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Linking Environment and Mind: Effects of Psychological Skill Training on Hockey Performance

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Abstract: *This study aims to investigate the effect of PST on self-talk, imagery ability, mental toughness, and related performance variables of university hockey players. The research followed a quasi-experimental design where thirty-two male hockey players of age ranging from 25-30 years completed the Automatic Self-Talk Questionnaire (ASTQ), Sport Imagery Ability Questionnaire (SIAQ), Sports Mental Toughness Questionnaire (SMTQ), and the Sports Performance Scale prior to and following the completion of the structured PST programme. The PST group underwent PST interventions self-talk, imagery and mental toughness, while the control group underwent no intervention. The results indicated that the experimental group, compared to the control group, gained more psychological benefits post-intervention on all psychological measures and with largest effect sizes (Cohen's d = 3.4 for self-talk, 3.67 for mental toughness). whereas, within the control group, there were no meaningful changes. Bivariate correlational analyses also showed mental toughness, ability to visualize, self-talk and performance had strong positive relationships. These findings support PST in the improvement of psychological skills and performance, which serves as a foundation for the practice of mental training in the systems for athlete development.*

Keywords: *Psychological Skill Training (PST), Self Talk, Imagery, Mental Toughness, Sports Performance.*

INTRODUCTION

Various aspects regarding the psychological nature of performances have been described in the literature of sport psychology. Researchers have recently been witnessing the psychological readiness, mental processes and cognitive strategies are equally important to physical potential in determining the outcome in sport performance, particularly in pressure situation sports like hockey. For hockey is a game of quick thinking and deep focus, more than it is of endurance, at least in stressful situations. More recently however, research has tended to challenge relationships between aspects of psychological skills (namely self-talk and imagery), mental toughness and performance (Brown & Fletcher, 2017; Hatzigeorgiadis et al., 2011; Vealey, 1994).

Among various methods to develop the mental ability and performance of athletes, PST is one of the best reflected therapies. Mental skills, such as self-talk, imagery and mental toughness are common areas of PST and are important psychological skills for athletes to have for coping with the mental demands of performing in sport (Alexander et al., 2019; Lange-Smith et al., 2023; Weinberg, 2019). The hypothesis is that PST could boost physical performance by reducing stress, replenishing attention, and managing emotions in high-pressure situations, as has already been observed (Dohme, 2019; Watson et al., 2022).

Self-talk, a key psychological skill which is associated with PST includes an athlete's thoughts that support movement cues, help support motivation and goals, and reduce anxiety associated with performance. These beneficial effects have been demonstrated by Hatzigeorgiadis et al. (2011) and Röthlin et al. (2020). The same was suggested by Rees and Freeman (2020) who found evidence that positive self-affirmations increase

athlete´s self-confidence, focus, and control, while negative self-talk negatively affects performance through elevated anxiety and reduced motivation. Competing in high-contact sports, like hockey, which require quick decision making and can result in collision-related injuries, self-talk is important to keep one's mind focused. Use of imagery in research has been significantly researched as a psychological tool used by athletes for cognitive performance rehearsal. Mental imagery means to imagine the skills or the games, winning, best performance, or to self-confidence, which consequently leads to better Competence (Ribeiro et al., 2019; Simonsmeier et al., 2020). Imagery training can increase competence as athletes that use imagery on a regular basis develop better technique and decision-making skills and reinforcement of confidence (Alexander et al., 2019; Pelka et al., 2016). Visualization in hockey is used for picturing big moments in games, passes, goals, and to prepare mentally for game situations outside of the rink.

Mental toughness, described as the capacity to maintain focus, self-belief and recover from setbacks under pressure, is considered to be a key psychological attribute that predicts positive competitive performance for athlete (Vealey, 2019; Watson, et al., 2022). Finally, these competitors are mentally tougher and deal with adversity better (digest bad moments better) and they still perform at the highest level when facing failure. Also, important aspect is player's psychological resilience, particularly in the case of hockey players who are subjected to intense physical demands as well as the very emotional and stressful circumstances that elite sport entails (Kelemen et al., 2024; Vella-Fondacaro & Romano-Smith, 2023).

Psychological skills training (PST) integrated in training programs have proven effective in various sports, including ice hockey. Psychological skills training (PST) programs have been successful in improving performers' ability to cope with psychological barriers, manage stress, and cope with pressure and even rendering greater psychological readiness and performance (Park & Jeon, 2023; Vealey, 2023). Although a growing body of the literature focuses on the effect of PST on specific mental skills (e.g., Trudeau & Janisse, 2010), a greater emphasis needs to be placed on comprehensive PST to improve self-talk, imagery, and mental toughness, especially in university hockey, and the subsequent competitive benefits associated with the interventions.

The objective of this research was to determine the outcome of PST on the psychological skills and performance of university hockey players. We wished to investigate extra benefits of PST on athletes' self-talk capabilities, ability to visualize, and mental toughness, and to what extent changes in these strategies were associated with performance. The focus of this study was to assess the effects of PST on the mental skills of the skaters using a pre and post testing, and to determine the relationship between mental skills and performance. The present research has filled a gap in the literature by investigating the influence of PST on university level hockey players.

It was expected that, as in previous studies (Park & Jeon, 2023; Vealey, 2023), psychological constituents (e.g., self-talk, imagery, and mental toughness) will be significantly improved post-PST. These changes were expected to explain variances between low and high performers according to the coach, expressed by the player. This research will provide valuable knowledge that could further develop the existing knowledge base of PST effects on performance as well as the integration of PST in a university-level hockey player training program.

RESEARCH METHODOLOGY

Sample: The purposive study samples include thirty-two male university hockey players age 18 – 25 years from a private sector university in Lahore. A pre-post quasi-experimental design and correlational analysis were adopted in this study to examine the effects of psychological skill training (PST) on university hockey players' performance. The research challenges the association of various psychological skills (self- talk, imagery ability, and mental toughness) with improvements in ice-hockey performance between pre- and post-PST intervention play. The volunteers participated with all of the information and consent they could ask for.

Instruments: Psychological abilities and performance of the participants were measured with four validated psychometric instruments:

Automatic Self-Talk Questionnaire (ASTQ): The ASTQ (Zourbanos, et al., 2009) was developed to quantify the frequency and content of automatic self-talk experienced whilst in action. It includes positive and negative self-talk subscales, providing clues as to how the athletes are feeling mentally.

Sport Imagery Ability Questionnaire (SIAQ): The SIAQ (Williams & Cumming 2014), examines their ability to generate a clear picture of themselves succeeding using the imagery ability questionnaire which evaluates how often and clearly, they see images connected to abilities, tactics and emotions and demonstrates how well a performer can produce clear, vivid images which lead to improved performance.

Sports Mental Toughness Questionnaire (SMTQ): The SMTQ (Golby et al., 2009) measures key characteristics of mental toughness such as confidence, resilience, concentration, and emotional control, known to be important for exceptional athletic achievement.

Self-Rating Scale of Athletic Performance: This self-report scale (Wolanin, 2007) assesses competency on how well athletes feel they performed in hockey even their technical performance, decision making ability, and teamwork performance to how they contributed to their team's success. It was used for performance before and after the intervention.

Procedure: To assess their psychological characteristics and sports performance, the participants completed four questionnaires, the ASTQ, SIAQ, SMTQ and Sports Performance Scale. Subsequently, the student athletes participated in an eight-week PST (Psychological Skill Training) program to attempt to improve their mental toughness, self-talk and ability to picture things in their mind. In 90-minute PST sessions that participants attended thrice a week for eight weeks, they were taught how to reframe negative self-talk, enhance mental images, increase resiliency and stay on task when things get difficult. Participants were instructed to both practice these skills during training and competition without any outside guidance, in addition to the weekly training session. After the eight-week training program of PST, the student athletes took the same questionnaires again, to measure how their mental skills and how well they could play. Ethical approval was taken from the institution before the start of the study. Informed consent was taken from the participants and they were assured about confidentiality of their details.

DATA ANALYSIS AND RESULTS

Data was analyzed using SPSS software, 23. Internal consistency of the scales was examined by reliability analyses. The Shapiro-Wilk test examined the normality of the data. Paired sample t-tests were also carried out for normally distributed variables to compare the mean of pre and post intervention scores. For variables that were not normally distributed, the Wilcoxon signed-rank test was used. Correlational analysis was used to study the correlation between the variables.

Table 1 *Reliability of the scales (n=32)*

Scales	No. of Items	Cronbach's Alpha		
		Pre-test	Post-test	Overall
Automatic Self-Talk Questionnaire (ASTQ)	36	.765	.954	.921
Sport Imagery Ability Questionnaire (SIAQ)	15	.777	.876	.892
Sports Mental Toughness Questionnaire (SMTQ)	14	.757	.914	.907
Sports Performance Scale	10	.648	.937	.904

Note: The reliability analysis indicated that most of the scales (ASTQ, SIAQ, SMTQ, and Sports Performance Scale) had excellent internal consistency, particularly in the post-test and total evaluations. The Cronbach's Alpha for the ASTQ, SIAQ, and SMTQ had alpha values above0.90, indicating that the measures are highly reliable in measuring their constructs. Although the pre-testing reliability of the Sports Performance Scale was relatively poor, the overall reliability of the scale was very high, indicating that it was a reliable measure of performance beliefs post-intervention.

Table 2*Normality of Data for the scales (n=32)*

Scales	**Shapiro-Wilk**		
	Statistic	**df**	***p***
Automatic Self-Talk Questionnaire (ASTQ)	.976	32	.665
Sport Imagery Ability Questionnaire (SIAQ)	.981	32	.834
Sports Mental Toughness Questionnaire (SMTQ)	.927	32	.032
Sports Performance (SP)	.962	32	.320

Note: The normality of the data at each scale was tested using the Shapiro–Wilk test. The data distribution as for ASTQ, SIAQ and SP scores were normal (p >. 0001), which indicate that for these variables parametric testing is appropriate. The SMTQ significantly deviated from normality (p = 0.032); thus, nonparametric tests were used to test for normality violation.

Table 3 Correlational Analysis for the Variables (n=32)

	Sub-Constructs	**M**	**SD**	**1**	**2**	**3**	**4**
1	Sports Mental Toughness Questionnaire	2.77	.592	0.595** <0.001			
2	Sport Imagery Ability Questionnaire (SIAQ)	2.70	.581	0.732** <0.001	0.580** <0.001		
3	Automatic Self-Talk Questionnaire (ASTQ)	2.52	.368	0.773** <0.001	0.641** <0.001	0.746** <0.001	
4	Sports Performance	179.4	22.91	0.563** 0.001	0.435** <0.001	0.707** <0.001	0.544** <0.001

** Correlation is significant at the 0.01 level (2-tailed).

Note: The results showed significant positive inter-relationships among all the psychological variables and sports performance. Increasing levels of mental toughness were significantly correlated with greater use of imagery and positive self-talk and these three areas were significantly related to improved performance. The high relationship between self-talk and imagery suggests the two skills are supportive components of the athlete's psychological make-up. Results indicate that the two characteristics are positively associated and are related to hockey participation.

Table 4 *Statistics of Paired Sample T-test of Automatic Self-Talk Questionnaire of the Participants of both Control and Experimental Groups (n=16 + n=16) before and after intervention*

Group	**Pre-test**		**Post-test**		**t(15)**	***p***	**r**	**Cohen's d**
	M	**SD**	**M**	**SD**				
Control	2.37	.22	2.42	.29	-1.809	.091	.95	.19
Experimental	2.43	.35	3.42	.20	-9.057	<0.001	-.164	3.4

Note. The results from the experimental group showed significant improvement in post-test results, t (15) = -9.06, p < .001, with improvement attributed to the intervention (Cohen's d = 3.4, extremely large). On the other hand, the control group's change in scores was t(15) = -1.81, p = .091, and demonstrated core in change with no significance (Cohen's d = 0.19, negligible). This means that the experimental group and control group had very high and very low significance attributed to the interventions, respectively.

Table 5 *Statistics of Paired Sample T-test of Sports Imagery Ability Questionnaire of the Participants of both Control and Experimental Group (n=16 + n=16) before and after Intervention*

Group	**Pre-test**		**Post-test**		**t(15)**	***p***	**r**	**Cohen's d**
	M	**SD**	**M**	**SD**				
Control	1.98	.28	2.14	.33	-1.94	.071	.46	.52

Experimental	2.56	.39	2.86	.37	-2.44	.027	.20	.78

Note. The experimental group showed significant improvement from pre-test to post-test, t(15) = -2.44, p = .027, while the control group's improvement t(15) = -1.94, p = .071, fails to meet the 0.05 threshold for significance, though both are considered to have medium effect sizes (Cohen's d = 0.78; 0.52). This suggests the experimental group was positively impacted by the intervention, while the control group's lack of significant improvement indicates the potential for uncontrolled influences, albeit weaker than the conducted intervention.

Table 6 *Statistics of Paired Sample T-test of Sports Performance for the Participants of both Control and Experimental Groups (n=16 + n=16) before and after Intervention*

Group	**Pre-test**		**Post-test**		**t(15)**	***p***	**r**	**Cohen's d**
	M	**SD**	**M**	**SD**				
Control	175	25.21	156	27.09	1.918	.078	-.155	-.726
Experimental	155.7	27.87	230.8	19.59	-10.66	<0.001	.336	3.11

Note. A paired samples t-test generated a statistically significant and large increase in post-test scores for the experimental group (Cohen's d = 3.11). By contrast, scores of the control condition decreased from pre-test to post-test, t(df) = 1.92, p =. 078, with a moderate effect size (Cohen's d =- 0.73). Thus, close analysis of mean scores demonstrates success of the intervention in the experimental condition, and, although not statistically significant, the control condition is either trending negatively or that further "regression to the mean" or variables over time could influence the comparison. The results are highly suggestive of a positive impact of the treatment on outcome.

Table 7 *Statistics of Wilcoxon Signed Rank test of Sports Mental Toughness Questionnaire of the Participants of both Control and Experimental Group (n=16 + n=16) before and after intervention*

Group	**Pre-test**		**Post-test**		**Cohen's d**
	M	**SD**	**M**	**SD**	
Control	2.41	.62	2.51	.71	.15
Experimental	2.46	.42	3.68	.21	3.67

Note. Both control and experimental pre-post score differences were analyzed with the Wilcoxon signed-rank test. The mean pre-test for the control group was 2.41 (SD =0.62) and the mean post-test was 2.51 (SD =0.71). The effect size (Cohen's d) was 0.15. The average pre-test marks were 2.46 (SD = 0.42) whilst average post-test scores were 3.68 (SD = 0.21). Effect size Cohen's d is 3.67. Pre-to-posttests demonstrated no significant difference for the control group, with a minimal effect size. The effect size of the experimental group's pre-test to post-test change was moderately enhanced.

Table 8 *Test Statistics and Ranks of Wilcoxon Signed Rank test of Sports Mental Toughness Questionnaire of the Participants of both Control and Experimental Group (n=16 + n=16) before and after intervention*

Group	**Test**	**Ranks**	**N**	**Mean Rank**	**Sum of Ranks**	**Z**	***p***
Control	PreTest- PostTest	Negative Ranks	3[a]	7.50	22.50	-2.151[d]	0.031
		Positive Ranks	12[b]	8.13	97.50		
		Ties	1[c]				
Experimental	PreTest- PostTest	Negative Ranks	0[a]	.00	.00	-3.52[d]	<.001
		Positive Ranks	16[b]	8.50	136.00		
		Ties	0[c]				

[a=]meanSMTQPost < meanSMTQ, b=meanSMTQPost > meanSMTQ, c=meanSMTQPost = meanSMTQ, d=Based on negative ranks.

Note. A Wilcoxon signed-rank test showed that the difference between pre-test and post-test scoring was statistically significant in the experimental group with a very large effect size (Cohen's d = 3.67). However, control participants showed little change, which was not statistically significant, and an effect size inconsequential (Cohen's d = 0.15). These findings suggest that the intervention delivered to the treatment group was highly successful, whereas the control group who did not receive the intervention demonstrated little change.

DISCUSSION

The purpose of this study was to evaluate the effects of psychological skills training (PST) on various psychological variables and athletic performance among university hockey players. Reliability of the scales, normality and paired samples t-tests showed that PST had an impact on performance, in that participants increased use of PST strategies (e.g., self-talk, imagery ability and mental toughness) and performance outcomes notably improved.

Reliability analysis results indicated high internal reliability in all scales used in the present study such as ASTQ, SIAQ and SMTQ, each Cronbach alpha values >0.90 for both post-test and for the overall measure. That means these scales had high reliability in measuring the constructs they aimed. Internal consistency of the Sports Performance Scale was satisfactory, although not very high, at pre-test and it can be considered good for establishing the validity of the scale to assess the athletes in terms of perceived performance.

These variables could be subjected to parametric statistical tests, since the data of the ASTQ, SIAQ and Sport Performance (SP) scales presented normal distribution, which was confirmed by the Shapiro-Wilk test, with level of significance of 0.05. Normality in terms of the p value for the SMTQ was marginal (p = 0.0326) and thus required a nonparametric analysis for analyses of this measure, especially before vs. after the test.

Our correlation analysis provided the relationship between evidence based on the studied variables. Mental toughness, imagery, self-talk, and performance were found to intercorrelate significantly. High mental toughness associated positively with higher visual imaginability ability, as well as more positive self-talk and better on hockey performance. This supports prior research highlighting the importance of mental skills such as mental toughness and self-talk in predicting sport performance (Hatzigeorgiadis et al., 2011; Vealey, 2019). Confirmed positive correlation of the process of capacity development through imagination and the result supports mental practice as a useful way to improve sports achievements (Ribeiro et al., 2019; Simonsmeier et al., 2020).

A comparative analysis was conducted to assess the effects of the PST program, with paired sample t-tests revealing statistically significant improvements in the ASTQ, SIAQ, and Sports Performance Scale scores. The experimental group demonstrated a notable increase in ASTQ scores ($t = -9.057$, $p < 0.001$), along with a considerable effect size ($d = 3.4$). This indicates that the PST intervention significantly altered participants' self-talk, leading to an improved ability to utilize positive facilitative self-statements (Röthlin et al., 2020; Watson et al., 2022). Furthermore, the experimental group showed a significant improvement in their SIAQ scores ($t = –2.44$, $p = 0.027$, $d = 0.78$), suggesting that the imagery training, as part of the PST, effectively enhanced participants' ability to visualize successful game scenarios, which is a vital element for enhanced performance (Alexander et al., 2019; Pelka et al., 2016).

The experimental group also displayed a significant improvement in the Sports Performance Scale (negative $t = −10.66$, $P < 0.001$, Cohen's $d = 3.11$), with participants' test scores significantly elevated post-treatment compared to their initial scores. This finding supports the notion that psychological skill interventions improve athletes' self-evaluations of performance quality, resulting in subsequent enhancements in actual competitive performance (Brown & Fletcher, 2017; Vealey, 2023). In contrast, the control group showed no significant changes in their scores across all variables, indicating that the improvements observed in the experimental group were solely due to the PST program, rather than external factors or practice effects.

The Sports Mental Toughness Questionnaire (SMTQ) was evaluated using the Wilcoxon signed-rank test, which indicated a significant improvement in the experimental group ($t = -3.52$, $p < 0.001$, Cohen's $d = 3.67$), thereby confirming the effectiveness of the PST in enhancing mental toughness. The results support the idea

that mental toughness can be improved via specific psychological interventions and highlight its importance as a factor in athletic achievement, particularly in high-stress situations (Kelemen et al., 2024; Vella-Fondacaro and Romano-Smith, 2023).

The control group led to a minor and statistically insignificant change in mental toughness performance, demonstrating a small to negligible effect size (Cohen's d = 0.15). This suggests that, if left without intervention, participants in the control group did not develop psychological skill to an equivalent level, highlighting the importance of PST for developing mental attributes, such as self-talk, imagery and mental toughness.

The improvement in the psychological scale scores, the attending characteristics of the experimental group show the mutual effect of mental qualities and their effect on sport performance. The results suggest that a "PST survival kit" rich in self-talk, visualization, and mental resilience can help athletes develop the mental strength and clarity required for optimal performance. The considerable effect sizes observed in the experimental group, related to the ASTQ (Cohen's d = 3.4) and SMTQ (Cohen's d = 3.67), strongly support the efficacy of PST in improving psychological skills and performance among athletes.

These results are consistent with other studies that have highlighted the importance of cognitive skills in sports. Thus, if athletes exercise positive self-talk, imagery and mental toughness, they are more likely to reach high levels of performance, as these skills impact their focus, anxiety and resilience in high straining situations (Lange-Smith et al., 2023; Röthlin et al., 2016; Vealey, 2023). This relationship suggests that mental rehearsal has a positive impact on the athlete´s developmental skills, confidence, and game plan approach (Ribeiro et al., 2019; Simonsmeier et al., 2020). The findings necessitate further research on elite hockey athletes in a university setting and provide additional information on how psychological skills training may be integrated into team sports. Although many studies have been conducted on PST in individual sports, relatively few studies have examined team sports, including hockey, where mental skills are crucial to not only individual athletes, but also to the team (Park & Jeon, 2023).

Study implications imply that psychological skills training can greatly enhance hockey players' psychological abilities and performances in university level hockey players. The improvements in self-talk, imagery ability, mental toughness, and on performance further emphasize the importance of PST as part of an athlete's training, particularly for team sports (i.e. hockey). It has been shown that PST has the potential to enhance psychological characteristics in athletes as well as team performance, which presents significant implications for sports practitioners and coaches to maximize mental and physical performance.

CONCLUSION

Finally, the research provides strong evidence that Psychological Skills Training (PST) of self-talk, imagery skill, and mental toughness followed by significant improvements in sport performance in university hockey players. The outcomes, supported by strong statistical significance and large effect sizes, validate that PST promotes mental toughness, confidence, and game readiness, especially under pressure situations. The poor progress of the control group is evidence that these benefits stem specifically from PST, rather than from extrinsic sources. These results support existing data and suggest that the integration of PST into typical training protocols may yield notable psychological and performance benefits in team sports like hockey. This is evidence of the critical role that coaches and sports psychologists play in developing mental skills for the improvement of individual and collective performance.

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