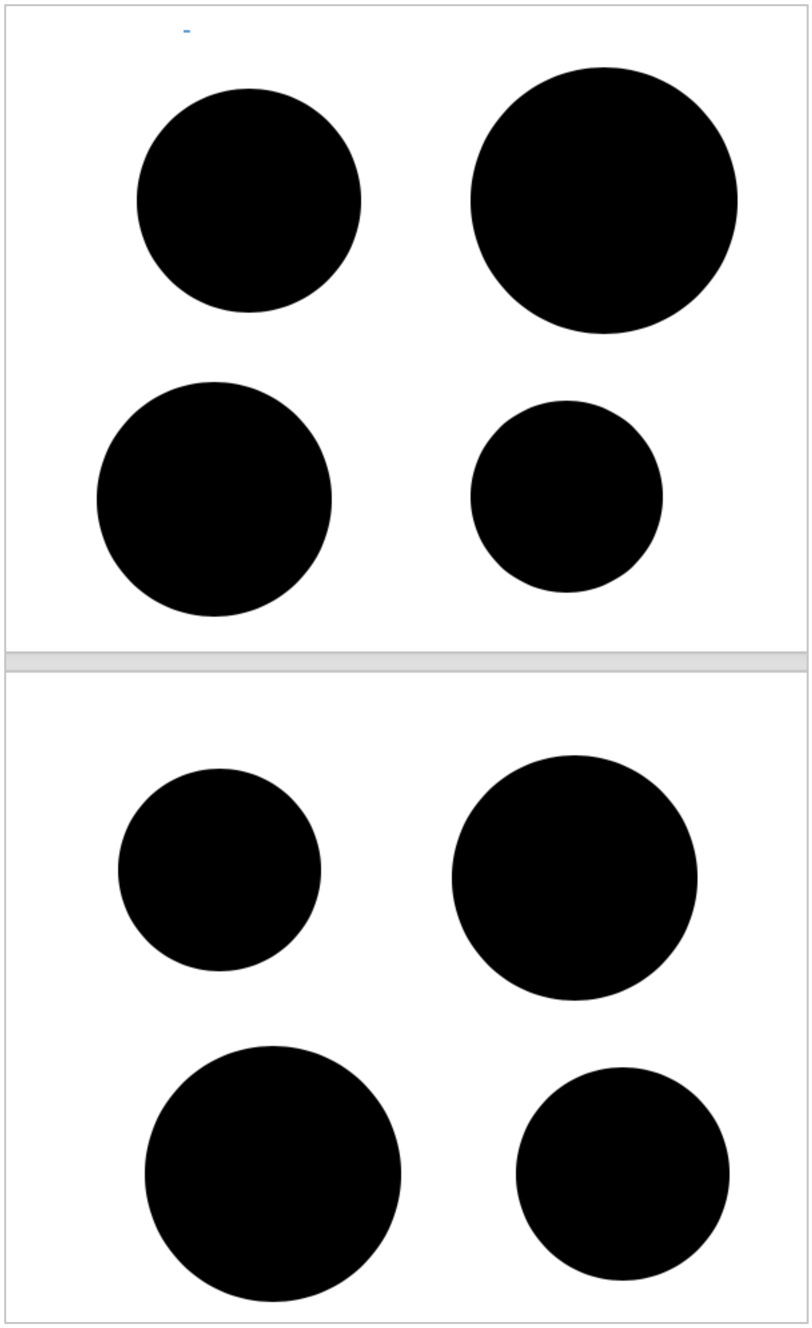

Figure 2.

Summary of Data Collected from Semi-Professional Athletes (Part 1 of 2)

Legend:

Number = Participant's code number

Age= Participant's age at the time of the study

ExpScl = A qualitative 1-5 rating of the player's experience over the summer with the team

PrfScl = A qualitative 1-5 rating of the player's performance over the summer with the team

BPScl = A qualitative 1-5 rating of the player's performance in their most recent batting practice

SizeGs = The player's choice out of the eight different sized circles shown in Figure 1

GmPlyd = The number of games the participant played in with the Mallards team

Number	Age	ExpScl	PrfScl	BPScl	SizeGs	GmPlyd
1	21	4	3	2	2	70
2	19	5	4	3	5	68
3	19	5	3	3	5	19
4	20	5	3	3	7	53
5	20	5	4	2	3	61
6	22	4	5	3	2	65
7	19	4	3	3	5	35
8	21	4	3	4	3	55
9	20	5	4	4	3	38
10	19	5	4	3	4	36
11	19	4	4	4	5	8
12	21	5	5	3	5	43
13	19	5	3	5	5	11
14	21	5	3	2	3	37
15	19	5	4	3	1	12
16	22	5	4	3	5	27

Figure 3.

Summary of Data Collected from Semi-Professional Athletes (Part 2 of 2)

Legend:

Number = Participant’s code number

BatAvg= Participant’s batting average (hits divided by at-bats)

Hits = The number of hits the participant had during the season

AtBats = The number of times the participant went up to bat during the season, excluding walks

XBH = The number of extra-base hits the participant had during the season (doubles, triples, home runs)

HR = The number of home runs the participant hit during the season

GsCM = The participants size estimate converted to centimeters.

Number	BatAvg	Hits	AtBats	XBH	HR	GsCM
1	0.31	86	277	24	7	7.62 cm
2	0.318	83	261	32	9	7.26 cm
3	0.2	12	60	4	0	7.26 cm
4	0.254	54	213	9	1	6.55 cm
5	0.298	73	245	23	7	6.91 cm
6	0.313	78	249	27	14	7.62 cm
7	0.283	34	120	8	0	7.26 cm
8	0.266	55	207	6	0	6.91 cm
9	0.3	54	180	11	0	6.91 cm
10	0.313	30	96	6	2	8.33 cm
11	0.296	8	27	0	1	7.26 cm
12	0.261	142	37	9	4	7.26 cm
13	0.295	13	44	0	0	7.26 cm
14	0.195	26	133	7	3	6.91 cm
15	0.244	10	41	0	0	6.20 cm
16	0.248	25	101	5	5	7.26 cm

Figure 4.

Batting Average and Perceived Ball Size (cm)