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RESEARCH ARTICLE

Self-Reported Focus of Attention of Collegiate Baseball Players

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Abstract

The purpose of the present study was to examine collegiate baseball player's self-reported focus of attention for three instances requiring performance of their baseball swing (i.e. during practice, on-deck and in-game at bats). Seventeen collegiate baseball players were recruited for the study. All players completed an on-line questionnaire that required them to choose amongst alternatives considered an internal focus (e.g. body position) or external focus of attention (e.g. bat) or 'other' (preferred focus of attention options not listed on questionnaire) when in practice, when on-deck and during their –in game batting. The responses provided by participants were retrospective based on the fact the questionnaire was completed once the baseball season was over. We predicted the following:1) during practice, a more frequent report of an internal focus of attention was expected based on the refinement of hitting mechanics; 2) a mix of internal and external focus of attention when on-deck; 3) and a more frequently reported external focus of attention during in game at bats. The results supported our predictions. Collegiate batters self-reported a change in focus of attention based on when they were required to perform their batting action. The results of the present experiment offer important practical implications for the baseball coach when directing collegiate batters focus of attention during practice, on-deck and in-game at bats.

Keywords: Focus of Attention, Motor Performance, Athletes.

1. Introduction

The perceptual-motor skills required to successfully hit a pitched baseball is considered one of the most challenging in sport (Gray 2022a). The processing demands required by the batter to decide whether or not to swing is suggested to be less than 200 milliseconds after ball release (Gray, 2004). Optimal baseball swing mechanics to increase the probability of success of the baseball swing is well documented (see Gray 2002b; Inkster, Murphy, Bower, & Watsford, 2011; Shaffer, Jobe, Pink, & Perry, 1993; Welch, Banks, Cook, Draovitch, 1995). Bat swing velocity is considered an important kinematic variable shown to distinguish skilled batters from unskilled batters (Inkster et al. 2011). Batting outcome success is preceded by the batter's ability to predict pitch speed (Gray, 2002a), and pitch type based on pitcher tendencies (Gray, 2002b; Gray, 2004, Uyeno, Frost, Chimera, Holmes, & Patterson, 2024). These findings are supported by Muraskin, Sherwin and Sajda (2015) who showed sooner activation of the brain areas responsible for response inhibition (i.e. supplementary motor area) in skilled compared to unskilled baseball batters. These neural differences have been suggested to account for superior response times and swing decisions from the skilled batter. Further, collegiate batters have self-reported a preference for visual feedback (e.g. ball leaving the bat) compared to auditory (e.g. sound of ball hitting the bat) or tactile feedback (e.g. feel of the ball off the bat) regarding the success of their baseball swing (Gray, 2009).

Based on the temporal and cognitive demands placed on the batter to accurately process the visual information of the pitched baseball, it would seem

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important to understand where to instruct the batter to focus their attention to before and during their baseball swing. In a simulated batting task, highly skilled batters were required to time their swing to strike a simulated approaching baseball (Castaneda & Gray, 2007). Swing timing error was greatest when batters were instructed to focus on their hands (i.e. defined as an internal focus of attention) compared to focusing on the movement of their bat (i.e. defined as an external focus of attention). The authors suggested that focusing attention away from the mechanics of the movement (i.e. external focus of attention) allowed the swing to remain automatic and strengthened the association between the swing and the outcome of the swing (i.e. decreased swing timing error). The constraint action hypothesis predicts that instructions that focus attention on the outcome of the motor action (e.g. external focus) results in superior motor performance compared to those instructions that focus attention on the movement (e.g. internal focus) (see Wulf, 2013 and Yamada, Higgins & Raisbeck, 2022 for reviews). The findings of Castaneda and Gray (2007) are consistent with the predictions of the challenge point framework.

A review by Yamada et al. (2022) showed instructions provided by the coach frequently focus the athlete's attention internally (e.g. focus on movement kinematics), rather than an external focus of attention (e.g. focus on the outcome of the motor). For example, in one study involving baseball pitcher training, providing instructions on movement technique (i.e. internal focus of attention) were most frequently provided by the coach. Of interest, pitchers also self-reported a preference for adopting an internal focus of attention (van der Graaff, Hoozemans, Pasteuning, Veeger, & Beek, 2018). These findings resonate with the findings from national track and field athletes who also self-reported their coaches most frequently provided instructions that were internally focused (e.g. movement to movement of the athlete's body / limbs), similar to their own preference during competition (Porter, Wu, Partridge 2010). Professional ballet dancers have also reported to primarily focus on their body movements (i.e. internal focus of attention) during various ballet positions (i.e. maintaining balance and postural alignment during the arabesque) (Guss-West, & Wulf, 2016). In another experiment examining differing skills levels in tennis, Keller, Schweizer and Gerber (2023) found focus of attention instructions provided to the leaner were more frequently internally focused, whereas instructions for the skilled tennis player were more frequently externally focused. Findings from the sport science literature highlight the provision of instructions are not entirely consistent with the predictions of the constraint action hypothesis, especially in motor actions where a defined biomechanical pattern increases the predictability of a successful outcome, much like the baseball swing.

More recently, focus of attention is believed be dynamic, with performers switching between an internal and external focus of attention based on the context the motor skill is being performed (Gose & Abraham, 2021). Identifying and understanding the variables contributing to potential shifts in focus of attention of the athlete is based on self-reports from the athlete at multiple time points (e.g. practice versus competition) (Yamada et al. 2022). The baseball swing is performed at three distinct time points: in practice, on-deck prior (i.e. next batter up), and in-game. During practice, the batter has the opportunity to focus on the kinematics of their baseball swing to improve the predictability of success of their swing. When on-deck, the batter is preparing for their in game at bat (i.e. they are the next batter up). This preparation could include one, some or all of the following: 1) focusing on mechanical components of the swing (e.g. front foot placement during swing); 2) timing their swing with the ball release of the pitcher; 3) anticipating the scenario when at bat (e.g. game situation, pitch selection of the pitcher, etc.). Finally, during the in game at bat, the outcome of the batter's swing is essential (e.g. hitting baseball to open area of field, watching ball release from pitcher to recognize pitch type). To date, the potential shifting focus of attention of collegiate baseball batters as a function of the context they are required to perform the baseball swing (e.g. practice versus in-game) is unknown. We believe the results from such research would offer important practical implications for the coach and athlete regarding where to focus their attention during the different situations they are required to perform their swing. This is especially so since focus of attention during skilled motor performance is believed to be dynamic, such that the expert performer may alternate between an internal and external focus of attention based on the context (Ghose & Abraham, 2021).

To address this gap in knowledge, the purpose of the present study was to examine collegiate batters self-reported focus of attention preferences in practice, on-deck and in game contexts. The design study of this study was based on the idea that focus of attention is dynamic in skilled athletes (Gose & Abraham, 2021)

and potential shifts in focus of attention requires the assessment at multiple time points (Yamanda et al. 2022). We predicted the following: 1) For practice, collegiate batters would more frequently self-report a preference for an internal focus of attention based on monitoring batting technique; 2) For the on-deck, collegiate batters would adopt a focus of attention that was consistent with their individual goal such as a focus on release point of the ball from the pitcher (external focus of attention), or reinforcing proper batting mechanics (internal focus of attention); 3). For the in game at bat, collegiate batters were expected to more frequently report a preference for an external focus of attention (e.g. hitting to open areas of the field) based on the expectation the outcome of their baseball swing was the priority.

2. Methods

2.1 Participants

Seventeen male collegiate players (M=19.6 years, SD= 1.4) of a Canadian University men's baseball team participated in the study. Self- reported collegiate playing experience was an average of 2.6 years (SD= 1.4) and the mean batting average from the 2021-2022 baseball season was 0.281 (SD=.08). The inclusion criteria included individuals who play University level baseball and were required to bat during practices and in-games. A total of 9 right-handed and 8 left-handed batters participated in the experiment. Players assuming a pitching only role were excluded since they do practice their baseball swing or were they required to hit in a game. All participants provided informed consent prior to their participation. This research was approved by the Institutional Research Ethics Board.

2.2 Task and Apparatus

Collegiate batters were required to self-report their preferred focus of attention for the three time points they were required to perform their batting swing (i.e. practice, on-deck, and in-game). The questionnaire was completed in Qualtrics (Qualtrics, Provo, UT) and was modified based on the work of Diekfuss and Raisbeck (2016) who asked collegiate athlete's participants to self-report their focus of attention during practice and competition. In the present study, participants were provided a series of questions that required the participant to choose one of the five options that matched their preferred focus of attention. Two options were consistent with an internal focus, and two were consistent with an external focus of attention. If none of the options presented matched the participants preferred focus of attention, they were instructed to choose the 'other' option. When the 'other' option was chosen, participants typed their preferred focus of attention on the questionnaire. The 'other' option was always the last option on the questionnaire. Participants were unaware of which questions were considered an 'internal' or 'external' focus of attention. The questionnaire took approximately thirty minutes to complete. The beginning of the questionnaire consisted of questions querying the athlete's previous collegiate playing background (i.e. number of years playing at the collegiate level) and batting average of the just completed season). Importantly, participants completed the questionnaire upon completion of the baseball season to ensure all participants had at least one year of collegiate playing experience.

Table 1. *Self-report questions completed by the collegiate batter regarding their focus of attention during practice,* **on-deck** *and* **in-game** *at bats.*

What do you concentrate on the most when you are **practicing** (example: performing) your swing? Please choose the statement that best represents your answer.
1. How your body, legs and / or arms are moving or should move (internal focus of attention)
2. Important locations / areas in the surrounding environment (external focus of attention)
3. Position in batter's box (foot position, stance width, shoulder position) (internal focus of attention)
4. The implement you are using (the bat) (external focus of attention)
5. Other (options not included above): please type what you concentrate on while practicing:

Note. *The* **bolded** *statement* **'practicing'** *was changed to* **'on-deck'** *and* **'in-game'** *based on the time period the collegiate batter was asked to comment on. The bolded statements in brackets was the defined focus of attention preference, not visible to the participant.*

2.3 Experimental Protocol

Participants recruitment was initiated by emailing the Head Coach an information letter outlining the purposes of the experiment, and requesting participants. Interested participants were instructed to email the researcher directly. Seventeen participants met the inclusion criteria (i.e. current University-level baseball batter on a University team who batted in practices and in games). Participants meeting the inclusion criteria were then scheduled for an

online introductory meeting with the researcher. The purpose of this meeting was to provide participants information regarding how to access the questionnaire via the email link, and how to complete and submit the questionnaire once completed. This meeting had a mean duration of approximately twenty minutes. Once the meeting was completed, participants were sent a link to the questionnaire to their email address. Participants could only complete the questionnaire once, and could complete the questionnaire at their own pace. The researcher received an automatic email via Qualtrics once a participant completed their questionnaire. This study was completed during the national and provincial lockdown regulations in Canada due to COIVD-19. Thus, all questionnaires were completed remotely on the participant's computer.

2.4 Data Analysis

Frequency counts for internal, external and 'other' focus of attention options were calculated for the practice, on-deck and in-game portions of the questionnaire. Separate Chi Square analyses were used to identify if there was a statistically significant difference between the athlete's self-reported focus of attention (internal, external, and 'other') for the practice, on-deck and during in-game at-bats conditions. If a statistically significant difference was found ($p < 0.01$) for a particular context (e.g. practice, on-deck, and in-game), three post hoc Chi Square analyses were performed for that context: internal and external, internal and other, external and other. A Chi Square analysis was utilized since the collected data was nominal. Expected values were calculated by dividing the total reported values from the batting condition by the number of options the participants could select from (internal, external and 'other' focus of attention).

3. Results

3.1 Athletes Self-Reported Focus of Attention: Practice

Athlete: All collegiate baseball hitters (n=17, 100%) self-reported adopting an internal focus of attention during practice. A majority of collegiate batters (n=15, 88.42%) chose to focus on 'how their body or specific body segments moved during a swing', while 11.76% (n=2) self-reported to focus on their 'specific position within the batter's box'.

The Chi square analysis showed a significant difference between focus of attention instruction (internal, external, and other) during the practice condition at bats, X^2 (2, N=17) = 34, $p < 0.01$. A follow up Chi Square analysis also showed a significant difference between internal and external focus of attention, X^2 (1 N=17) = 17, $p < 0.01$.

3.2 Athletes Self-Reported Focus of Attention: On-Deck

The self-report results from the collegiate batters regarding their on-deck focus of attention showed 35.3% (n=6) self- reported an external focus and 35.3% (n=6) reported to focus on 'other' components, whereas 29.4% of participants (n=5) reported an internal focus of attention. For participants choosing an internal focus of attention, all selected 'how their body or specific body segments are moving during their at-bat'. The five participants (83.33%) who chose an external focus of attention, most selected to focus on 'important locations or areas in the playing environment', while one participant (16.67%) self-reported they focused or their bat (the implement). For the six participants choosing the 'other' option, their self-reports included timing swing to pitchers release; assessing situation; timing of front foot placement and stride; and focusing on the release point of pitcher for potential pitch type information (see Table 2). The chi-square analysis did not show a statistically significant difference between focus of attention instruction (internal, external, and other), X^2 (2 N=17) = 0.12, $p = 0.943$.

3.3 Athletes Self-Reported Focus of Attention: Game At-Bat

During in-game at bats, 76.47% (n=13) of collegiate batters chose options that were consistent an external focus of attention, 11.76% of participants (n=2) chose options that were consistent with an internal focus of attention, whereas and two individuals (11.76%) self-reported focusing on 'other' components. For the thirteen collegiate batters that chose an 'external' option, twelve participants (92.31%) selected focusing on 'important locations or areas in the playing environment' and one participant (7.69%) indicated an attentional focus on their bat during swings. For the two participants that selected options that were considered internally focused, one participant focus based on 'how their body or specific body segments are moving during a swing' while another participant self-reported to focus on 'their specific position within the batter's box'. For the two participants that chose 'other', participants reported to focus on 'timing of their movements with pitchers ball release' and 'maintaining focus on the ball to ensure proper shoulder position' (see Table 2).

Table 2. *Self-report responses of participant that chose the 'other' option for the on-deck and in-game at bats. Please note, no 'other' option was selected by participants for the practice portion of the questionnaire.*

On Deck	When I'm on deck, my focus is solely on the pitcher, timing my stride with his, and just getting every part of my swing on the same page with what I am about to face Ensuring timing is correct in the swing as well as assessing the situation so I can have a plan going to the plate depending on the circumstance in the game When I'm on deck, I focus on timing my foot movement and arm movement to the pitchers movements. This could mean making sure I get my foot down In time for me to start my swing or when I should start moving the bat. This will depend on how the pitcher goes through his motion, what his different pitches look like, how fast his arm movement is, etc. Timing the pitcher by focusing on contact of my front foot with the ground, specifically with the different pitches they throw (curveball, fastball, etc.). When I am on deck, I am focusing on getting my front foot down at the proper time for when the ball is in front of the plate, which allows me to generate the most amount of momentum possible Timing the pitcher and the tendencies they use. Pitch selection and location, getting my foot down on time, identifying spin and seeking what pitch is thrown. Thinking about mechanics in game gets me too in my head and will not perform as well.
In Game	When In game, it's a combination of my practice swings and on deck swings. I'm focused on my body's fluidity, utilizing what I've practiced with my swing and timing it with the pitchers movements (leg up, release of ball). Similar to on deck. More so on how hips are rotating and hands are getting to the ball. When I am at bat during a game, the most important thing going through my head is to have my eyes on the ball when it makes contact with my bat. This allows me to make sure my front shoulder isn't flying open as well as gives me the best chance at using all parts of the field.

The Chi Square analysis showed a significant difference between reported focus of attention instruction (internal, external, and other) during the in-game at bats, X^2 (2, N=17) = 14, $p < 0.01$. Statistically significant differences were noted between an internal and external focus of attention, X^2 (1 N=15) = 8, $p < 0.01$ and self-reported an external or 'other' focus of attention, X^2 (1 N=15) = 8, $p < 0.01$. Statistically significant differences were not identified between self-reported internal or 'other' focus of attention, X^2 (1 N=4) = 0, p = 1.

4. Discussion

The purpose of the present study was to identify collegiate batters self-reported focus of attention for contexts that included practice, on-deck and in-game at bats. To our knowledge, this was the first study to identify collegiate batters self-reported focus of attention preference for these three distinct baseball swing contexts. The present study differed from previous research in two important ways. First, collegiate batters in the presented study were asked to self-report their preferred focus of attention rather than be instructed to adopt a specific focus of attention (Castenda & Gray, 2007). Second, collegiate batters were asked to self-report their preferred focus of attention for the three contexts they are required to perform their swing. This study was an extension of previous research examining self-reported focus of attention preferences by collegiate athletes in such sports as soccer, tennis, golf and volleyball (Diekfuss & Raisbeck, 2016; Porter et al., 2010). We predicted the following: 1) During practice, an internal focus of attention would be most commonly reported based on the focus on improving swing mechanics; 2) when on-deck, self-reported focus of attention would vary between an internal and external focus of attention based on the individual batter preference and their goal when on-deck; 3) during in game at bats, an external focus of attention would be most frequently reported based on the importance of the outcome of their performance. Our predictions were mostly supported. A discussion of these findings follows.

For practice, we predicted the collegiate batter would most frequently self-report a preference for an internal focus of attention. This prediction was based on the previously highlighted importance of optimal batting kinematics and subsequent batting performance success (e.g. Welch et al. 1995). This prediction was supported. All collegiate batters (100%) self-reported a preference for an internal focus of attention (i.e. focused on their position in the batter's box, how their body segments moved during the swing). These findings are consistent with baseball pitchers who also self- reported a preference for an internal focus of attention when practicing components of the pitching technique (van der Graff et al. 2018). Our

findings also support the findings from collegiate soccer, tennis and volleyball players who also self-reported preference for an internal focus of attention during practice (Diekfuss & Raisbeck, 2016; Porter et al., 2010). Our findings for practice do not support the predictions of the constraint action hypothesis where an internal focus of attention would be expected to undermine motor performance. However, the self-reported preference to focus on the mechanics of the baseball swing (i.e. internal focus of attention) are seemingly consistent with the goal to improve batting mechanics (i.e. internal goal) during practice.

Examining preferred focus of attention for collegiate batters when on-deck context was rather exploratory since this context has previously not been considered. As outlined previously, the collegiate batter could prefer an external focus of attention, such as timing their swing with pitcher ball release, or an internal focus of attention, such as focusing on their batting mechanics. Thus, we predicted focus of attention preference would be based on the individual preference of the collegiate batter. As expected, the preferred focus of attention by collegiate batters on-deck was individual to the collegiate batter, and was not unanimous like the practice period. Collegiate batters self-reported a preference for an external focus of attention (i.e. their bat) or an internal focus of attention (i.e. 'how their body or specific body segments are moving during their at-bat') or 'other' sources of information not on the questionnaire (i.e. timing their swing to pitcher, front foot placement, pitcher tendencies, or game situations). Our findings are similar to Arnold and Sakar (2104) who found Olympic athletes varied in their self-reported focus of attention during their preparation for competition with some focusing on either their expected results (i.e. external focus of attention) or on technical components of the movement (i.e. internal focus of attention). Our findings offer novel in identifying the individualized focus of attention preference for collegiate batters on-deck. It is recommended the coach support the collegiate batter's autonomy in choosing where they prefer to focus their attention during their preparation for in-game at bat. The motor performance superiority of providing the performer autonomy in their choices prior to motor performance is well supported (see Sanli, Patterson, Bray & Lee, 2013 for review).

For in-game batting, we predicted collegiate batters would self-report a more frequent preference for an external focus of attention. This was especially so since the successful outcome of their swing (e.g. hitting ball to an open area of the field) was expected to be the focus. Our prediction was consistent with other sport skills research such as landing the golf ball close to the pin, basketball free throw, and standing long jump distance (see Werner & Federolf 2023 for review) where an external focus of attention led to superior performance. Our prediction was partially supported. Seventy-seven percent of collegiate batters self-reported they adopted an external focus of attention during their in game at bats. Such areas of external focus included areas of the playing field or their baseball bat. The findings from the in-game at bats, similar to the practice period, support the importance of consistency between the athlete's focus of attention (i.e. external) and the goal of the motor task (i.e. external: advance base runners, hit ball to open area).

However, we cannot ignore that some of the batters self-reported a preference for an internal focus of attention during in-game at bats. We find these results rather curious since an internal focus (e.g. focus of batting mechanics) is inconsistent with an expected external goal. The two participants that reported a preference for an internal focus of attention reported to focus on 'shifting their load from their back foot to front foot' and to 'stay relaxed'. Research examining the acquisition of tennis stroke technique has shown a preference for an internal focus of attention (Keller et al. 2023) by those with less skill. However in the present study, one collegiate batter was a first year collegiate player with the 4th highest self-reported batting average on the team, and the other had three years collegiate playing experience with the 6th highest self-reported batting average. Thus, a preference for an internal focus of attention by these batters seemingly does not undermine their in game at-bat performances. These findings are similar to the preference for an internal focus of attention by baseball pitchers (van der Graff et al. 2018), that similar to the baseball swing, the proper mechanics of the motor action increases the probability of a successful outcome. Much like the on-deck context, we suggest that although adopting an external focus of attention was preferred by most collegiate batters in the present study, the coach should also support the autonomy of the collegiate batter to adopt an individualized focus of attention.

In summary, the findings from the current study offers novel recommendations for the collegiate coach regarding focus of attention instructions during three distinct context the collegiate batter performs their baseball swing. Examining self-reported focus of attention preferences for collegiate batters when

in practice, on-deck and in-games has previously not been examined. Examining three time points was consistent with the recommendation of Yamada et al. (2022) who suggested examination at multiple time points to understand the variables contributing to athlete's potential shifts in focus of attention. Our findings did show collegiate batters focus do change their focus of attention based on context they are performing their baseball swing. For example, when practice batting mechanics, an internal focus of attention was preferred. However, during in-game at bats where the outcome of the at bat performance was critical, an external focus of attention was most frequently preferred. Providing the collegiate batter autonomy regarding where they prefer to focus their attention was highlighted in the on-deck and in-game context. The motor performance benefits of providing the performer autonomy over their choice of practice variables has previously been highlighted by Sanli et al (2013).

5. Conclusion

The findings from the present offer novel contributions to the coaching science literature regarding the use of focus of attention based on the context the collegiate batter is required to perform their swing. These findings are consistent with the idea that focus of attention instructions are dynamic for the collegiate batter based on the context (Gose & Abraham, 2021). The importance of providing the collegiate batter autonomy over their choice of where to focus their attention was highlighted, especially for the on-deck and in-game context. Future research should examine self-reports from the coach regarding where they instruct their collegiate batters to focus their attention during the three identified contexts the batting skill is performed. The findings from such research would identify whether the instructions provided by the coach are consistent with the self-reported focus of attention preference of the athlete. Finally, future research should examine preferred focus of attention of athletes of different batting skill levels (e.g. beginners compared to collegiate batters). Previous research has shown focus of attention instructions provided by the coach differ for learners of different skill levels (Keller et al. 2023). However, it is unknown the focus of attention preferences for the coach and of the batters of different skill levels. In summary, examining self-reported focus of attention preferences for baseball batters remains a fruitful area for future research with important applications to coaches and athletes.

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