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The Effect of Choice on Throwing Speed in Baseball Players

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THE EFFECT OF CHOICE ON THROWING SPEED IN BASEBALL PLAYERS

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Abstract

Incidental choices have been identified as one way to support the need for autonomy. The purpose of this study was to determine if choice in type and color of wrist tape would influence throwing speed in baseball players. Participants were experienced male baseball players from a local high school. All participants performed 10 throws under choice and no-choice conditions. Throwing speed did not differ as a function of choice versus no choice. Possible explanations and limitations of the present study are discussed.

Keywords: Incidental choices, autonomy, baseball, throwing

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Chapter 1: Introduction

Autonomy is a basic psychological need. It is related to an individual's ability to control or determine their own actions and behaviors (Halperin, Chapman, Martin, Lewthwaite, & Wulf, 2016; Lewthwaite, Chiviacowsky, Drews, & Wulf, 2015; Hooyman, Wulf, & Lewthwaite, 2014; Carter & Ste-Marie, 2017). It is essential to well-being and quality of life (Halperin et al., 2016; Wulf, Freitas, & Tandy, 2014; Langer & Rodin, 1976; Wulf & Adams, 2014). The ability to express autonomy can be done through choices and having control over situations (Wulf et al., 2014).

When a choice is given to a participant, it has been shown to facilitate motor learning (Halperin et al., 2016; Carter & Ste-Marie, 2017) by creating a more effective learning environment (Hartman, 2007). Choice also increases motivation to perform well (Halperin et al., 2016; Tafarodi, Milne, & Smith, 1999) and is a crucial variable to enhance a participant's sense of control over a situation (Langer & Rodin, 1976). Not all choices have to be related to the task at hand, they can be incidental as well. Previous studies have shown that incidental choices strongly effect intrinsic motivation (Tafarodi et al., 1999; Wulf et al., 2017) and behavior (Wulf et al., 2017), increase motivation and performance (Wulf et al., 2014), boost self-perception of performance (Tafarodi et al., 1999), and benefit skill learning compared to conditions that don't provide autonomy support (Lemos et al., 2017). Participants can experience these kinds of choices as meaningful ways to express themselves as an individual. Once choice is an option, anticipation of future choices activates the reward circuitry in the brain causing dopamine to pair with the experience and enhances the participants' memory

(Wulf et al., 2017). Motor skill learning is also enhanced when participants are given control over aspects of a task (Lewthwaite et al., 2015; Carter & Ste-Marie, 2017; Hartman, 2007; Wulf, Raupach, & Pfeiffer, 2005). Having control allows participants to promote their use of self-regulation strategies that leads to deeper information processing (Lewthwaite et al., 2015; Hartman, 2007; Wulf & Toole, 1999). Participant control over practice conditions can be more motivating and satisfy their need for autonomy (Lewthwaite et al., 2015; Hooyman et al., 2014).

Practice conditions that allow for participants' fundamental psychological needs to be supported create an environment that optimizes performance and learning (Hooyman et al., 2014). Wulf and Lewthwaite incorporated this idea in the OPTIMAL Theory (Wulf & Lewthwaite, 2016). This theory was built on the concept that motor learning can only be understood when the influence of motivation (autonomy and enhanced expectancies) and attention (external focus) on behavior are considered. To ensure our psychological needs are fulfilled, these influences must be met and not threatened (Wulf & Lewthwaite, 2016). Motivation is dependent on a participant's actions influencing their environment. Instructional language also has an impact on motor learning (Wulf & Lewthwaite, 2016). Autonomy-supportive instructions for a task can positively influence participants' learning and motivation (Wulf & Adams, 2014), give them confidence, and induce positive affect (Hooyman et al., 2014). Enhanced expectancies enhance learning by increasing a participant's perception of competence or self-efficacy (Wulf & Lewthwaite, 2016). Participants' expectancies are enhanced to a greater level when they are told how well they are performing. This allows participants to focus on a task, reduces their self-focus, and frees up other resources for attention during performance. When focus is driven away from the body and to the intended

movement, performance and learning are enhanced. Movement patterns become more efficient and less energy is used to achieve the intended goal. Autonomy, enhanced expectancies, and external focus are necessary for complete focus on a task to occur and drive motor performance and learning.

The purpose of this study was to look at baseball athletes and incidental choices involving color and types of wrist tape options to see if those incidental choices would affect throwing speed. Baseball athletes participated in the study during spring season at a local high school. Literature is extensive in novice learners (Halperin et al., 2016; Lewthwaite et al., 2015; Wulf et al., 2014; Wulf & Adams, 2014; Carter & Ste-Marie, 2017; Wulf et al., 2017), but only one has experimented with skilled athletes (Halperin et al., 2016). Tape color was used due to previous studies (Lewthwaite et al. 2015; Carter & Ste-Marie, and Wulf et al. 2017) having success with color being an incidental choice. Different wrist tape options were added as another incidental choice, but one that has not been referenced in literature before. We hypothesized that when given the opportunity to pick the wrist tape option and color of tape, the choice condition would produce faster throwing speeds than the yoked control condition. That is, when baseball athletes had a choice, we expected their throwing speed to be higher compared to the control condition. We also expected there to be differences in the questionnaire responses with what color and type of wrist option they threw faster with.

Chapter 2: Literature Review

The purpose of this study was to look at baseball athletes and incidental choices involving color and types of wrist tape options and see if those incidental choices would affect their throwing speed. Studies on autonomy support have been circulating through literature for decades and nearly all of them focus on novice learners. This literature review will analyze the use of autonomy in relation to assistive devices, feedback control, instructional language, and choices. These studies are reviewed next.

Assistive Devices

Having the ability to control the way you learn a task effects the learning process. A way to enhance learning is to let participants choose when they want to receive feedback. Previous research shows that participants who could select (choice) when they received feedback performed better during retention tests than those who had no choice (yoked) in when they received feedback. It is assumed that assistive devices enhance learning by allowing the participant to feel for a movement goal, have a reduction in errors, and giving security to participants in certain situations.

Wulf and Toole (1999) examined the effects of a learner-controlled practice schedule with the use of assistive devices to aid in learning a ski-simulator task. To examine whether self-controlled or yoked conditions had different effects on participants' fear of falling or certainty about reaching maximum amplitudes, the participants filled out a questionnaire after every other practice trial. Participants were randomly assigned to self-control and yoked groups to move the ski stimulator platform that they were standing on as far right and left as possible. Before practice began, the self-control and yoked groups were told that using poles

would enhance learning of this task and the self-control group was encouraged to use them whenever they wanted. The yoked group was handed the poles during the trials their counterparts used them. Both groups were informed they could not use the poles on the third day. The task was practiced on two back-to-back days and performed on a third day with seven 90-second trials and 90-second breaks between trials. A questionnaire on certainty between groups with falling and reaching maximum amplitudes was given after the first, third, fifth, and seventh trials on both practice days. There was an increase in movement amplitudes and both groups showed similar performances across the two days of practice; however, performance gains on day one compared to day two were greater. The retention test showed differences between groups, with the self-control group demonstrating more effective learning (larger amplitudes) than the control group. The questionnaire data showed that participants became less afraid of falling across practice and became more confident that they would not fall. Question three showed that participants were unsure about reaching maximum amplitudes by the end of the experiment. There were no differences between groups. Wulf and Toole (1999) allowed participants to select when they wanted physical assistance affected learning. Whether or not participants could select when to use the poles did not affect fear of falling or confidence that they would achieve the task goal.

Hartman (2007) examined the relationship between self-controlled conditions and the participant's perception of when and how to use assistive devices while performing a balancing task. Undergraduate students were randomly assigned to self-control and yoked groups and balanced on a stabilometer for several 30-second trials. The self-controlled and yoked groups were told that using a balance pole would facilitate learning. The yoked group was informed

they may get the chance to use the balance pole, whereas the self-controlled group was encouraged to use the balance pole. Those in the yoked group would be handed the balance pole depending on when their counterpart in the self-controlled group asked for the pole. This balancing task was done for 20 trials (10 30 second trials on each practice). After practice each day, a questionnaire about when/why they asked for the pole (after good/bad/equal/random trials) and when they didn't ask for the pole (good/bad/other trials) was given. On the third day, the balance pole was not given and 10 30-second trials were performed. Results showed that the self-control group requested the assistive device after 32% of practice trials. Average frequency of pole use was 38% on day one and 27% on day two. Self-control group used the assistive device less often on day two compared to day one. Significantly better performance scores were shown in no assistive device trials compared to trials when the assistive device was used. Regarding performance scores, both groups increased their time in balance during practice. The self-control group performed the task significantly better than the yoked group. The retention test showed that the group effect was significant with the self-control group) performing better than the yoked group. The questionnaire results showed that after day one, the self-control group asked for the pole for a new strategy 44% of the time or for other reasons 44%. Day two showed the same response with 44% wanting the pole for other reasons, but 22% wanting the pole for new strategy. Of those in the yoked group, 55% would have wanted the pole when attempting a new strategy on day one. On day two, 77% said they did not receive the pole after the right trial. Hartman's results support that self-control conditions facilitate learning because participants can choose when to have assistance in a self-performance strategy. This translates to their perception of success in the task given.

Observational Learning

Learning by observation is a common technique used in motor skill teaching. Although physical practice is considered the most effective, observational learning is still an applicable teaching method. Observational practice can allow the observer to process things that might not be possible in early practice of complex skills. A participant can pull information about coordination, take requirements, and evaluate effective strategies that would be difficult to do while practicing the task. Through observational learning we can examination a participant's self-efficacy, positive affect, and thoughts during practice and see how it affects retention.

Wulf, Raupach, and Pfeiffer (2005) compared the effectiveness of a self-control modeling condition with a yoked condition. Participants learned about the basketball jump shot and practiced it under self-controlled or yoked observational practice conditions. Participants were randomly assigned to one of the conditions. All participants were told they would practice the basketball jump shot, have 25 practice trials, and be retested one week later. Participants were instructed that the throws were to be done from the free-throw line and to hit the basket. It was emphasized that movement quality was important. A video of the basketball jump shot was presented and the participants were asked to match the movements as close as possible. Their shots were recorded, and movement form and accuracy of shots were assessed. Instructions were different for both conditions. The self-control group was told they could watch the video at any time as often as they wanted during practice. They were told to use it as a reminder or to observe specifics of the technique. The yoked group was told the video would be shown to them from time to time during practice as a reminder to observe specifics of the technique. The retention test had 10 trials with no video available, but the

participants were told to pay attention to quality of movement and throwing accuracy. Movement quality had the following criteria: 1) stable throwing position resulting from the vertical jump; 2) the ball lifted to forehead height in conjunction of jumping motion; 3) elbow is under the ball pointing to the basket with a 90° angle between the upper arm and upper body; 4) delayed throwing motion with the ball released before or at the highest point; 5) throwing arm hand is under the ball with the other hand supporting the ball from the other side, with the wrist flexed during throwing motion; 6) arm is extended in the follow through. Movement accuracy measured by points: five for the ball going through the basket; three if the ball touching the rim; two if the ball touches the board and rim; one if the ball only touches the board. Results from the practice phase show that the self-control condition requests for the video went down from eight in the first block to one in the fifth block. In relation to form, the self-control participants had greater improvement compared to the yoked condition. During retention, the self-control condition had higher form scores compared to yoked. When participants were given the opportunity to choose when to see the video, it was effective. While the yoked participants showed a decrease in performance, the self-control group did not. This could suggest that more effective information processing occurs compared to those that don't have self-engagement control; that is participants could be pulling more pertinent information from the video demonstrations when they have control over the schedule versus no control.

Lemos, Wulf, Lewthwaite, and Chiviacowsky (2017) conducted a study to test expectancy-related predictions with autonomy support on learners' self-efficacy, positive affect, and thoughts during practice. Adolescent girls with an average age of 11 years were

recruited from a southern Brazilian city. The task the girls had to learn were movement forms associated with five classical ballet positions: preparatory, *demi plié*, *tendu* in second position of arms and legs, *passé* with arms in first position, and *elev*é with feet in first position. Participants were randomly assigned to a choice or control group. At the beginning of practice, participants were shown pictures of the five ballet positions. Along with pictures, they were given a verbal description of the tasks. Participants performed the first trial. After, the choice group was told they could ask for video demonstrations of any of the positions at the beginning of any practice trials remaining. Those in the control group were told the experimenter would occasionally show a video demonstration of the tasks. The control group was yoked with the choice group. Fifty trials were in the practice phase and the retention test occurred a day later that had 10 trials with no reminders or demonstrations. Assessment of movement was done by movement form. One point was awarded for each correct feature and no points for incorrect ones. A maximum score of 25 points could be given for each trial. Before the beginning of practice, after practice on day one, and the retention test on day two a five-item self-efficacy questionnaire was given, rate from 1-10 how confident they were to perform any or all positions, rate their happiness on 200 mm line marked “not at all happy” and “very happy”. At the end of the practice phase an open question about what they were thinking while practicing the ballet task was asked. Demonstrations were requested 17.2% of the time from participants in the choice, with requests declining across practice blocks. During practice, the choice group showed better form scores in relation to the control group. In relation to self-efficacy, ratings were similar for both groups before practice, but the choice group had higher self-efficacy at the end of practice. Before the retention test on day two took place, self-efficacy was higher in

choice (8.0) compared to the control group (4.9). At the end of practice, the choice group had greater positive affect compared to the control group. In relation to the thoughts during practice, 9/12 participants responded with a task focus; whereas 1/12 responded with a self-related focus, and 2/12 had no focus on the task at all. In the control group, several participants reported non-task-related thoughts. Those in the choice group had more positive or neutral thoughts, whereas those in the control group had reported negative thoughts. During the retention test, participants in the choice group outperformed the control group. Lemos et al.'s study showed that giving participants a choice with video demonstrations supported their need for autonomy and allowed for an intrinsic reward opportunity. This led to more effective learning. The feelings of self-efficacy and positive affect correlate well with learning and allowed the choice group to do better than the control. This related to the OPTIMAL theory of motor learning that states a person's perception of autonomy has an effect on their motivation and that can affect learning (Lemos et al., 2017). Having a sense of autonomy though supportive language allows participants to feel happier and increases their confidence to accomplish the task. Autonomy seems to reduce stress and non-task, self-focused attention.

Andrieux, Danna, and Thon (2012) analyzed the influence of difficulty in self-controlled tasks on motor learning via the challenge point hypothesis. The challenge point hypothesis states that for a learner to interpret information, they have to reach a level of difficulty in the task to facilitate learning (Andrieux et al., 2012). Participants sat in a chair facing a computer, keyboard, and a color monitor and had their right hand to move a stylus on the digitizer. There was a choice and no choice group where the choice group could choose the racquet width at

the beginning of each trial. The control group was yoked to the choice group in relation to racquet width and they were told the racquet width would change from trial to trial. The task was to intercept three targets going from top to bottom of the screen by moving the racquet from left to right to intercept the first target, reverse the movement to the left to intercept the second target, and reverse the movement to the right to intercept the third target. At the start of the trial, all targets appeared on the screen in their starting positions and the participant would start the trial by pressing the stylus. The targets would then move at their own speeds. If a target was intercepted, it disappeared; if a target was missed it remained on the screen until it hit the bottom. The screen provided knowledge of results (KR) at the end of the trial in relation to targets being intercepted or not. There were 100 trials in the practice session and the immediate retention test had 20 trials after 15 minutes of rest. A delayed retention test occurred the next day with 20 trials, a smaller racquet width, and no KR given. Results show for the practice trials, the constant error (CE) group effect was not significant. The more participants practiced blocking the target, they better they got over time. Those in the self-control group were more accurate compared to the yoked group. Accuracy in both groups became better with trials. The self-controlled difficulty group was more consistent compared to the yoked group. Intercepted targets had no significance across trial or between groups. Racquet width that was chosen by the self-control group decreased across trials showing increase in task difficulty during sessions. There was a correlation between racquet width as a function of performance in previous trials. This study concluded that motor skill learning improves when a participant can adjust aspects of the training parameters. Referring to the challenge point hypothesis, if a task is too easy, it shouldn't add to the learning process. If a

task is too difficult, success is small, and the task information is too much to be processed efficiently. Overall, when we give participants some control over the practice parameters, motivation tends to increase the need to perform and learn.

Instructional Language

Autonomy-supportive instructions give a sense of trust that can contribute to task-specific self-efficacy. Hooyman, Wulf, and Lewthwaite (2014) examined the influence of autonomy-supportive (ASL), controlling (CL), and neutral instructional language (NL) on a motor learning skill. Participants did a modified cricket bowling action and were randomly assigned to one of three groups: ASL, CL, NL. The difference in the groups was the voice-over instructions that were in the video they watched of the bowling action. The video showed the bowling action with a tennis ball to a target that was hung in a net from 10 m and the target was a bullseye. The video showed the skill demonstration from different angles. This clip was shown before each block of 10 practice trials with the first 10 trials being a pre-test. After the participants completed 60 total trials, they filled out a questionnaire that had three questions about their perception of choice. There was a rating scale the participants used from a scale of one (no choice) to 10 (a lot of choice). A self-efficacy measure was included in the questionnaire. It had three statements about the participants' confidence to obtain an average score in relation to the bullseye (five for the bullseye and four to zero for the surrounding areas). The Positive and Negative Affect Schedule (PANAS) was used to see positive and negative effect through adjectives. Participants had to rate each word from one to five (not at all to extremely). A retention test of 20 trials was performed a day later with no video demonstration or instructions. The same questionnaire from day one was also filled out.

Throwing accuracy during practice was higher for the ASL group relative to the other groups. Retention test results showed that the ASL groups had the greatest accuracy and the CL group has the largest errors. Hooyman et al. (2014) demonstrated that when a skill is learned, it can be enhanced with autonomy-supportive language. Key words such as "you may, feel free, here's a hint" seemed to be necessary to give a sense of autonomy to the participants. Using controlling instructional language can alter a participant's confidence and not allow them to do well. Autonomy-supportive language has shown greater perceived competence (Wulf & Adams, 2014). Once again, allowing for autonomy gives participants confidence in their ability to do well and results in positive affect.

Langer and Rodin (1976) conducted a field experiment to examine the effects of responsibility and choice on a group of nursing home residents. Participants were put in a responsibility-induced condition and a comparison group. A nursing home administrator introduced the experiment. The responsibility-induced condition received instruction that they have more influence over their own lives and they can make decisions, give their own opinions. The comparison group received instruction that the nursing home is providing them options and that it is the nursing home responsibility to make the environment the best it can be. Questionnaires to assess the effects of induced responsibility were given one week prior and three weeks after communication. The residents had to rate how happy and active they were on an 8-point scale (zero is none, eight is total). The research assistant then rated the resident on an 8-point scale of alertness. A second questionnaire was filled out by the nurses about happiness, and how alert, dependent, social, and active the residents were, as well as their sleeping and eating habits. Results based off the questionnaire revealed the residents in the

responsibility-induced group were significantly happier by 48%, compared to the control group at 25%. Langer and Rodin (1976) proved that when you allow for more sense of responsibility in an older population, over time it will produce improvement in involvement in responsibilities they didn't take part in previously. Giving the opportunity to make decisions creates a feeling of competence.

Incidental Choices

Motor learning is enhanced when participants are given control over their environment (Lewthwaite et al., 2015; Carter & Ste-Marie, 2017; Wulf et al., 2017). Having choice over control is intrinsically rewarding (Halperin et al., 2016; Carter & Ste-Marie, 2017; Tafarodi et al., 1999) and drives the participant's ability to engage in strategies for task performance (Carter & Ste-Marie, 2017) and promotes deeper processing of relevant information (Lewthwaite et al., 2015). Incidental or irrelevant choices have shown to have stronger effects on intrinsic motivation and participant behavior. When incidental choices are introduced, participants may think of this as a way to express their individuality (Wulf et al., 2017) and the situation becomes more meaningful and respectful (Carter & Ste-Marie, 2017). Incidental choices intensify the drive to do well, promote performance, and increase confidence (Tafarodi et al., 1999).

Carter and Ste-Marie (2017) investigated how relevant and irrelevant tasks affect motor learning. Fifty-four healthy participants were put in three groups: task-relevant, task-irrelevant, and no-choice. The participants were to perform two rapid extension-flexion reversals of the elbow of their non-dominant arm to create a target waveform as accurate as possible. The movement time goal was 900 ms in both practice and retention. In all experimental phases, participants faced a computer monitor with their left forearm in an arm rest so that the elbow

was bent at 90° and attached to a manipulandum. The arm-wrap was placed around the left forearm and armrest and only used during practice. The task-irrelevant group was allowed a choice between two video games to play at the end of day two and which arm wrap color to be used during the task. The distinction between the groups was the relevant group was asked during practice and the irrelevant group was asked before practice. Those in the no-choice group had choices made from them regarding color and video game. All participants were told the arm wrap was to help keep their arm in the correct position. Those in the task-irrelevant and no-choice groups were yoked to the participants in the task-relevant group. All participants had instructions about the task and movement time goals (900 or 1,150 ms) along with three feedback displays shown so there was an understanding of how feedback was given. There was a visual "Get Ready" and "Go" signal where the participants would start the movement. The practice phase was six blocks of 10 trials. After each block, questions on a 7-point Likert scale were answered to assess competence and autonomy. The retention and transfer tests involved one block of 10 no feedback trials and participant had to estimate their errors with respect to their movement time goal after each trial. Results from this study concluded that performance accuracy increased in all groups. The task relevant group had the lowest errors in retention and transfer tests compared to the control group. This study leans more towards motivational factors as primary mechanism for exercising choice as it is intrinsically rewarding and supports participants' fundamental need for autonomy. Due to the lack of significance, Carter and Ste-Marie (2017) proposed that motivation is the root for self-controlled learning advantages. This was preliminary evidence that task-relevant and task-irrelevant choices are not equal in

learning motor skills. The authors argued that, if a participant is going to be provided choice during a task, the task should be related to what they are doing.

Wulf, Iwatsuki, Machin, Kellogg, Copeland, and Lewthwaite (2017) conducted two experiments with throwing a lasso. The authors wanted to examine issues related to motor learning when participants are given a choice. Participants were randomly assigned into either choice or control groups with the task to throw a lasso over an orange plastic cone. Both groups were shown a two minute 16 second video of how to throw the lasso. The point system for lasso throwing was as follows: two points for throwing it over the cone, one point if it just touched the cone, and no points if it was a complete miss. A five-trial pre-test was given where a white mat was used under the cone. Then a 15-trial practice phase occurred where the choice group chose the color of the mat, and the control group was told the experiment would change the mat color before a three-trial block. The control group was yoked to the choice group. A day later a retention test was done with 10 trials and a white mat was used. To assess the participants' affective state, the Self-Assessment Manikin was used. It consisted of faces showing emotions and with numbers under each emotion (lower numbers were better). This scale was used before the pretest, after practice, and before the retention tests. Throughout practice, the choice group had better throwing accuracy, higher scores, more positive affect than the control group. Affect explained 25% of the variance but was not a predictor of retention performance. An incidental choice, color, led to more effective learning. The amount of affect a participant experiencing could impact the amount of dopamine release and the response on motor learning and memory. A second experiment was done to compare the effectiveness of task-relevant and irrelevant choices. In experiment two, the task-irrelevant

choice stayed the same (mat color). The task-relevant choice allowed participants to view more video demonstration of the skill during practice. The task was like experiment one; however, the video was only one-minute long. Participants were shown the video and did a five-trial pretest with the white mat under the cone. Then 18 practice trials occurred under three conditions: task-irrelevant (choice-mat) select the color of the mat before each block of three trials; task-relevant (choice-video) saw the one-minute video at their own request before each block of three trials; control group (no choice) were yoked to participants in the previous groups. Those in the choice-mat group were yoked to choice-video and vice versa. A retention test was performed with 10 trials with a white mat. The retention test revealed that choice-mat and choice-video groups had higher throwing accuracy and scores compared to the control. Wulf et al.'s study follows what other studies have found, that participants who are given a choice have more effective skill learning than those without a choice. Choice is intrinsically rewarding and anticipating the choice can be beneficial for learning. In this and previous experiments, choice is a motivator to do a task well. Choice increases the activity in our brain that is related to reward. When we do well, those areas in our brain related to reward allow for memory consolidation. Giving participants control (with choice) enhances motivation and expectation to perform well.

Lewthwaite, Chiviacowsky, Drews, and Wulf (2015) conducted two experiments and hypothesized that learning can be enhanced when you give participants choices. In the first experiment, participants were quasi-randomly assigned to two groups: choice and yoked. The task was to putt a colored golf ball to a target that was placed on the floor at a short distance from the participant. There were circles around the target that served as performance accuracy

zones. Points were awarded as the following: 100 for bullseye, 90 to zero were awarded it the ball landed in one of the other zones or outside the circles. Those in the choice group were told they could choose the color of the golf ball and change it or not after every 10 trials. The yoked participants were told the experimenter would choose the color used before each block of 10 trials. Sixty trials were performed during the practice phase and a retention test a day later was performed with only white balls and 10 trials. The choice group had greater putting accuracy than the yoked group did on the last four of six blocks. On the retention test, the choice group had better putting accuracy (36.8) compared to the yoked group (26.4). When participants are given an incidental choice, such as color, learning is promoted and enhanced. The second experiment was conducted to rule out that participants had developed expectations that a certain ball color "worked." Lewthwaite et al. examined a more distinct unrelated choice and saw if it had an impact on the task. Participants in this study agreed to balance on a movable platform. The goal was to keep the platform as horizontal as possible during 30 second trials. Participants were quasi-randomly assigned to choice or no-choice groups. They were told to keep the platform as horizontal as possible and feedback about their time would be given after practice trials. Before the start of the practice trials, the choice group was presented with two incidental choices: 1) would they want to do a timing or hand dynamometry task; and 2) which of the two Renoir paintings would they want to have on the examination wall. Those in the no-choice group were told two things were already decided for them: 1) there were two tasks they could be done the next day; and 2) and the painting would be on the wall (this was shown to them). Following this, all participants did 10 trials on the balance platform with 30 seconds for each trial followed by 90 seconds of rest between the trials. The retention test was five 30-

second trials with 90 second breaks without feedback that was done a day later. Those in the choice-group increased their times faster than the yoked group. Longer times in balance were shown in the choice group on the retention test. Lewthwaite et al.'s results still show that incidental choices enhance skill learning because it is an autonomy-supportive condition that channels a sense of respect for the participants' capabilities, and this increases their confidence and self-efficacy.

Wulf and Adams (2014) examined whether giving participants incidental choices would enhance learning of exercise routines. Participants were randomly put into choice or no choice groups. They had to perform thee balance exercises with each foot, but they started with the dominant. Choice participants could choose the order of exercises before practice after they were demonstrated. The control group was yoked to the choice group and was told the order they would perform. The exercises were: 1) toe touch (single leg balance and touching the ipsilateral toe with the ipsilateral arm for 30 seconds continuously); 2) head turn (stand on one leg and rotate to the left-then forward, to the right-then forward, and looking down-then forward all for three seconds each; 3) ball pass (stand on one leg and catch a medicine ball 10 times. The number of errors (each time the opposite foot touched the floor) were calculated for each set. A retention test was done with two sets of each exercise with each leg done in the same order as practice. Results from the practice phase revealed errors decreased across sets and the choice group has smaller errors compared to the no-choice group. Allowing participants the decision of task order impacted their performance and learning. The choice group had fewer errors during practice and retention tests. This shows a single choice is enough to produce an advantage in learning. Supporting participants' need for autonomy can

be critical for their learning. When participants are allowed a choice, it gives trust and that will increase their confidence to do well.

Wulf, Freitas, and Tandy (2014) examined whether motivation to exercise could be increased with incidental choices. Participants were randomly assigned to choice and control. A baseline fitness test was performed to ensure participants were comparable in relation to fitness levels. One day after, a 10-minute warm-up was done and a workout program of lunges, jumping jacks, bear crawls, and medicine ball throws was performed. A demonstration of all exercises was given. Those in the choice group chose the order to perform the exercises and the control group was told the order they would perform the exercises. All participants decided the sets and repetitions to complete and they had to be same for all exercises. Following the exercises, participants were led in a cool-down. The sets and repetitions were analyzed in a univariate ANOVA. Regarding the total number of repetitions, the choice group did more sets compared to the control group. There was significance in the total repetitions for choice than the control. The choice group performed 60% more repetitions than the control group. Providing a small choice impacted motivation to work out in a positive way. When choices relate to a participant's interest and are not hard to figure out, they can be motivating.

Halperin, Chapman, Martin, Lewthwaite, and Wulf (2016) conducted two experiments with self-controlled practice to see if motor learning is enhanced with athletes performing familiar skills. The first experiment examined if autonomy-supportive conditions enhance punching performance of a kickboxing world champion. They looked to see if giving choice in relation to order of punches would affect velocity and impact forces. An elite kickboxer, male, was used in this study. He was an amateur K-1 league kickboxing world champion and a

professional kickboxing world titleholder in the 57 kg division. His record was 21-10. He trained competitively for seven years and did six to ten training sessions per week. Punches were delivered to a custom-built punch integrator mounted and made of load cell with an integrated amplifier bolted to a metal plate that was covered with a foam pad wrapped by leather. The participant completed six testing sessions that were separated by two to four days in a choice (A) and control (B) counterbalanced order on 6 days (AB-BA-AB-BA-AB-BA). The same 16 oz boxing gloved were worn each testing day. Instructions to "focus on punching the pad as fast and forceful as possible" were given. It was thought that these instructions would stimulate an external focus of attention. There was a 10 to 15-minute self-selected warm-up, and then the punching protocol was performed under two conditions (choice and control). The control condition consisted of 12 single, maximal effort punched in the following order: lead straight, rear straight, lead hook, rear hook all of which was delivered three times in a row. A five-second rest was given between each punch. The choice condition the same number and type of punches were delivered, but the participant could choose the order. One-minute of rest was provided between choice and control conditions. Five-second rest was also permitted between punches. Cohen's *d* effect sizes (ES) were calculated for mean differences in punches between conditions. Results show that velocities and forces were greater in lead straight, followed by the rear straight, lead hook, and rear hook. These results show that choice had a positive effect on performance of a world-class athlete who you would expect to a mastery of this skill. This experiment supports the view that when autonomy is satisfying, even for elite athletes. A second experiment was done to support the first experiment, but with a larger sample size. Thirteen amateur kickboxers volunteered for this study. They were classified as

amateur due to competing only in national-level events and did one to six competitive national bouts. The participants training for one year as a minimum, for at least three times a week, and did between five to seven weekly sessions. The punching apparatus was the same and so was the task with the exception that the participants did two testing sessions separated by two to four days in a counterbalanced order (AB-BA or BA-AB). When participants chose the order of the punches, their velocities were higher compared to the control. The rear hook had the highest velocities. Forces were greater in the choice compared to the control group. Differences in the lead straight were significant. The rear hook had the greatest force, except the rear straight and lead hook that had no significance. Impact forces were higher on the first day of testing compared to the second day. Halperin et al.'s study demonstrated that when amateur athletes are given the opportunity to choose the order of punches, it increased their punching velocity and force. This was likely due to the enhanced sense of autonomy and competency that improved performance. Findings from this study demonstrate that giving participants choices can enhance learning of novel skills and improve performance of elite athletes who have experience in the task.

Purpose of the present study

The purpose of this study was to examine the effects of incidental choices on throwing speed in baseball athletes. We hypothesized that the opportunity to pick the wrist tape option and color of tape (choice condition) would lead to faster throwing speeds than no choice (yoked control condition).

Chapter 3: Methodology

Participants

This study used a convenience sample of 4A Clark County School District (CCSD) high school athletes from the 2016-2017 varsity and junior varsity baseball teams. The principal, Athletic Administrator (AA), and head coach of the baseball team granted approval for this study. Prior to testing, participants and their parents were introduced to the study. Participants provided their assent, and parents/guardians signed informed consent forms. The population characteristics of the exclusively male population are shown in Table 1. The study was approved by the University of Nevada, Las Vegas Institutional Review Board.

Table 1: Population Characteristics

Number of participants	Age (years)	Weight kg)	Height (cm)	Years of experience (avg)	Throwing arm
N=19	15.89	70	175.26	9.5	4L/15R

Apparatus and Task

The task was to throw a total of 20 maximum-effort pitches with PowerFlex taped to the wrist of their pitching arm. Pitching speeds were measured using the Jugs R2050 Radar Gun with ± .5 miles per hour accuracy (see Appendix A: Jugs R2050 Radar Gun) and written onto an Excel spreadsheet (see Appendix B: Excel Spreadsheet) following each pitch.

Procedure

Participants arrived at the public CCSD high school baseball field. These athletes were randomly assigned to groups that performed the choice first or second. Each participant took part in their regular baseball warm-up on the baseball field for 10 minutes. After, the participants went to the baseball clubhouse adjacent to the baseball field to meet with their

Athletic Trainer (AT). In the baseball clubhouse, the participants were instructed by their AT that they were going to watch two videos via laptop on two different wrist tape options. The videos demonstrated what the Type A and Type B wrist tape options were (see APPENDIX C: WRIST TAPE OPTIONS). Each participant was then told to choose which option they wanted or were told which option they would receive, respectively. Participants were then shown three colors of PowerFlex – green, blue or red – and could choose or were told which color they would have. After, each participant went to the baseball pitching mound.

At the baseball pitching mound, the participants were told by the blinded volunteer who was measuring pitching speeds that they would perform two warm-up pitches followed by 10 fast ball pitches. Each participant was instructed to throw the ball as fast as they could and that they would have five minutes to complete 10 pitches. Following the 10 pitches, the participants went back to the baseball clubhouse where they chose (or not) another wrist tape. The participants who were in the choice condition were now in the no choice condition and vice-versa. The same protocol as above was followed.

Following the second set of measured pitches, the participants went back to the baseball clubhouse and received a questionnaire from the AT. The questionnaire (see APPENDIX D: QUESTIONNAIRE) included the following questions:

1) Which tape job do you think you threw faster with and why (the one you chose or the one chosen for you)?

2) If you could throw with wrist tape on again which tape option would it be and why (the one you chose or the one chosen for you)?

3) How many years of experience do you have playing baseball (club and high school)?

Each participant was allotted five minutes to answer the questionnaire.

After the questionnaire was completed, the participants were thanked for their participation.

Data Analysis

Throwing speed was analyzed in SPSS (Version 25) using a 2 (Conditions: choice, no choice) x 10 (Trials) analysis of variance (ANOVA) with repeated measures on both factors. To analyze the questionnaire data, chi-square tests were used. Random assignment for the no-choice condition was done via endmemo.com

Chapter 4: Results

Chosen tape and color

All participants participated in both choice and no-choice conditions. These data are presented in Table 2 and 3.

Table 2: Color of tape in choice and no-choice conditions (First number = trial 1; Second number = trial 2)

Color	Choice	No Choice
Blue	5; 3	3; 1
Red	1; 3	4; 4
Green	3; 4	3; 4

Table 3: Type of wrist tape in choice and no-choice conditions (A = no twist, B = twist; First number = trial 1; Second number = trial 2)

Type	Choice	No Choice
A	5; 6	5; 4
B	4; 4	5; 5

Throwing speed

Throwing speeds across trials in the choice and no-choice conditions are shown in Figure 1. There was no significant difference between conditions. Also, throwing speeds did not change considerably across trials in either condition. There was no main effect of condition, F (1, 18) < 1, η_p^2 = .038. The main effect of trial was significant, F (9, 162)=2.30, p =.019, η_p^2 = .113. Post-hoc tests indicated that only the difference between Trials 5 and 10 was significant, with Trial 10 having higher throwing velocity than Trial 5, p < .05. There was no interaction between condition and trial, F (9, 162) = 1.48, p = .159, = .076.

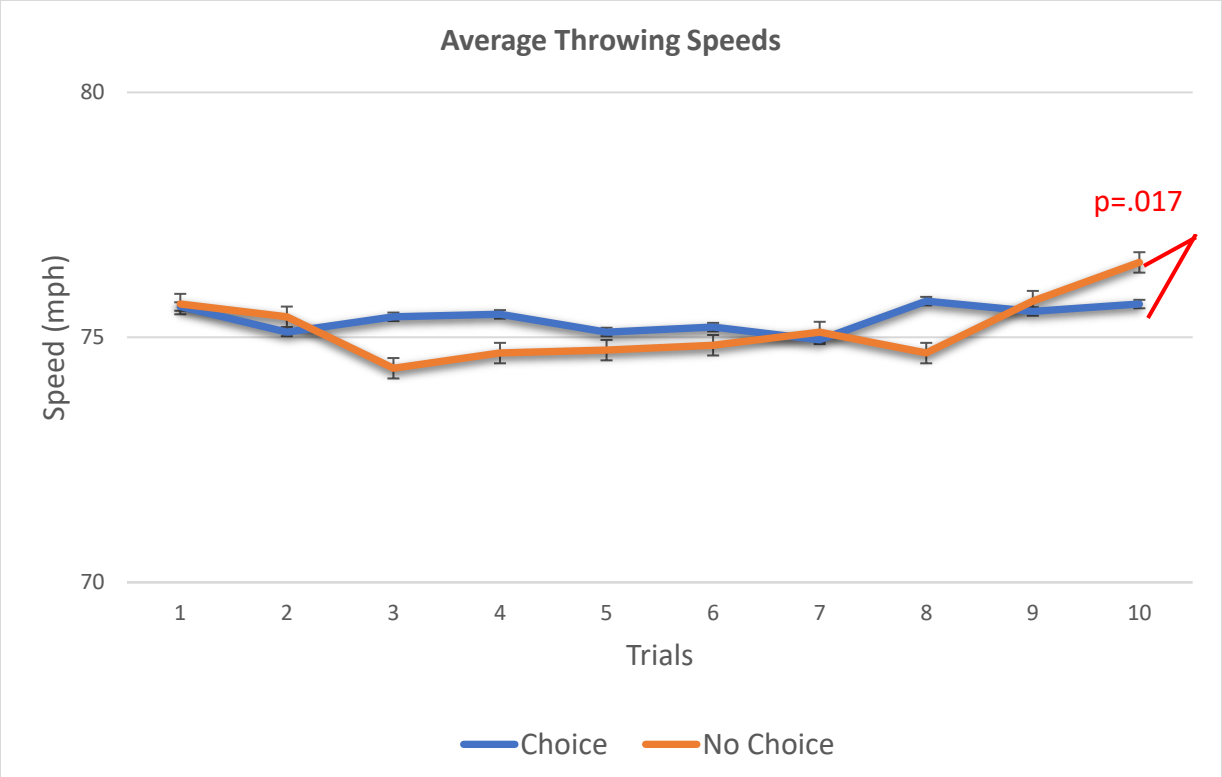


Fig. 1: Average throwing speeds across the ten choice (Avg 75.38 mph, S.D. 0.27) and no choice (Avg 75.17 mph, S.D. 0.66) trials.

Questionnaire

Questionnaire results can be seen in Figures 2 and 3. Out of 19 participants, 8 pitchers thought they threw faster with their tape choice, whereas 11 pitchers thought they threw faster with tape chosen for them (Figure 2). A chi-square test showed that those differences were not significant, $p = 0.49$.

Out of 19 participants, 10 pitchers indicated that they would want to throw again with the tape chosen for them while 9 pitchers said that would want a choice (see Figure 3). A chi-square test showed that those differences were not significant, $p = 0.81$

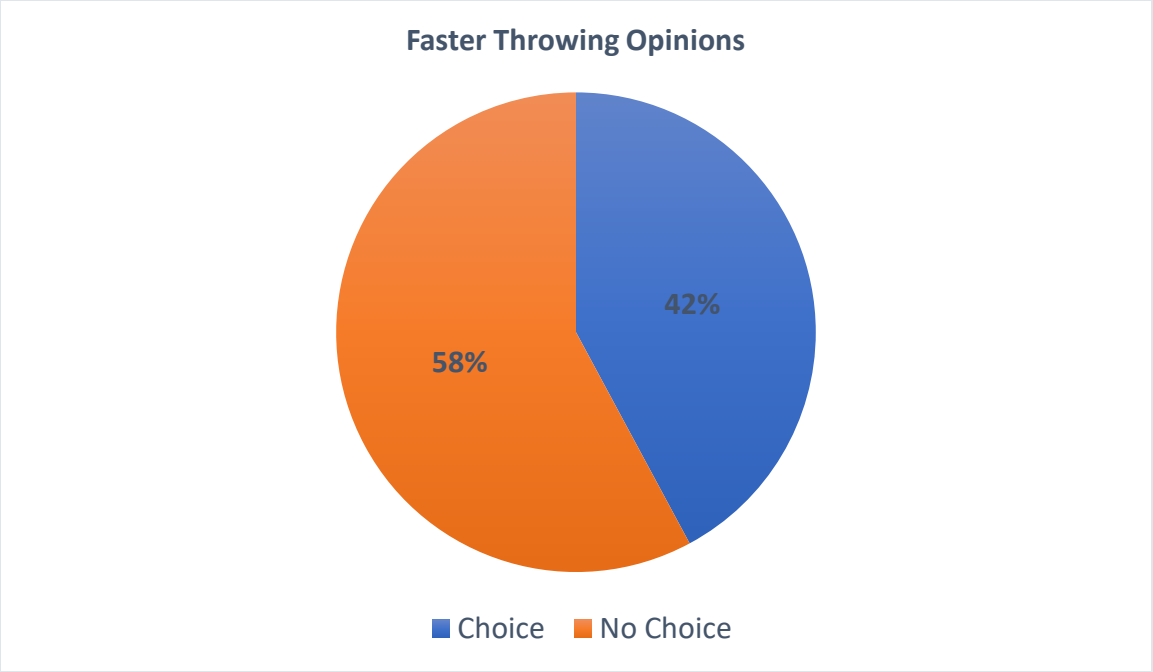


Fig. 2: Percentages representing pitchers that thought and did throw faster with choice vs no choice.

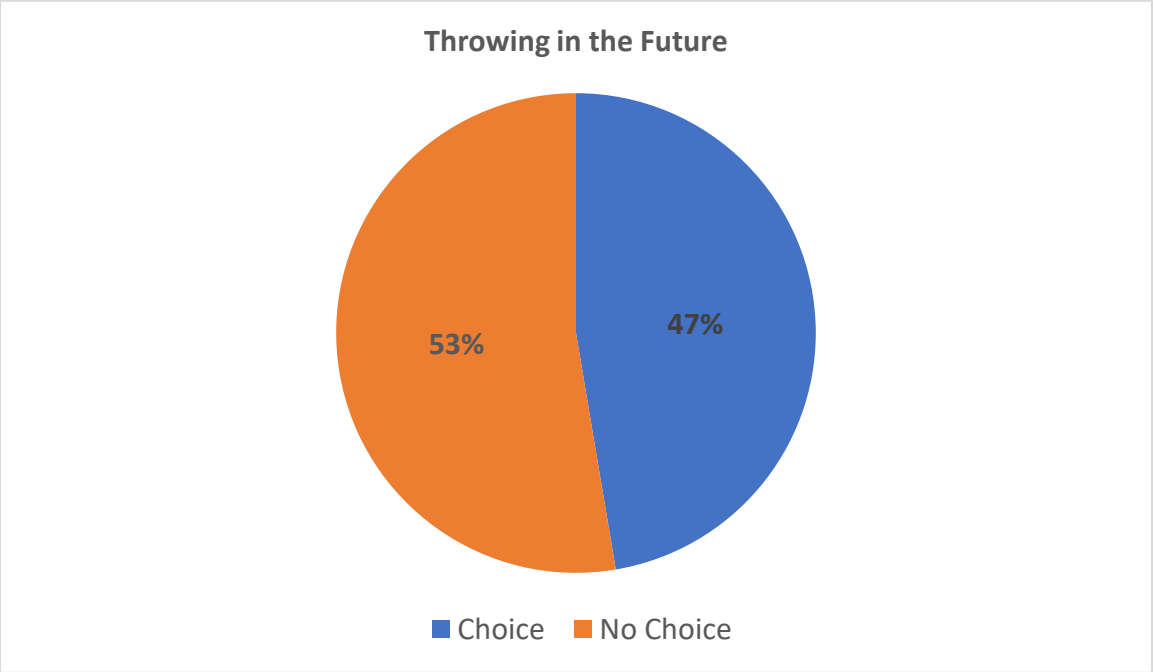


Fig 3: Percentages representing pitchers that would rather throw with a tape given to them rather than choosing.

Chapter 5: Discussion

The purpose of this study was to examine the effects of incidental choices, involving color and types of a wrist tape, on throwing speed in baseball athletes. As stated previously, autonomy, or the ability to control or determine one's own actions and behaviors, is a basic psychological need (Halperin et al., 2016; Lewthwaite et al., 2015; Hooyman et al., 2014). It is essential to one's well-being and quality of life (Halperin et al., 2016; Wulf et al., 2014; Langer & Rodin, 1976; Wulf & Adams, 2014; Carter & Ste-Marie, 2017). Numerous studies have shown that when participants' need for autonomy is supported, they are more motivated and demonstrate more effective performance and learning (Wulf et al., 2014; Hartman, 2007; Lemos et al., 2017). Choices, including incidental choice, convey a sense of trust and increase participants' confidence in their ability to do well on a task (Wulf et al., 2014; Langer & Rodin, 1976; Wulf & Adams, 2014).

Multiple studies on autonomy support have all agreed that choice conditions lead to better results; however, the results of this original study were not expected as they did not have similar results. There was no difference between choice and no-choice conditions and no interaction between condition and trial. Furthermore, 58% of the participants (11 pitchers) thought they threw faster with the tape chosen for them, and 53% (10 pitchers) said they would throw again with tape chosen for them. The study is not without limitations, and these might explain the lack of difference between conditions. One of the two biggest limitations in this study is related to the researcher-participant interaction. Self-Determination Theory (SDT) is a framework that helps us understand people's different types of motivation to engage in

activity (Puente & Anshel, 2010; Deci & Ryan, 2008). Of the four types of regulation that describe SDT, it appears external, identified regulation, and integrated regulation played a factor in this present study. External regulation can be defined as the influence of outside forces on someone's behavior (Puente & Anshel, 2010). Self-Determination Theory states that social relatedness is the need for social inclusion. Instructor interacting style has been shown to hinder or fulfill participants' need for autonomy, competence, and relatedness. In relation to this study, the researcher was also the participants' AT, that is, someone they interacted with daily for advice, injuries, and sicknesses. The participants in this study could have felt the need to please the instructor and choose what the instructor wanted instead of making their own choice. They might also have seen the AT as an authority figure that always has their best interest in mind. Either of these possibilities could have affected their behavior and performance. As stated by Deci and Ryan (2008), controlled motivation is when a participant's behavior is a result of external (one's behavior is a result of chance due to reward or punishment) and internal (the action is internalized and energized by approval, avoiding shame, self-esteem, and ego) regulations. When participants are controlled, there is pressure that they experience to think, feel, and behave in certain ways. Participants in the no-choice condition could have felt the choice made for them was what was best; therefore, they thought they threw faster compared to the choice condition. Identified regulation reflects the extent to which someone values a task (Puente & Anshel, 2010). All participants voluntarily agreed to be in the study two months before the study was conducted. When this study was conducted the participant's interest, motivation, and energy to participate could have gone down or not existed. Integrated regulation reflects the participants' perception of the task in relation with

their own goals, needs, and values (Puente & Anshel, 2010). Even though participants were told to throw as hard as they could, average throwing speeds either stayed the same or declined as trials went on. Because the participants wore tape on their wrists, their awareness of the tape could have posed as a distraction (internal focus of attention). When performing, participants need an external focus of attention to achieve the best results. The constrained action hypothesis (CAH) as explained by Wulf, McNevin, and Shea (2001) and Kal, van der Kamp, and Houdijk (2013) state the following: 1) internal focus of attention limits the motor system and interferes with our processes that are automatic, 2) external focus of attention promotes the usage of our processes that are automatic. With the tape causing an internal focus of attention the participants had increased attentional demands and less fluid throwing movement; thus, creating different throwing speed outcomes than expected.

Another limitation stems from the baseball rule, as explained by Gardner (2014), that pitchers are not to wear tape on their wrists, palms or hands as it could interfere with the way the ball is thrown or become a distraction for the batter or umpire. The task to throw the ball as hard as they could have seemed pointless due to the participants being aware that they cannot throw with tape on in normal practice or game situations. This limitation relates to the SDT definition that external factors can facilitate or inhibit exercise as part of one's lifestyle. Because pitchers cannot throw with tape on their wrists, their performances were inhibited, causing the participants to not throw as hard as they could. Distraction of the wrist tape could perhaps have been eliminated if the participants had been given more than two warm-up pitches with the tape on. There is a possibility that warming up with multiple pitches could have allowed them to get used to the tape on their wrists and focus more on throwing hard.

Another possible limitation in this study was the amount of throws these experienced athletes were given. Although the study by Halperin et al. (2016) concluded that choices improved performance of amateur and highly skilled athletes, this study did not seem to challenge the participants like previous successful studies have. Of the literature discussed, literature on novice participants learning a task are supported the most in the motor control and learning domain. Participants involved in choice conditions in these learning studies outperformed those in no-choice conditions regardless of the learning task (Andrieux et al., 2012; Carter & Ste-Marie; Lemos et al.; Wulf et al., 2017; Hartman, 2007; Hooyman et al., 2014, Lewthwaite et al., 2015; Wulf & Toole, 1999; and Wulf et al., 2005). The current study had experienced participants with a task they are familiar with resulting in no challenges in performance. Comparing previous literature with this current study, instructors for all but one study did not know the participants and were blinded to the purpose of the study. Langer and Rodin (1976) had an instructor who had interacted with residents daily and used different dialog and specific words for both the responsibility-induced and comparison group. The dialog in the current study was kept short and relatively the same apart from "can" for the choice condition and "will" for the no-choice condition. Therefore, the interactions and dialog did not challenge the participants to become more motivated to perform a task they know well. The amount of pitches in this study would be considered low. During usual practices, each pitcher throws 40-50 pitches, while the NIAA does not want any pitcher to exceed more than 110 pitches in one day or 140 pitches during four consecutive days (Thompson, B.). This study limited the participants to a total of 20 pitches with four warm-up pitches. The limited amount of pitches could be considered a warm-up for the participants causing them to not reach their

best pitching potential due to pitching almost seven times the amount in games. Thus, the task used in the present study could have been considered "too easy."

Overall, in contrast to previous studies, there was no significant difference between choice and no-choice conditions in the present study. Several possible limitations outlined here (AT being the experimenter, wrist tape not being considered useful, task not being challenging enough) may have contributed to this null effect. Therefore, it is recommended that in future studies examining effects of autonomy support in athletes, researchers provide participants with meaningful choices and use tasks that are challenging and sensitive enough to produce performance improvements that can result from small choices.

Appendix A: Jugs R2050 Radar Gun[19]

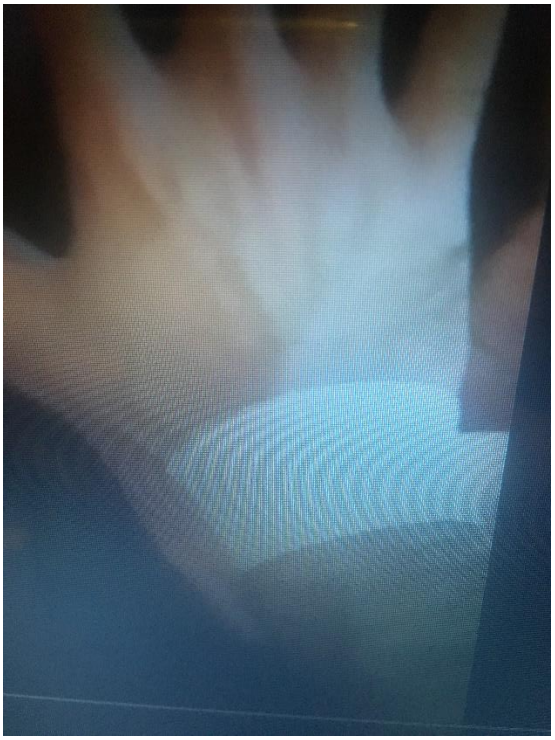
Appendix B: Excel Spreadsheet

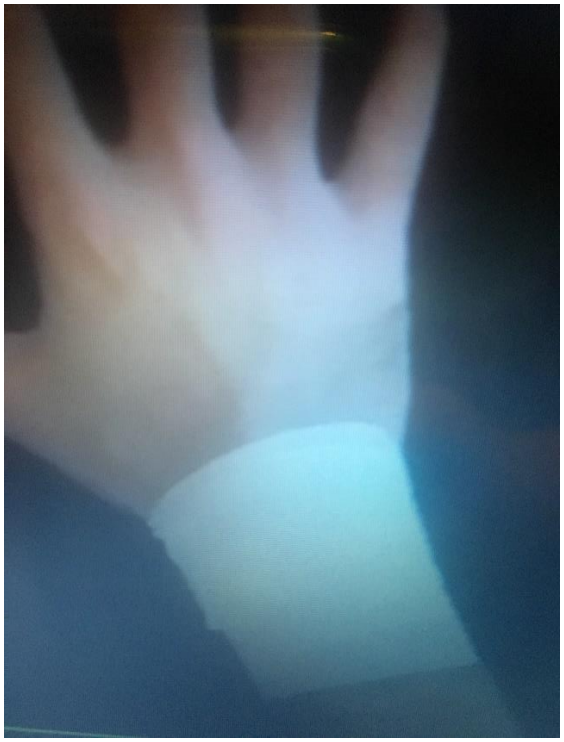
KEY: P=Pitcher C=Choice NC=No Choice B=Blue R=Red G=Green

Subjects Trial 1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
1st throw										
2nd throw										
3rd throw										
4th throw										
5th throw										
6th throw										
7th throw										
8th throw										
9th throw										
10th throw										
Average:										
	P11	P12	P13	P14	P15	P16	P17	P18	P19	
1st throw										
2nd throw										
3rd throw										
4th throw										
5th throw										
6th throw										
7th throw										
8th throw										
9th throw										
10th throw										
Average:										

Appendix C: Wrist Tape Options

Still images from Option A (no twist) video





Still images from Option B (twist) video

Appendix D: Questionnaire

1) Which tape job do you think you threw faster with and why (the one you chose or the one chosen for you)?

2) If you could throw with wrist tape on again which tape option would it be and why (the one you chose or the one chosen for you)?

3) How many years of experience do you have playing baseball (club and high school)?

Height: Weight: Throwing arm:

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Curriculum Vitae

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Education

Master of Science | Anticipated May 2018 | University of Nevada, Las Vegas

- Major: Kinesiology – emphasis in Athletic Training

Bachelor of Science | May 14, 2016 | University of Nevada, Las Vegas

- Major: Athletic Training

Bachelor of Science | December 14, 2013 | University of Nevada, Las Vegas

- Major: Kinesiology

Work Experience

Centennial High School | August 2016-Present

- Head Athletic Trainer for a 4A Division CCSD high school to over 700 athletes.
- Administration duties, collaboration with coaches on lower extremity prevention injuries in runners, utilizing Physical Therapy outreach at the high school to ensure quality patient care

Licensed Athletic Training Experience

Over 500 hours of coverage for secondary schools, youth sport teams, and national sports coverage

Leadership Experience

Secretary | Nevada Athletic Trainers' Association | April 2018-Present

- Record minutes during NEVATA meetings and FWATA conferences
- Keep up-to-date records on state licensures for the state of Nevada
- Continue to bridge the gap of communication between Southern and Northern Nevada in regards to the Athletic Training profession

Professional Memberships

- American Heart Association Basic Life Support 2014-Present
- National Athletic Trainers' Association; Certification #2000024998 2014-Present
- Nevada State Board of Athletic Trainers; License #0506409 2016-Present
- Far West Athletic Trainers' Association 2013-Present

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