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Examining Movement-Specific Reinvestment and the Yips in Professional Baseball

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Abstract

The sudden inability of a professional baseball player to throw the baseball accurately, a condition known as the “yips”, is considered a motor movement disruption. Movement-specific reinvestment, including movement self-consciousness (MS-C) and conscious motor processing (CMP), explains the disruption of well-learned motor movements in different performance domains such as throwing. The purpose of this quantitative, causal-comparative study is to examine movement-specific reinvestment level differences between self-reported yips-afflicted and non-afflicted professional baseball players in the United States as measured by the Movement Specific Reinvestment Scale (MSRS). A total of 130 professional baseball players (65 yips-afflicted and 65 non-afflicted) participated in the study. The findings demonstrated that significant differences in movement-specific reinvestment levels existed between the yips-afflicted group and the non-afflicted group. Movement-specific reinvestment total levels were higher in yips-afflicted participants (M = 43.60, SD= 9.28) than in non-afflicted participants (M = 33.98, SD = 8.71), U = 922, z = -5.55, p < .001. MS-C scores were higher in yips-afflicted participants (M = 19.30, SD = 5.82) than in non-afflicted participants (M = 13.61, SD = 5.01), U = 969.5, z = -5.33, p < .001. CMP scores were higher in yips-afflicted participants (M = 24.29, SD = 4.79) than in non-afflicted participants (M = 20.37, SD = 4.84), U = 1073, z = -4.85, p < .001.

Keywords

yips, movement-specific reinvestment, conscious motor processing, movement self-consciousness

Introduction

Motor movement disruption interrupts the successful execution of well-learned skills and can be a performance debilitating condition (Weiss & Reber, 2012). One of the most glaring motor movement disruptions in sports is the sudden inability of a professional baseball player to throw the baseball accurately, a condition otherwise known as the "yips" (Martin, 2015; Weiss & Reber, 2012). According to Roberts, Rotheram, Maynard, Thomas, and Woodman (2013), the "yips" are characterized as a persistent motor performance ailment that features involuntary movements during the execution of a motor skill. This motor performance ailment created multiple questions for players and coaches without practical solutions (Martin, 2015; Weiss & Reber, 2012). Prior research has demonstrated that movement-specific reinvestment, and its two dimensions, movement self-consciousness (MS-C) and conscious motor processing (CMP), is a valid and reliable motor behavior concept that explains the disruption of well-learned motor movements (Malhotra et al., 2015a; Masters & Maxwell, 2008). Movement-specific reinvestment contends that an individual's propensity to consciously process well-learned motor movements can lead to disruption of movement mechanics (Masters, 1992; Masters & Maxwell, 2008; Masters et al., 1993). Moreover, neurophysiological research on motor movement behavior and movement-specific reinvestment have demonstrated differences in cortical activity between individuals that reinvest and those that do not and displayed a correlation with Movement Specific Reinvestment Scale (MSRS) scores (Gallicchio et al., 2016; Gallicchio et al., 2017; Zhu et al., 2011). As promising, but limited research is available in this area, an opportunity exists to study movement-specific reinvestment's role in the "yips" in professional baseball.

The purpose of this study was to examine movement-specific reinvestment level differences between yips-afflicted and non-afflicted professional baseball players as measured by the MSRS. The MSRS is a psychometric assessment that measures an individual's propensity to consciously monitor and control well-learned motor skills (Masters et al., 2005). The MSRS appraises two dimensions of reinvestment: MS-C and conscious CMP (Uiga et al., 2015). MS-C is the concern with the style of the movement when moving in public. CMP is contemplating the mechanics of the movement. The 10-question assessment is divided into 2 sets of 5 questions that measure MS-C, such as, "I am concerned with my style of movement" and 5 questions that measure CMP, such as, "I reflect about my movement a lot". The questions are appraised on a 6-point Likert Scale that ranges from strongly disagree (1) to strongly agree (6), generating a total score ranging from 10 to 60 points.

Literature Review

Efficient and effective motor movement is essential for many performers, such as professional players, to carry out a task at an optimal level. For some performers, failure to compete at an optimal level may result in less than desirable occupational consequences (Gröpel, 2016). The "yips" has been described as a motor movement ailment in which unwarranted movement patterns disrupt the execution of well-learned motor movements (Bennett et al., 2016; Roberts et al., 2013). This condition has presented researchers and practitioners with a challenging motor movement ailment whose origins are considered psychoneuromuscular (Dhungana & Jankovic, 2013). This has led researchers to suggest that the "yips" exists on a spectrum that includes neuromuscular origins on one end and psychological origins on the opposite end (Detling et al., 2000; Martin, 2015).

The available research has outlined two types of "yips" based on their unique characteristics. The neuromuscular version of the "yips" (Yips I) identifies task-specific focal dystonia (TSFD) as a task-specific neuromuscular movement disorder that inhibits the execution of a skill due to involuntary movements (Detling et al., 2000). The psychological version of the "yips" (Yips II) is an anxiety related version with cognitive and movement control decrements (Bennett et al., 2016). Specific to the current study, the theory of reinvestment presents a valid and reliable concept that has the potential to explain the cause of the anxiety related version of the "yips."

A professional baseball player's sudden inability to throw the baseball accurately may result in lessening the player's perceived value, and in its most severe cases, may end the player's career (Meisel, 2013). To provide some context, throwing a baseball is a second nature skill for a professional baseball player. Meisel (2013) documents one of the most famous cases of motor movement disruption, or the "yips", in that of former professional baseball player Steve Blass. Blass was a successful pitcher for the Pittsburg Pirates in the early 1970's, playing a prominent role in the 1971 World Series Championship. The following year, he proceeded to win 19 games. In 1973, without warning, he suddenly developed difficulties throwing the baseball accurately. His career unraveled as he continued to throw a baseball inaccurately, and he retired in his prime before the 1975 season. This motor movement disruption, or the "yips," was coined the "Steve Blass Disease" (Weiss & Reber, 2012). There are other similar examples of elite professional baseball players whose careers have been negatively impacted by this sudden inability to throw the baseball accurately. Steve Sax, Chuck Knobloch,

Mark Wohlers, Rick Ankiel, and Ryan Zimmerman are some noteworthy examples (Meisel, 2013).

Motor movement disruption is described as a decrement or the impairment of motor performance output (Masters, 1992). The classical motor learning theories, in particular human performance theory (Fitts & Posner, 1967), outline a motor acquiring process that develops in phases. The human performance theory proposes a sequential system in which learners gradually progress through three phases. The learner advances from a cognitive phase to an associative phase, and finally, an autonomous phase. Simply stated, the learner progresses from consciously monitoring and controlling new movements to an autonomous phase in which the movements are automatized and characterized as fluid with minimal error (Masters & Maxwell, 2008). Moreover, the cognitive phase is defined by an internal focus that monitors the new movements, whereas the autonomous phase is defined by automatization, which allows the individual to focus on the environment (Gröpel, 2016). Consequently, motor movement disruptions of well-learned movements can be attributed to dynamics (*i.e.*, movement-specific reinvestment) that fracture or regress this sequential process of motor skill acquisition and performance.

The theory of reinvestment postulates that a performer's propensity to consciously monitor and control well-learned movements results in motor movement disruption (Masters & Maxwell, 2008). Furthermore, the theory posits that movement-specific reinvestment is composed of two dimensions: MS-C and CMP (Malhotra et al., 2015a). MS-C refers to the individual's propensity to focus on the style of the movement, whereas CMP refers to the individual's propensity to focus on the mechanics of the movement (Malhotra et al., 2015a; Malhotra et al., 2015b; Masters et al., 2005).

To assess a performer's tendency to reinvest, the MSRS was developed and has been demonstrated to be a valid and reliable psychometric measurement instrument (Kal et al., 2016). Prior studies have indicated that individuals that have a propensity to consciously monitor and control well-learned motor movements generally score higher on the MSRS, whereas individuals that do not demonstrate a lower MSRS score (Accardo, 2017). The 10-question assessment is divided into two sets of five questions measuring MS-C and CMP. Research that has included the MSRS has exposed the instrument to different domains, languages, and sub-populations (Kal et al., 2016). More specifically, studies that have focused on motor movement disruption and have utilized the theory of reinvestment as a theoretical foundation have concentrated in domains like

surgical settings, golf, marksmanship, basketball, cricket, and in therapeutic settings of patients suffering from Parkinson's or recovering from a stroke (Kleynen et al., 2013). Moreover, neurophysiological research has been shown to validate MSRS score results (Gallicchio et al., 2016; Gallicchio et al., 2017; Zhu et al., 2015), and more recent studies have supported the validity and reliability of the concept and of its assessment, the MSRS. Gallicchio, Cooke, and Ring (2016) propose that neurophysiological functions are consistent with movement-specific reinvestment.

That is, individuals that display higher levels of movement-specific reinvestment per MSRS scores display more cortical activity between essential and non-essential brain regions (Zhu, Poolton, Wilson, Maxwell, & Masters, 2011). In contrast, lower levels of movement-specific reinvestment correlate with cortical efficiency. Studies have indicated that individuals that reinvest display high cortical connectivity between the left temporal (T3 – processes and analyzes verbal activity) and the frontal premotor regions (Fz – pre-motor programming), whereas those that do not, display cortical efficiency (i.e., task-relevant cortical activity; Dyke et al., 2014). Stated simply, the neurophysiological evidence supports the score results of the MSRS (Gallicchio et al., 2016), providing further evidence of the validity and reliability of the MSRS as a measurement tool. The researchers' hypotheses for the study proposed that movement-specific reinvestment levels, in its different forms, would be significantly different between the yips-afflicted and non-afflicted groups.

Methods

The target population for this study was composed of yips-afflicted and non-afflicted professional baseball players that were either active or had been retired for five years or less. A G*Power analysis was calculated for an independent t-test and indicated that the sample size for this causal-comparative study must include 128 participants (64 yips-afflicted and 64 non-afflicted) to measure statistical significance. The two-tailed analysis with an alpha-level of .05 and a power of .80, made it necessary to include 128 participants so that statistical significance is achieved (Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009). Accordingly, the G*Power analysis determined that yips-afflicted and non-afflicted groups would each have 64 participants.

Upon approval of the research project by the Grand Canyon University Institutional Review Board (IRB), potential yips-afflicted and non-afflicted

participants were recruited via announcements made on social media and professional internet-based networks that are known to include baseball players. Even though internet-based networks are public social media platforms (i.e., Twitter, Facebook), site authorization was required from groups created within these platforms. This is consistent with earlier research that has utilized social media or open access platforms (Cheung, Lee, & Chan, 2015). Moreover, potential participants were also contacted by other methods including telephone, email, in person, and through their representatives. With the integration of online social media platforms in everyday life, it was considered advantageous to tap into these platforms to reach a broader pool of potential participants. Inclusion criteria for the study's participants were based on assignments to either the yips-afflicted or non-afflicted group based on their yips history, a convenience sampling approach was used and seen as appropriate for a casual-comparative study that included participants that had been non-randomly (i.e., self-selected) assigned to a group. The potential participants were provided a link to the study survey hosted by Survey Monkey. Once the participants accessed the survey via the link, they were provided with the informed consent form and indicated their agreement and were directed to the survey. The participants answered a brief series of questions that collected personal and professional demographic information. In this series of questions, the participants disclosed whether they had or had not suffered from the yips. Based on this disclosure, the participants were assigned to either the yips-afflicted or non-afflicted group and proceeded to complete the MSRS.

Data Analysis Procedures and Hypothesis

Earlier research on movement-specific reinvestment and the "yips" demonstrated the benefits of comparing yips-afflicted and non-afflicted groups by collecting descriptive statistics such as analysis of means, standard deviations, and range of scores for the variables. The MSRS is a 10-question assessment, and the questions are appraised on a 6-point Likert Scale that generates a total score ranging from 10 to 60 points. The MS-C (*i.e.*, style of movement) and CMP (*i.e.*, mechanics of movement) dimensions are individually appraised on a 5-to-30-point scale. The established research has measured total MSRS scores, and individual MS-C and CMP scores, to assess comparative statistics between groups (Laborde, Furley, & Schempp, 2015; Malhotra et al., 2015a; Malhotra et al., 2015b). The researchers conducted inferential statistical analysis utilizing independent *t*-tests, or a non-parametric test, to compare groups (yips-afflicted and non-afflicted) for the three dependent measures (total score MSRS, MS-C, and CMP).

Results

The study included 130 eligible participants (65 yips-afflicted and 65 non-afflicted). If any surveys were completed by potential participants that did not meet the eligibility status included in the informed consent, they were excluded from the study. The Personal and Professional Demographic Characteristics questionnaire (Appendix B) provided the current study with more in-depth information about the sample group. The average age of the participants was 28.65 (*SD* = 5.37 years; Table 1). The study included 57 active professional baseball players and 73 retired professional baseball players (Table 1). The sample included 17 left-handed participants and 113 right-handed participants (Table 1). Moreover, the study included 107 minor professional baseball players and 23 participants that played at the major league level (Table 1).

Study Participant Characteristics

Table 1. Personal and Professional Characteristics

	Yips-afflicted (n = 65)	Non-afflicted (n = 65)	Total (N = 130)
Age, years	30.01 (SD = 5.82)	27.29 (SD = 4.93)	28.65 (SD = 5.37)
Active participants	19 (29.2%)	38 (58.5%)	57 (43.8%)
Retired participants	47 (72.3%)	26 (40.0%)	73 (56.2%)
Left-handed participants	10 (15.4%)	7 (10.8%)	17 (13.1%)
Right-handed participants	56 (86.2%)	57 (87.7%)	113 (86.9%)
Minor League participants	54 (83.1%)	53 (81.5%)	107 (82.3%)
Major League participants	12 (18.5%)	11 (16.9%)	23 (17.6%)

Descriptive Statistics for the Variables of Interest and Statistical Analysis

The mean MSRS total score for the yips-afflicted group was 43.60 (*SD* = 9.28), whereas the mean MSRS total score for the non-afflicted group was 33.98 (*SD* = 8.71; Table 2). In the MSRS total score for the yips-afflicted group, one outlier was identified (Figure 1). The mean MS-C score for the yips-afflicted group was

19.30 (*SD* = 5.82), whereas the mean MS-C score for the non-afflicted group was 13.61 (*SD* = 5.01; Table 2). No outliers were identified for either group. Lastly, the mean CMP score for the yips-afflicted group was 24.29 (*SD* = 4.79), whereas the mean CMP score for the non-afflicted group was 20.37 (*SD* = 4.84; Table 2). In the CMP score for the yips-afflicted group, two outliers were identified (Figure 3).

Table 2. Descriptive Results

Variable	Yips-afflicted	n:	Mean:	Standard Deviation:	Range:
MSRS Total	Yes	65	43.60	9.28	11-60
	No	65	33.98	8.71	14-53
MS-C	Yes	65	19.30	5.82	6-30
	No	65	13.61	5.01	5-25
CMP	Yes	65	24.29	4.79	5-30
	No	65	20.37	4.84	9-28

The reliability of the MSRS as a measurement instrument was critical to the current study. Cronbach's alpha was calculated to assess internal item consistency and instrument reliability. A Cronbach's alpha value of .70 and above is considered as acceptable (König et al., 2018). It assessed the MSRS total score, and MS-C and CMP dimensional scores in the sample of yips-afflicted and non-afflicted professional baseball players. The MSRS total score and each of the dimensional scores exhibited a high level of internal consistency (MSRS=0.99; MS-C=0.99; CMP=.098).

Before performing parametric statistical procedures, assumption testing was conducted to determine when it was appropriate to use an independent samples *t*-test for comparing differences between groups for the MSRS total score, and the MSC and CMP scores. According to assumption testing for an independent samples *t*-test, the dependent variable must be continuous, and the independent variable must consist of two groups. Moreover, the independence of observations did not allow participants to be included in more than one group. The assumption of normality was violated ($p < .05$) using both the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test (Table 4). The presence of outliers in the MSRS total score and in the CMP, score was also noted (Table 4). Therefore, the parametric *t*-test

was abandoned, and a non-parametric test was employed to compare differences between the yips-afflicted and non-afflicted groups. The Mann-Whitney *U* test was employed, as the two groups for comparison were independent of each other. Based on the non-parametric parameters, a post hoc analysis was conducted for the Mann-Whitney *U* test, and it determined that the power of the actual sample size was .78 (Appendix B). All statistical analyses were completed using SPSS (version 24, IBM, Armonk, USA).

The Mann-Whitney *U* test was performed to determine if there were significant differences in the MSRS score between yips-afflicted and non-afflicted participants. Distributions of the MSRS for yips-afflicted and non-afflicted participants were not similar, as assessed by visual inspection. MSRS total scores for yips-afflicted participants (mean rank = 83.82) were statistically significantly higher than for non-afflicted participants (mean rank = 47.18), $U = 922$, $z = -5.55$, $p < .001$, using an exact sampling distribution for *U* (Figure 1). A statistically significant difference in MS-C scores between yips-afflicted participants (mean rank = 83.08) and non-afflicted participants (mean rank = 47.92) was observed, $U = 969.5$, $z = -5.33$, $p < .001$ (Figure 2). Finally, the statistical significance of CMP scores was higher in yips-afflicted participants (mean rank = 81.49) than non-afflicted participants (mean rank = 49.51) $U = 1073$, $z = -4.85$, $p < .001$ (Figure 3).

According to the results of the Mann-Whitney *U* test, the yips-afflicted group presented significantly higher total movement-specific reinvestment scores than the non-afflicted group (Figure 1). Thus, the findings of the Mann-Whitney *U* test caused us to reject the null hypothesis and accept the alternative hypothesis associated with the first research question of no significant difference between the yips-afflicted and non-afflicted groups. More specifically, there is a statistically significant difference in movement-specific reinvestment levels between yips-afflicted ($M = 43.60$, $SD = 9.28$) and non-afflicted ($M = 33.98$, $SD = 8.71$), professional baseball players.

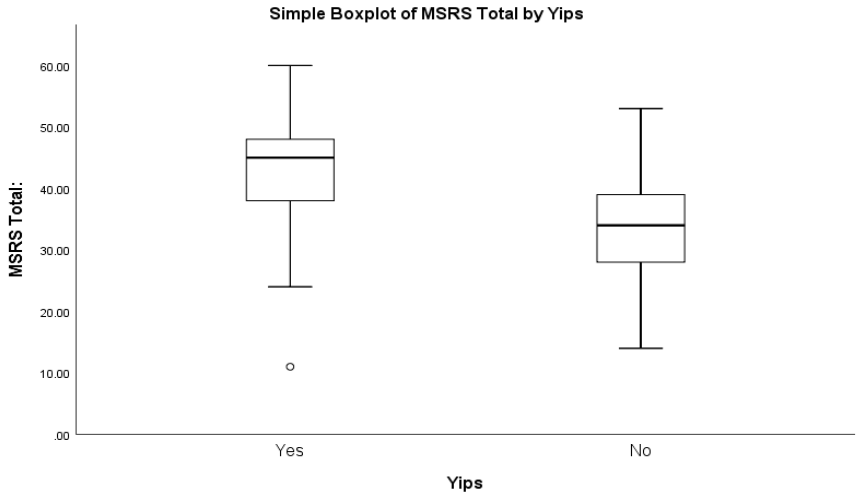

Figure 1. Mean MSRS total scores by group.

Additionally, the results of the Mann-Whitney *U* test, the yips-afflicted group presented significantly higher MS-C scores than the non-afflicted group (Figure 2). Thus, the findings of the Mann-Whitney *U* test caused us to reject the null hypothesis and accept the alternative hypothesis associated with the second research question. More specifically, there is a statistically significant difference in the propensity to focus on the style of the movement between yips-afflicted (M = 19.30, SD = 5.82) and non-afflicted (M = 13.61, SD = 5.01), $p < .001$ professional baseball players.

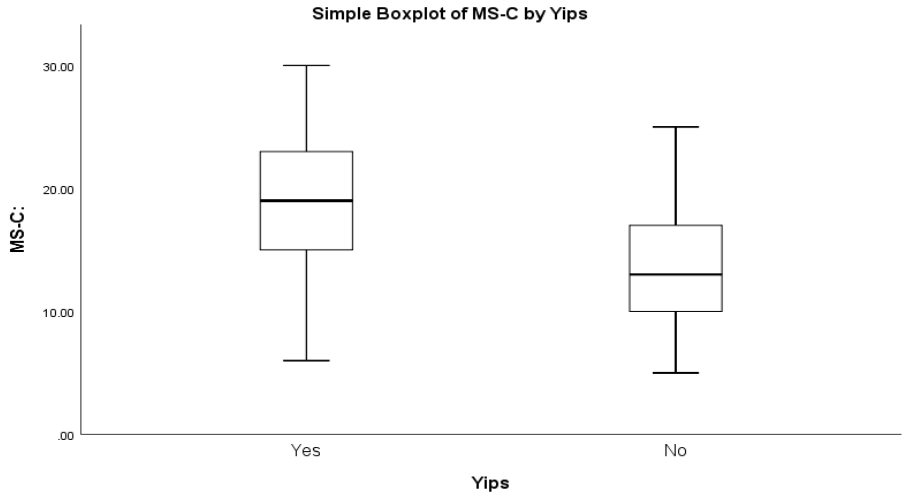

Figure 2. Mean MS-C scores by group.

Lastly, the results of the Mann-Whitney *U* test, the yips-afflicted group presented significantly higher CMP scores than the non-afflicted group (Figure 3).

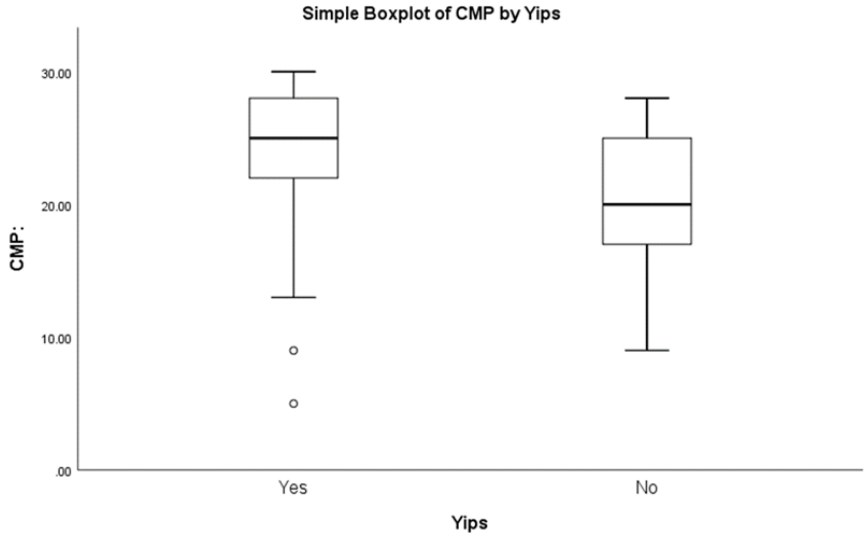

Figure 3. Mean CMP scores by group.

Thus, the findings of the Mann-Whitney *U* test caused us to reject the null hypothesis and accept the alternative hypothesis associated with the third research question. More specifically, there is a statistically significant difference in the propensity to focus on the mechanics of the movement between yips-afflicted (M = 24.29, SD = 4.79) and non-afflicted (M = 20.37, SD = 4.84), professional baseball players.

Limitations

The research was limited to examining movement-specific reinvestment levels in a specific population of performers, and the findings of this study cannot be extrapolated to conclude that movement-specific reinvestment is the cause of the "yips" in all activities. In addition, the findings of this study cannot determine if the participants in the yips-afflicted group had a propensity to reinvest before or after suffering from the "yips." Moreover, pre-existing performance differences between the yips-afflicted and non-afflicted groups could not be accounted for. Therefore, performance level differences between the groups were not considered as they pertained to their respective MSRS scores. Lastly, motor learning

environments have been identified as a critical component in the tendency to reinvest. To understand the participants' youth motor learning environment, participants were asked about their first exposure to a specialized coach in the Personal and Professional Demographic Characteristics questionnaire. It could not be determined if exposure to a specialized coach at a certain age played a role in reinvestment scores, nor could the motor learning environment of the participants be identified.

Discussion

This quantitative, causal-comparative study examined movement-specific reinvestment level differences between yips-afflicted and non-afflicted professional baseball players in the United States as measured by the MSRS. The study presented three questions that aimed to examine movement-specific reinvestment's role in the "yips" in professional baseball players. More specifically, the research questions examined movement-specific reinvestment and its two dimensions, MS-C and CMP. The Mann-Whitney *U* test was employed to test the study's hypotheses by comparing the mean rank of the yips-afflicted and non-afflicted groups.

More specifically, the Mann-Whitney *U* test is set to examine the hypotheses associated with the three research questions. The research questions asked if statistically significant differences existed in movement-specific reinvestment levels, in its different forms, between yips-afflicted and non-afflicted professional baseball players as measured by the MSRS. The findings determined that significant differences in the MSRS total score, and in the MS-C and CMP scores exist between the yips-afflicted group and the non-afflicted group. The researchers' hypotheses claimed that movement-specific reinvestment, in its different forms, would be significantly different between the two groups. Hence, the results are consistent with much of the established literature that proposes that the propensity to reinvest, per MSRS scores, is detrimental to well-learned motor movements. The research results of the study provide unprecedented insight into movement-specific reinvestment's role in the "yips" in an exclusive highly skilled population.

It was observed that the yips-afflicted group scored higher than the non-afflicted group in MSRS total score, and in MS-C and CMP dimensional scores. Hence, these results lead the researchers of the study to conclude that movement-specific reinvestment is a characteristic of the yips-afflicted professional baseball players. Lastly, these findings contribute to the theory of reinvestment as a valid and

reliable concept that aims to explain the disruption of well-learned motor movements.

Theoretical Implications

The sudden inability of a professional baseball player to throw the baseball accurately, known as the "yips," is an egregious motor movement disruption. However, movement-specific reinvestment's role in the "yips" in professional baseball players had not been examined previously. Therefore, the lack of research in this area provided the opportunity to examine movement-specific reinvestment's role in the "yips" in a highly skilled population. By utilizing quantitative methodology and causal-comparative design, the current study expanded on the precedence established by earlier research. That is, add quantitative data to clarify the findings of established research on movement-specific reinvestment and the "yips." For instance, both Klämplf, Lobinger, and Raab (2013a) and Klämplf, Lobinger, and Raab (2013b) studied movement-specific reinvestment's role in the "yips" in the sport of golf by comparing yips-afflicted and non-afflicted participants per MSRS scores. Also, the current study examined MS-C and CMP dimensional scores, per the MSRS, when comparing yips-afflicted and non-afflicted professional baseball players. Thus, the findings of the current study add to the growing body of research on the unique role the dimensions have on motor movement dysfunction.

Practical Implications

Per the study's results, it can be proposed that movement-specific reinvestment is a characteristic of yips-afflicted performers. This provides instructors, coaches, and practitioners (*e.g.,* sport psychologists, mental performance coaches) with an assessment when working with yips-afflicted baseball players. Instructors, coaches, and practitioners can then assess movement-specific reinvestment levels and develop a more appropriate coaching strategy and intervention plan.

One challenge for coaches is to develop coaching strategies that best meet the player's needs. Thus, assessing those needs from the onset allows coaches to better understand their players from the very beginning. The findings of the current study provide coaches with an assessment tool that allows staff members to develop coaching plans that best meet the player's needs. Earlier studies have indicated the importance of developing optimal motor learning environments for individual performers. For example, implicit motor learning environments are preferred over explicit motor learning environments, especially in high reinvestors (Zhu et al., 2015). By administering the MSRS at the onset, it allows coaches to

develop a more optimal coaching strategy that complements the needs of each individual player.

Future Implications

Baseball continues to evolve as analytical models are used to evaluate players and tailor training methods to improve skill acquisition. Moreover, one can also argue that the frequency of the "yips" phenomenon in baseball has increased in a parallel manner with changes in training methods. Learning environments are a determinant in the robustness of motor movements and essential to better understand motor movement disruption, potential causes, interactions, and tools to assist players and coaches. As this study addresses movement-specific reinvestment's role in the "yips" in professional baseball players, it provides further understanding of the interaction between this theoretical concept and motor movement disruption. It clarifies the importance for future studies to examine movement-specific reinvestment's role in the "yips" with other highly skilled professional populations. To date, earlier studies that examined the concept's role in the "yips" ailment, like Klämplf et al. (2013a) and Klämplf et al. (2013b), did not utilize professional-level performers. From the perspective of the researchers, the current study is the first to analyze the "yips" in professional performers. It would be of benefit to better understand movement-specific reinvestment's role in the "yips" with participants that are the best in their performance domain. Therefore, examination of movement-specific reinvestment's role in the "yips" in other highly skilled performer population would be of significant benefit. The current study provides the framework for future studies to replicate the research in other skilled populations.

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