Mental Toughness and Self-Talk as Predictors of Softball Batting Performance

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Abstract

Mental toughness and self-talk are established concepts within sports psychology due to their multitude of benefits, including their impact on performance. This study provides further understanding of the predictive relationship between mental toughness and self-talk on softball batting performance. A survey was administered to 46 Australian softball athletes who completed the Mental Toughness Inventory (MTI) established by Gucciardi et al. (2015), and a Self-Talk Questionnaire (STQ) developed for this study. An exploratory factor analysis found that the STQ data fit a two-factor model, splitting self-talk into positive and negative. This was an unexpected result, as the STQ was developed with positive and negative self-talk as a spectrum, not two separate constructs. The survey results were then data matched to participant's batting average, and a linear regression analysis revealed that mental toughness was a significant predictor of softball batting performance, supporting hypothesis 1. However, hypothesis 2 was not supported, as self-talk was not significantly linked with batting performance. These results suggest that focusing on enhancing psychological tools such as mental toughness is more beneficial to performance than establishing positive self-talk. Building on this, further research in this area might consider replicating the study with a larger participant pool and moving away from self-report measures, which were found to be limitations in this study. A future direction may involve investigating cognitive concepts such as inhibitory control to gain a new perspective on sport performance. This research contributes to a better understanding of the relationship between psychological strategies, self-talk tools, and athletic performance.

Keywords: Mental toughness, self-talk, softball performance, sport performance

Declaration

This thesis contains no material which has been accepted for the award of any other degree of diploma in any University, and, to the best of my knowledge, this thesis contains no material previously published except where due reference is made. I give permission for the digital version of this thesis to be made available on the web, via the University of Adelaide's digital thesis repository, the Library Search and through web search engines, unless permission has been granted by the school to restrict access for a period of time.

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25 September 2023

Contributor Roles Table

ROLE	ROLE DESCRIPTION	STUDENT	SUPERVISOR
CONCEPTUALIZATION	Ideas: formulation or evolution of overarching research goals and aims.	X	X
METHODOLOGY	Development or design of methodology; creation of models.	X	X
PROJECT ADMINISTRATION	Management and coordination responsibility for the research activity planning and execution.	X	X
SUPERVISION	Oversight and leadership responsibility for the research activity planning and execution, including mentorship external to the core team.		X
RESOURCES	Provision of study materials, laboratory samples, instrumentation, computing resources, or other analysis tools.		X
SOFTWARE	Programming, software development; designing computer programs; implementation of the computer code and supporting algorithms; testing of existing code.	X	X
INVESTIGATION	Conducting research - specifically performing experiments, or data/evidence collection.	X	
VALIDATION	Verification of the overall replication/reproducibility of results/experiments.		X
DATA CURATION	Management activities to annotate (produce metadata), scrub data and maintain research data (including software code, where it is necessary for interpreting the data itself) for initial use and later re-use.	X	
FORMAL ANALYSIS	Application of statistical, mathematical, computational, or other formal techniques to analyse or synthesize study data.	X	X
VISUALIZATION	Visualization/data presentation of the results.	X	
WRITING – ORIGINAL DRAFT	Specifically writing the initial draft.	X	
WRITING – REVIEW & EDITING	Critical review, commentary, or revision of original draft	X	X

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This psychology honours thesis has been written according to American Psychological Association (APA) 7th edition.

Introduction

Sport Performance and Psychology

Sport psychology plays a vital role in exploring the relationship of how physical activity and mental well-being interact by understanding the social, cognitive, emotional, and educational aspects that benefit athletes (Raglin, 2001). One of the most significant domains in sport psychology focuses on performance. The Mental Health Model of sport performance (SP) proposes an athlete's mental health deteriorates or improves based on their performance (Raglin, 2001). Achieving athletic success is equivalent to achieving success in any life domain such as the workplace or education. This is a goal everyone strives for. Therefore, understanding the psychology behind successful SP is crucial (Golby & Wood, 2016; McCormick et al., 2015).

SP is a complex concept that takes on unique characteristics in different sporting disciplines. Broadly, SP encompasses a mixture of physical attributes and functions such as fitness, power, speed, and reaction time (National Strength and Conditioning Association, 2017). Additionally, it incorporates emotional elements ("*Sport Performance"*, n.d.), and psychological attributes including self-confidence, mental toughness, and self-talk (Vealey & Chase, 2008; Hatzigeorgiadis et al., 2013; Aizava et al., 2023). Research consistently demonstrates that cultivating psychological skills in athletes indicate a significant correlation with achieving optimal and consistent performance (Harmison, 2006; Sheard & Golby, 2011). However, measuring this area of psychology is challenging due to the variation in dispositional and situational aspects of performance outcomes across different sports.

Lipoński (2003) highlights a list of over 8,000 sports and sporting games worldwide, each characterised by its own set of objectives such as bat and ball sports. These include but are not limited to tennis, badminton, cricket, and baseball. These sports involve the use of a bat or racquet to hit away the ball that is moving toward the athlete, with each sport containing its own measure of success of this similar task.

Softball and Performance

One of these bat and ball sports is softball. This sport is played on a mixed field of dirt and grass where the main portion of play occurs on the diamond-shaped section of the field marked by four bases. There are two teams: the defensive team who has a pitcher responsible for throwing the ball, and the offensive team, represented by the batter. The batter's objective is to hit the ball into the field and run around the four bases while the offensive team attempts to prevent them from scoring. To score one run, a player must reach the final base, known as 'home plate', while the defensive team tries to get them out. The sport is played over seven innings, with each team getting seven attempts to score runs while at bat. The team with the most runs at the end of inning seven wins the game.

In softball, where winning relies on scoring runs, an athlete's success could be measured by their batting performance. Batting success is one aspect of being a good softball player and this can be measured by how often they hit the ball. This statistic can be measured in many ways, with each performance outcome telling a different story. The batting performance statistic this study had focused on was batting average (BA).

BA is a numerical value ranging from 0.000 to 1.000, calculated by dividing the number of safe hits by the number of attempted at bats (Taylor, 2022). A safe hit is classified by the batter making contact with the pitched ball by hitting it through the field and advancing to one of the four bases. If the offensive team catches the ball or fields and throws the ball to the base before the batter arrives, then the batter is out and the attempted at bat does not count as a safe hit. If an offensive player tried to field the ball, but made an error, the batter does not receive a safe hit, as the mistake on field could have led to an out. Each game, an athlete could expect to have three or more at bats.

For instance, if a player had 44 at bats and 10 safe hits, their BA would be .227 [10/44 = .227]. Determining what constitutes a good BA can be challenging due to variations in competition level. Nevertheless, it is widely accepted that a BA ranging from 0.280-0.330 is considered good, 0.330-0.400 is regarded great, and anything above .400 is exceptional (Riley, 2022).

Considering this, a good outcome for a softball batter is achieving only three safe hits out of ten attempts. This perspective might seem unusual when compared to other sports where a 70% failure rate would be seen as exceptionally poor. However, it is important to recognise that batting is widely regarded as one of the most demanding tasks in softball. What makes it particularly challenging is that the batter may be the only player from their team on the field. From the batter's perspective, it can feel like a one versus nine scenario, with the entire defensive team focused on preventing them from reaching base (Riley, 2022). This situation highlights the immense pressure and difficulty associated with the role of the softball batter, where even a 30% success rate is considered commendable.

One of the most important psychological factors a softball batter needs to foster for their success is resilience (Riley, 2022). Resilience is the capacity to withstand, adapt and bounce back after a poor performance or mistake (Gupta & McCarthy, 2022). A softball player must recognise that failure and setbacks are part of the sport, especially within the task of batting so being resilient and learning from failure are critical to put the batter in a better headspace for their next batting attempt.

Mental Toughness

Resilience is a broad concept within the domain of sport psychology and mental toughness (MT) has been acknowledged as one of the pivotal factors within this framework (Sheard, 2010). Although there is debate about the concrete definition of MT, the predominant consensus suggests that within sport, MT is a multifaceted construct encompassing various attributes and characteristics that contribute to an athlete's ability to excel in their sport (Sheard, 2010). It includes factors such as commitment (Connaughton et al., 2008), self-motivation (Clough et al., 2002), self-belief (Crust, 2008), persistence (Crust & Clough, 2005), concentration (Dekker et al., 2014), effective coping mechanisms and adaptability (Kaiseler et al., 2009). It is important to note that MT is not a static trait but rather a dynamic attribute that can be developed and improved over time through training and psychological interventions (Sheard, 2010). Sport psychologists often work with athletes to enhance

their MT through various techniques and strategies, including visualisation, goal setting and stress management (Sheard, 2010).

The development of MT within individuals is a debated subject. However, the general consensus among researchers agree that both nature (genetics) and nurture (environment and experiences) play a role in shaping an individual's development of the construct (Crust & Clough, 2011). Additionally, an athlete's drive and motivation to succeed in their sport are crucial factors for the development of MT, as athletes who are highly motivated and driven to achieve their goals are more likely to be committed and invest more effort into the sport (Mariani et al., 2019; Connaughton et al., 2008).

Numerous studies have been conducted to explore and understand how to measure MT in individuals (Gould et al., 2010; Gordon & Sridhar, 2005). Researchers have developed various questionnaires and assessment tools. Among these, a pivotal contribution by Gucciardi et al. (2015) stands out. This study included participants from diverse cohorts including education, military, the workplace, and sports with the aim of providing context to MT across various domains. The study comprised four investigations. Within the second investigation, four models of MT were evaluated against 445 sport participants, 500 tertiary students, and 550 employees. The following data analysis revealed that model four, a unidimensional model consisting of eight items, displayed strong factor loadings and reliable scores across all participant groups, therefore prevailing as the best model fit for measuring MT among these groups (Gucciardi et al., 2015). This model was called the Mental Toughness Inventory (MTI).

Gucciardi has contributed to multiple studies on the concept of MT including the creation of a MT scale specifically for the sports of Australian football (Gucciardi et al., 2009) and cricket (Bull et al., 2007; Gucciardi & Gordon, 2009). He has also explored the concept of MT and performance within multiple sports including golf (Gucciardi et al., 2010), Australian soccer (Coulter et al., 2010), tennis (Gucciardi et al., 2015), rowing (Mahoney et al., 2016), and netball (Gucciardi et al., 2017).

Additionally, he has contributed to ten book chapters and over 36 articles solely on the concept of MT within sports.

Since its development, the MTI has been tested against various contexts to measure its validity and predictability of the outcome it measures. This includes special forces (Gucciardi et al., 2021), the military (Gucciardi et al., 2015) education and sport (Cowden, 2016; Li et al., 2019). This inventory emerges as a suitable tool for assessing MT among athletes given its proven reliability, predictive validity, and its ease of administration. On this basis, I used the MTI to measure MT in this study.

Mental Toughness and Sport Performance

It is believed that MT sets apart athletes who possess comparable levels of skill; those with this attribute are thought to perform at a higher standard, enabling them to excel beyond their physical capabilities (Gucciardi et al., 2008; Gould et al., 2010). However, some studies have failed to support the link between MT and SP (Brace et al., 2020). Such studies simply presume that MT is an important factor for performance due to its definition. Nevertheless, they have found that MT may be dependent on a specific sporting situations and the overall construct may not be imperative to success (Cowden, 2016). Despite this, certain qualitative studies have revealed that elite athletes rank MT as one of the most crucial psychological constructs linked with successful performance (Gould, 2002).

Li et al. (2019) suggested that individual athletes nurtured in the right environment are likely to develop MT, thereby enhancing their athletic potential and increasing successful performance. It is noteworthy that this study included the sport badminton which, like softball, is a bat and ball sport. As of now, there are no studies based on softball performance and MT, which is strange considering softball batting requires the athlete to be on their own against the entire opposing team. With a commendable success rate of 30% and the demands of this task, athletes are likely to require a high level of MT as it has been previously linked to successful performance under pressure (Gucciardi et al., 2008; Gould et al., 2010).

This study further contributed to the understanding of MT in achieving successful softball batting performance (SBP) and provided the first psychological study on this matter.

Self-Talk and Sport Performance

The second sport psychology concept this study focused on was construct of self-talk (ST). ST is a significant psychological theory that plays a vital role in various domains. It encompasses intentional and automatic self-focused verbalisations that take place aloud or as internal thoughts (Mohiyeddini & Essau, 2011).

ST can influence various factors for an athlete. This includes an impact on performance (Kremer et al., 2013), self-regulation (Hatzigeorgiadis et al., 2013), and goal setting (Horcajo et al., 2019). The concept of ST is a broad scope with researchers categorising it based on its focus and implementation. These categories include task-oriented and goal-oriented (Horcajo et al., 2019), motivational and instructional (Theodorakis et al., 2000) and positive and negative (Goodhard, 1986).

Latinjak et al. (2018) conducted a study aimed at understanding the intricate relationship between athletes and their implementation of ST during performance. Their findings revealed a notable association: participants performed to a higher standard when utilising positive ST and positive body language. Latinjak et al. (2019) continued research on ST, focusing on endurance sport. The main outcome of this study indicated that goal-directed ST did not effectively enhance performance, suggesting that ST is more complex than previously explored. This emphasises that the understanding of ST interventions within SP is incomplete (Horcajo et al., 2019).

Weinberg et al. (1984) found positive ST strategies used during endurance performance increased individuals' persistence in completing the activity; however, it did not yield a significant difference in performance outcomes compared to those who did not use such strategies. Van Raalte et al. (1995) contributed to this topic by revealing positive ST was not significantly linked to winning, but negative ST was connected with losing. Intriguingly, negative ST has shown to carry a motivational aspect, with individuals using such techniques anticipated to engage in better future performances compared to those employing positive ST (Goodhard, 1986).

Additionally, suggestions that positive ST (e.g., “you can do this”) can effectively reduce anxiety, increase effort, and heighten self-confidence (Dagrou et al., 1992; Weinberg et al., 1988), whereas negative ST (e.g., “there is no way I can do this”) may produce anxiety, self-doubt, and negatively impact performance (Mahoney & Avener, 1977). This highlights the complexity and context-dependent nature of ST in SP, especially that of the positive and negative spectrum.

Self-Talk Questionnaire

Research on ST has been conducted in both field and laboratory settings, yielding mixed results. While laboratory studies tend to support that ST enhances performance, field studies present a varied story, showcasing diverse outcomes regarding the influence and implementation of ST (Van Raalte et al., 1995). This discrepancy in findings could be attributed to factors such as recall bias, subjectivity, and the reliance on self-report measures when assessing ST (Brinthaupt et al., 2015; Kreitchmann et al., 2019).

Given the diverse findings in previous literature, including the situational factors that can influence ST, a reliable method of ST measurement aligning with this studies aims was not found. With a focus on softball batting, a ST questionnaire (STQ) was developed for this study. The questionnaire comprised of eleven situational self-report questions specific to the scenarios encountered in softball (Appendix A). Unlike previous ST scales, which were conducted for the general disposition of ST, this study aimed to focus on situational aspects of ST throughout a softball game. This focus was displayed through the STQ items that addressed different scenarios a softball batter may encounter before, during, or after their at-bat. The scale ranged from 1 (extremely negative) to 7 (extremely positive), covering the spectrum of positive and negative ST that an athlete may use.

Chang et al. (2014) investigated the relationship between ST and softball, with a specific focus on examining instructional and motivational ST and its impact on throwing performance. Their results found that both instructional and motivational ST contributed to better performance compared to unrelated ST. Similar to throwing, it is reasonable to assume successful softball batting

may require an understanding of ST strategies. This area of focus expands upon Chang's previous work as the current study aims to explore the relationship between ST and SBP.

The Current Study

The psychological concepts of MT and ST were closely examined to understand if they predict SBP. The results of this study are anticipated to establish new knowledge to the broader literature within the key areas of the participant demographics, and the sport itself.

Due to the lack of literature that examines softball performance and these constructs, this study will begin to fill that gap with new knowledge. To do this, the study enlisted high-level amateur athletes who volunteered from the club level sporting community. Unlike the majority of sporting studies that predominantly explored the psychology of elite and professional athletes this study concentrated on individuals who engage in sports for enjoyment and competitiveness rather than monetary gains or career pursuits. This demographic may be more representative of the Australian population, as only a minority of athletes reach elite or professional status. Therefore, data generated from this study may be more representative of the broader softball population.

Interpreting the outcomes obtained from these participants shed light upon the psychological constructs of MT and ST and their potential predictive value in relation to SBP. The hypotheses for this study are:

(H1) Mental toughness score will positively predict batting average.

(H2) Higher self-talk score, reflecting more positive self-talk, will positively predict batting average.

Method

Participants

46 Australian softball athletes (31 females and 15 males) participated in the study, with a mean age of 27.89 (*SD* = 8.97*)*. All participants met the eligibility criteria, requiring them to be at least 18 years old and to have played in at least 50% of their previous completed season games in the highest-level competition entered by their club (A grade/Div. 1). The inclusion of the 50% games-played requirement aimed to ensure the reliability and accuracy of their batting average (BA), as participating in less games could potentially skew the BA due to the smaller amount of at bats. The requirement to play at the highest level within their club was established to standardise the competition level, ensuring that all participants were competing in a similar level of competitiveness and difficulty.

The survey was distributed to numerous Australian softball clubs. Participants played in New South Wales (2), Queensland (5), South Australia (23), Tasmania (1), Victoria (5) and Western Australia (10).

Materials

Mental Toughness Inventory

Gucciardi et al. (2015) developed the Mental Toughness Inventory (MTI) to assess mental toughness (MT) in their study. The MTI scale comprised of eight items with participants rating each statement based on their thoughts, emotions, and behaviours as an athlete, e.g., “I strive for continued success”. Responses to these statements ranged from 1 (false, 100% of the time) to 7 (true, 100% of the time) with a score range of 7-56. Appendix B details the MTI.

Previous research on this inventory supported the validity and reliability across a broad range of contexts (Gucciardi et al., 2015). In line with previous results, data collected from this study exhibited appropriate internal consistency, as indicated by Cronbach’s alpha ($\alpha = .849$).

Self-Talk Questionnaire

A self-talk questionnaire (STQ) developed specifically for this study consisted of eleven self-report questions. These items asked participants to indicate whether their thought process during softball specific situations leaned toward positive or negative. In the preamble of the survey, examples of positive and negative self-talk (ST) were provided, i.e. “I am good at hitting an inside pitch” and “I don’t want to have another at bat” respectively. The STQ questions were created based on scenarios participants may encounter during a softball game (e.g., “In the on-deck circle before my first at bat, my self-talk looks like…”). The full STQ can be found in Appendix A. Responses to the items ranged from 1 (extremely negative) to 7 (extremely positive) with a score range of 11-77. Due to the newly developed scale, prior results demonstrating validity and reliability were absent. However, after data collection, the questionnaire’s reliability was supported by Cronbach’s alpha ($\alpha = .839$).

Procedure

The survey was distributed to softball clubs around Australia, using contact information gathered from publicly accessible websites. The respective club authorities were approached and requested to share the survey link to their eligible athletes. The link directed participants to Qualtrics, accessible from various electronic devices. The survey began with a participant information sheet, providing a comprehensive overview of relevant study information, including an estimated survey completion time of approximately five minutes. To participate, individuals had to indicate if they met the three eligibility criteria and grant specific consent for their identifiable information to be accessible to researchers. This consent was essential due to the subsequent data matching requirements administered post survey collection. This requirement was outlined in the participant information sheet that stated researchers would access their BA from their recent previous competitive season, documented in their club’s official records.

Upon providing their understanding and consent of the eligibility criteria, participants were prompted to supply their demographic information such as name, age, and the club they represent.

After completion of this section, participants were guided to complete the MTI and subsequently the STQ. Once finished, participants received a thank you message, acknowledging their contribution, and confirming the recording of their responses.

Data Matching for Batting Averages

This studies dependant measure was participant's BA. This outcome variable is indicative of the participant's performance and skill level. BA is a statistic ranging from 0.000 and 1.000, calculated by dividing the number of safe hits by the amount of attempted at bats e.g., 44 at bats, 10 safe hits [10/44 = .227].

I did not calculate the BA for participants in this study nor was it collected during the survey as some participants may not have access to this information and could have guessed, resulting in an inaccurate measure of their batting performance. To ensure the accuracy of the BA data, I contacted the club representing each participant via email to obtain their official competition statistics. This requirement was clearly communicated in the initial email to the clubs and reiterated as an eligibility question at the start of the survey.

Following the completion of the survey, I contacted each participant's club with their information to obtain their BA. In cases where clubs did not respond to the follow up requests, the survey responses from those participants were excluded and all related information deleted. Upon receiving the majority of participants official BA, this data was matched to their questionnaire scores using their full name. Subsequently, all identifying information was removed, leaving only the survey responses and BA for analysis.

Data Processing and Analysis

Raw data from Qualtrics was imported into an Excel file, where all data matching and cleaning procedures were carried out (Microsoft 365, 2023). To validate the STQ as a reliable data collection instrument, an exploratory factor analysis was conducted using JASP (JASP Team, 2023). The research aims of the study were examined through a linear regression analysis performed using R programming language (R Core Team, 2023).

Results

After performing data cleaning and matching in Excel, Table 1 provides a summary of the descriptive statistics for the dataset.

Table 1

Descriptive Statistics

	N	Mean	SD	Min	Max
MTI	46	42.33	6.37	26	55
STQ	46	52.41	8.61	37	68
BA	46	.275	.10	.071	.508

Note. MTI = Mental Toughness Inventory, STQ = Self-Talk Questionnaire, BA = batting average, SD = standard deviation.

Exploratory Factor Analysis

To commence analysis, I conducted an exploratory factor analysis (EFA) using the statistical program JASP to determine the suitability of the Self-Talk Questionnaire (STQ) due to its recent development (JASP Team, 2023). The STQ was designed to measure a single construct, where higher scores indicate positive self-talk (ST), and lower scores suggest negative ST.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .77 which determined the data suitable for factor analysis, as the conventional cutoff for factorability is usually .6 ("*What is KMO Test?"*, n.d.). Subsequently, I conducted a principal component analysis with oblique rotation using the promax rotation method in order to establish how many factors should be extracted. Initially, it was anticipated that STQ scores would load on a single factor. However, upon inspecting the scree plot, Figure 1, it became evident that scores were loading on two factors. This outcome was unexpected, as the STQ was originally designed to measure a single construct. I used Horn's (1965) parallel analysis method to determine how many factors to retain. The triangles in figure one represent eigenvalues from a simulated, random dataset of the same size as the observed data. The criterion is to retain factors with eigenvalues that are greater than those that could be observed in random data. For the observed data, this condition suggests two-factors.

Figure 1

Scree Plot: *Factor Loadings for STQ*

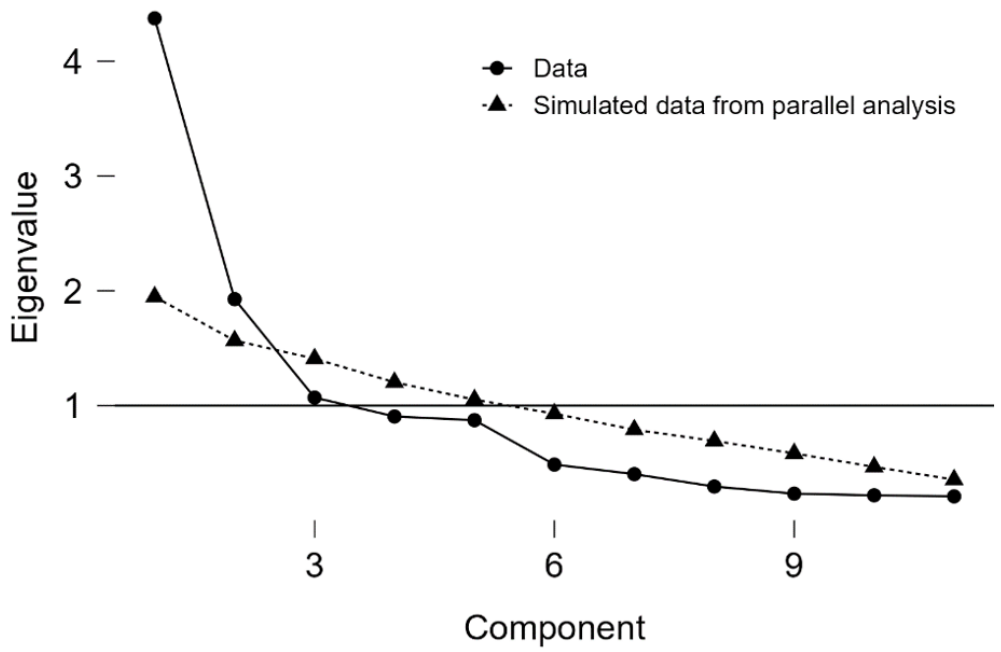

Table 2

Two-Factor STQ Summary

	Eigenvalues	SumSq. Loadings	Proportion Var.	Cumulative Var.
Factor 1	4.369	2.794	.254	.254
Factor 2	1.999	2.646	.241	.495

Note. Rotated solution is reported. SumSq. Loadings = sum of square loadings, Proportion Var. = proportion of variance, Cumulative Var. = cumulative variance.

Proceeding with the EFA, Table 2 summaries the two-factor solution and Table 3 shows the factor loadings, both of which reinforce the two-factor solution. Since I was anticipating a one-factor solution, I decided to check the outcomes for this option, as one could argue in favour of using the one-factor solution if there were little difference in the model fits. To test this, I conducted a follow-up EFA, with the intention of forcing the model to produce a one-factor solution. The results indicated that the one-factor model was a poor fit for the data; χ^2 (44) = 97.940, p < .001, whereas the two-factor model was a better fit; X^2 (34) = 47.00, p <.068.

Table 3

Two-Factor Loadings for STQ Items

	Factor 1 (Positively Framed STQ Items)	Factor 2 (Negatively Framed STQ Items)	Uniqueness
STQ 1	.003	**.625**	.607
STQ 2	**.497**	.173	.648
STQ 3	.392	**.553**	.350
STQ 4	**.703**	-.263	.599
STQ 5	.392	.268	.683
STQ 6	**.697**	-.051	.543
STQ 7	-.130	**.810**	.420
STQ 8	**.527**	-.072	.750
STQ 9	**.890**	.059	.158
STQ 10	.287	**.579**	.436
STQ 11	-.304	**.882**	.366

Note. Applied rotation method is promax. Highest loadings for each item is bolded. STQ = Self-Talk Questionnaire

When attempting to identify the two-factors, it was discovered that questions loading higher on factor-one were related to positively framed STQ items, whereas questions with higher loadings on factor-two were associated with negatively framed STQ items, as seen in Table 3.

Upon scrutinising the factor loadings for each individual STQ item, it was apparent that STQ5 did not exhibit a strong loading onto either factor, with a minimal loading threshold of .4 on the factor loading scale (Finch, 2020). Interestingly, this item displays similar loadings across both factors but held a slightly higher loading on factor-one, which primarily contained positive questions. It is noteworthy that STQ5 was a negatively framed question. Given these considerations, it was deemed prudent to exclude this item from the final analysis.

To proceed with the analysis based on the two-factor solution, I divided the STQ scores. Returning to the collated raw data in excel, I calculated two new scores for each participant, according to the results of the EFA. These new factors were categorised as ST Positive (STQ2, STQ4,

STQ6, STQ8, STQ9) and ST Negative (STQ1, STQ3, STQ7, STQ10, STQ11), with STQ5 excluded. Descriptive statistics for these factors are presented in Table 4 and breakdown of the factor split is presented in Appendix A.

The lower mean score ST Negative displays in Table 4 could potentially be attributed to the negative framing of the STQ items, therefore leading participants to report lower scores for these questions. However, this has no overall impact since ST Positive and ST Negative are positively correlated at .33.

Table 4

Descriptive Statistics for STQ Two-Factors

	Mean	SD	Min	Max	Cronbach's alpha
ST Positive	46	4.26	18	33	α = .775
ST Negative	46	4.90	11	31	α = .815

Note. ST = Self-Talk, SD = standard deviation

Regression Model

Examination of skewness and kurtosis confirmed the data absent of any univariate or multivariate normality issues which was further supported by the results of Q-Q plots, Residuals vs Fitted plots, Histograms, and Cook's distance. Collectively, this reinforced the conclusion that the data was normally distributed and suitable for analysis. The final analysis for this study was conducted on RStudio (R Core Team, 2023) where a linear regression model was determined to be best suited for the data type.

Results of the regression analysis are shown in Table 5. The overall model was found to be statistically significant ($F = 7.03$, $p < .001$), accounting for the effect size of approximately 33.41% of the variance in the outcome variable.

Table 5

Regression Model Results

	Coefficient β	Standard Error	t-value	p-value	95% CI Lower Bound	95% CI Upper Bound
MTI	.01	.002	4.181	< .001	.005	.013
ST Positive	-.001	.003	-.458	.65	-.008	.005
ST Negative	.0002	.003	.078	.94	-.005	.006

Note. Residual standard error: .85 on 42 degrees of freedom. MTI = Mental Toughness Inventory, ST = Self-Talk

The regression analysis examined the relationship between participant's batting average (BA) and their scores for Mental Toughness Inventory (MTI), ST Positive and ST Negative. The results show that MTI was a significant predictor of BA whereby a one unit increase of MTI score, is associated with a .010 increase in BA. This outcome supports hypothesis one: Mental toughness score will positively predict batting average.

As shown in Table 5, ST Positive and ST Negative were not significant predictors of BA. This does not support hypothesis two: Higher self-talk score, reflecting more positive self-talk, will positively predict batting average.

Given the initial expectation of STQ having one-factor, I ran an additional liner regression model with a single factor STQ score comprised of all summed items. These results did not affect the outcome of the unsupported hypothesis two and can be found in Appendix C.

Discussion

The broad aim of this study was to delve into the psychological constructs of mental toughness (MT) and self-talk (ST) focusing on their predictive relationship to softball batting performance (SBP). Two hypotheses were developed in accordance to background research:

(H1) Mental toughness score will positively predict batting average.

(H2) Higher self-talk score, reflecting more positive self-talk, will positively predict batting average.

Investigation of these predictions were tested through 46 amateur-level softball athletes around Australia who completed two self-report measures on MT and ST. Analysis began with an exploratory factor analysis (EFA), where the self-talk questionnaire (STQ) resulted in a two-factor model that fit the data significantly better than a one-factor model. The participant's survey responses were data matched with their batting average (BA) and a linear regression analysis was conducted to interpret the results. The conclusions from this analysis found that hypothesis one was supported by data, and hypothesis two was not supported by the data.

Mental Toughness and Sport Performance

This principal finding of this study, which supported hypothesis one, aligns with prior literature in the field particularly with the work of Gucciardi. Gucciardi's extensive research has delved into the relationship between MT and athletic performance across various sports, consistently identifying MT as a significant factor in successful sport performance (SP).

The results of the mental toughness inventory (MTI) in this study provide further evidence of the significant link between MT and athletic performance, confirming the MTI's validity and reliability. Specifically, this study discovered that MT is significantly linked to SBP, where a one-unit increase on the MTI corresponds to a .010 increase in BA. This finding highlights the predictive value of MT in SP, particularly in softball, where a BA of .280-.330 is considered a good outcome. An increase of .010 is impactful, illustrating the importance of MT in SBP, a particularly noteworthy discovery from this study.

Importantly, this result is reflective and consistent with prior research across a variety of sports and exercise concepts, including but not limited to marathon runners (Brace et al., 2020), physical endurance (Crust & Clough, 2005), gymnastics (Dekker et al., 2014), and swimming (Sheard & Golby, 2011). This consistency reinforces the notion that MT plays a crucial role in predicting performance outcomes in SP.

This study's findings provide significant implications for both sport psychology and the broader understanding of MT as a psychological construct. This article contributes valuable insights to the existing literature, further substantiating the role of MT in SP. Additionally, the reliability and validity of Gucciardi's MTI are reaffirmed, demonstrating its ability to encompass a variety of contexts. This is a commendable feat when measuring a dispositional aspect reliant on self-report responses. These results have implications that extend beyond sport and may be relevant in daily life, education, the workplace, and other domains where MT can influence outcomes.

This study's significance in part is due to the lack of previous literature on softball. While MT has been studied extensively, there has been a notable gap in the literature when it comes to the domain of softball. The results of this study not only contribute to the overall knowledge of SBP but also serve as a starting point for the expanded softball literature. Additionally, it affirms the concept of MT as a universal construct and sheds light on the broader implications of MT in the field of sport psychology and performance.

Self-Talk and Sport Performance

The second hypothesis in this study was notably not supported by the data. Due to the mixed results in prior literature, this study adds to the complexity of ST as a construct and the difficulties in measuring it in a sporting context. This further highlights the complexity and conflicting outcomes ST exhibits within SP. In particular, ST has been previously categorised into various types including task-oriented and goal-oriented (Horcajo et al., 2019), motivational and instructional (Theodorakis et al., 2000), and positive and negative (Goodhard, 1986).

The conflicting nature of ST can be attributed to its context-dependent and situationally dependant nature, as well as its reliance on self-reports for measurement. The results of this study, which demonstrate no significant relationship between ST and SBP, further empathise the complexity of this concept and contribute to the existing conflicts seen previously.

The purpose behind the development of the STQ was due to the lack of a previous measure on softball-specific scenarios, as prior research indicates the importance of situational aspects and context to ST. The EFA found that the STQ best fit a two-factor solution, which was unexpected as it was designed to measure positive and negative ST as a continuum, not as separate concepts. Despite these results, neither the two-factor nor one-factor solution had any impact on SBP.

These results contribute to the broader understanding of ST in SP by indicating that neither positive nor negative ST impact performance outcomes. This result is in line with prior research, which showed positive ST gave athletes higher persistence to complete the required task but had no significant effect on performance outcomes (Weinberg, 1984). However, the result also diverges from prior literature that supports the idea that participants perform more successfully when using positive ST (Latinjak et al., 2018).

The outcomes of this study challenge the notion that ST is a crucial psychological construct in SP. Despite literature considering this concept as an important psychological strategy, both this study and previous ones disagree with this idea, suggesting it might not be as important as researchers believe it to be. Indeed, it may be indicative that simply speaking to oneself and attempting to be positive is not as important to performance outcomes as physical skill or psychological constructs such as MT that have extensive research confirming its relationship to performance.

Latinjak's (2019) study delved deeper into ST, distinguishing between goal-directed ST (e.g., "relax", "give 100%") and future-oriented ST ("there is time left", "we have to win"). Results indicated that goal-directed ST was less effective compared to future-oriented ST. This discovery is particularly interesting as it questions the effectiveness of positive ST, suggesting that its impact may vary depending on how its employed.

This discovery may shed light on the reasons behind the non-supported hypothesis of this study. Perhaps it is not positive and negative ST themselves that influence performance outcomes, but rather the implementation and purpose of the ST within the sporting domain. This may explain the study's results as the STQ was developed to measure only the positive and negative ST spectrum.

The construction of the STQ might have also contributed to these results, and using a previously validated scale may have yielded different outcomes. However, it is essential to assess whether these results would truly reflect the softball batting domain or merely the everyday thought processes of the participants.

The results from this study challenge the notion of the importance of ST within the domain of SP, especially that of positive and negative nature within SBP.

Limitations

The primary limitation of this study was the participant pool. While there was good diversity in terms of geographical locations and age, the main concern came from the limited number of participants. This small sample size may have impacted the overall results of the study in several areas. One of these could have been sampling bias, whereby a larger participant pool could have yielding more reliable and balanced results that are truer to the actual outcomes. A larger number of participants would have also reduced Type II errors and increased the study's statistical power. In the future, it is highly recommended to use a larger participant pool to gain a more comprehensive understanding of the study's outcomes, contributing to new knowledge in the field.

Another notable limitation in this study is the reliance on self-report measures as the data collection method. While these measures are commonly used, easy to attain lots of data from, and easy to disperse, they come with a multitude of setbacks. Responses on self-report measures can be influenced by individual perspective, social desirability bias, and response bias (Brinthaupt et al., 2015; Kreitchmann et al., 2019). These problems have the potential to impact the study's validity and accuracy, which can lead to false conclusions drawn from the results.

Future Directions

One future direction within this area of study could involve examining the cognitive factors that influence performance. Exploring cognitive measures may offer a better understanding of the specific factors impacting athletic performance, as this approach allows researchers to move beyond self-report measures and their potential biases. However, a significant obstacle in investigating this direction is that each sport involves distinct movements, techniques, and skills that are specific to that sport's desired outcomes.

In softball, for instance, one cognitive concept worthy of investigation is inhibitory control. This cognitive function is a core process that regulates our capacity to engage in purposeful thought before reacting (Diamond, 2012). It controls our automatic urges, including our attention, behaviour, thoughts, and emotions, and instead guides us to use reasoning and logic to react appropriately. This function is important for many daily tasks, as it prevents us from acting on our impulses and maintains our focus (Afek et al., 2020).

Inhibitory control may be pivotal in SBP, given the limited time athletes have to react to a pitched ball. The ESPN Sport Science team wanted to understand the specifics behind this and calculated that for a ball travelling at 70mph (approx. 112kmh, a speed consistent with professional leagues and college-level play), softball batters have only .35 seconds to react (ESPN, 2011). Furthermore, another study by Flyger et al. (2006) claims batters have only .2 seconds to react to a pitched ball. Within this fraction of a second, batters must perform a series of tasks where they initially identify the incoming ball from the pitcher's hand, recognise whether it is a good pitch to swing at, make the decision to swing, and if they choose to swing, make contact with the ball. All of these processes must unfold in a timeframe of less than half a second, emphasising the cognitive demands inherent in softball batting.

To put this in perspective, let's compare this to the cardiac cycle, which is the process of the beginning of one heartbeat to the next. Within this cycle, the ventricular systole phase, during which both ventricles contract, pushing blood through the pulmonary trunk to the lungs, typically takes .3

seconds to occur (*"The Cardiac Cycle",* n.d.). This highlights the incredibly short timeframe in which a softball batter must decide whether to swing at the pitched ball. It is noteworthy that not every ball pitched at the batter will be one to swing at. The ball needs to be thrown in the correct zone as batters don't swing at every pitch. If batters perceives the pitch to be in the wrong zone, they will need to hold back their initial reaction of swinging.

Nasu et al. (2020) set out to understand the demands of softball and baseball batting and found that cognitive and motor processes are highly significant for batting outcomes. Research into this area would be an interesting future direction, particularly as it moves away from the self-report measures that could be influenced by subjectivity and bias. One promising measure that could be used to test inhibitory control is a stop-signal task. This task requires participants to perform a 'go' task such as pressing a key on the keyboard when the stimulus appears on screen. Occasionally, the 'go' stimulus is followed by a 'stop' signal, and the participant's objective is to withhold their response to the initial 'go' stimulus [1]. This is where the inhibitory control function is effective and is highly relevant to SBP. Batters must remain ready to hit the incoming pitch but must possess the cognitive ability to withhold their initial response based on their perception.

Investigating cognitive concepts such as inhibitory control will allow researchers to move away from self-report measures, which may provide further understanding of the psychology behind predicting performance outcomes.

Conclusion

This study aimed to examine the predictive value and impact of MT and ST on SBP. The first hypothesis, 'mental toughness score will positively predict batting average', was supported by the data found in this study, as a one unit increase of MT score on the MTI increased BA by .010. This supportive result aligns with existing literature.

[1] A stop-signal task was originally planned to take place within this study. This portion of the study had to be dropped due to the difficulty in implementing the task and subsequent data collection.

However, the second study hypothesis, 'higher self-talk score, reflecting more positive self-talk, will positively predict batting average', was not supported by the data. This outcome contributes to the conflicting nature of ST as a construct and indicates the need for further research on this topic.

This study had a few limitations, including the small participant pool size and the reliance on self-report measures, which are associated with several biases. Future research on predicting SBP may explore cognitive concepts such as inhibitory control, moving beyond commonly used dispositional self-reporting measures.

The key findings of this study contribute to new knowledge in the field of softball, which has seen limited research in the past. The benefits of this study's outcomes highlight the importance of MT as a psychological construct in the sporting domain and emphasise the need for further investigation into ST.

From a psychological perspective, this study empathises the importance of psychological skills within the sporting world. Athletes who invest in skills that have supportive framework and background results backing the constructs may enhance their performance on a consistent basis. The use of these psychological skills may play a vital role along their journey of athletic success.

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Appendix A: Detailed STQ

1 Extremely Negative	2 Negative	3 Slightly Negative	4 Neither Positive nor Negative	5 Slightly Positive	6 Positive	7 Extremely Positive
STQ 1	Before the game, I have a horrible hitting warm up. My self-talk response is					
ST Negative						
STQ 2	In the on-deck circle before my first at bat, my self-talk looks like					
ST Positive						
STQ 3	Over the last two games, I have gone 0-6. What self-talk do I engage in before my					
ST Negative	next at bat					
STQ 4	My count is 3 balls, 1 strike. What does my self-talk look like					
ST Positive						
STQ 5	My count is 0 balls, 2 strikes. What does my self-talk look like					
Excluded						
STQ 6	Bottom 7 inning, the tying run is on 2nd, and I am the winning run with one out.					
ST Positive	What self-talk do I engage in when in the batting box					
STQ 7	I went 0-3 this game. What does my self-talk look like					
ST Negative						
STQ 8	I went 3-3 this game. What does my self-talk look like					
ST Positive						
STQ 9	In the on-deck circle, I tend to think about my batting ability in which mindset					
ST Positive						
STQ 10	Up against the best pitcher in the league, what does your self-talk look like when					
ST Negative	walking up to the box					
STQ 11	I have struck out in three pitches. On my way back to the bench and for the rest of					
ST Negative	the batting inning, my self-talk is					

Note. ST Positive and ST Negative indicate which factor the item was put into due to EFA outcome
Table Abbreviations: STQ = Self-Talk Questionnaire

Appendix B: Mental Toughness Inventory

INSTRUCTIONS: Using the scale below, please indicate how true each of the following statements is an indication of how you typically think, feel, and behave as an athlete – *remember there are no right or wrong answers so be as honest as possible*.

1	**2**	**3**	**4**	**5**		**6**		**7**	
False, 100% of the time								***True, 100% of the time***	
1	I believe in my ability to achieve my goals	1	2	3	4	5	6	7	
2	I am able to regulate my focus when performing tasks	1	2	3	4	5	6	7	
3	I am able to use my emotions to perform the way I want to	1	2	3	4	5	6	7	
4	I strive for continued success	1	2	3	4	5	6	7	
5	I execute my knowledge of what is required to achieve my goals	1	2	3	4	5	6	7	
6	I consistently overcome adversity	1	2	3	4	5	6	7	
7	I am able execute appropriate skills or knowledge when challenged	1	2	3	4	5	6	7	
8	I can find a positive in most situations	1	2	3	4	5	6	7	

Note. This table was downloaded directly from Gucciardi's personal website (Gucciardi, 2023). Minor formatting modifications have been applied.

Appendix C: Regression Model Results for One-Factor STQ

	Coefficient β	Standard Error	t-value	p-value	95% CI Lower Bound	95% CI Upper Bound
MTI	.01	.0002	3.82	< .001	.005	.015
STQ	-.001	.002	-.54	.59	-.005	.003

Notes: Residual standard error: 0.08399 on 43 degrees of freedom

Mental Toughness is a significant predictor of softball batting performance (β = .01) whereas Self-Talk is not a significantly predictive of softball batting performance (β = -.001).

Overall model *(F* = 10.84, *p* < .001), effect size of approximant 33.41% of variance in the outcome variable. MTI = Mental Toughness Inventory, STQ = Self-Talk Questionnaire