

Psychophysiological Interventions in Hockey: A Review of Biofeedback and Performance Under Pressure

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Abstract

Competitive hockey is played at a very high level of intensity and is characterized by a quick tempo. Three elements of successful play must be rapidly integrated by players during the fast action of a game, including physical skills (technical proficiency), mental skills (tactical awareness), and emotional skills (mental control). Choking and underperforming as a result of uncontrollable psychological elements are common occurrences for many athletes. Choking can happen to an athlete who has elite-level talent and skill. Historically, choking research has been primarily focused on the physical and tactical dimensions of choking; however, in recent years, researchers have begun to investigate some of the psychobiological factors related to choking through research in sports psychology. The purpose of this article is to serve as a literature review describing how choking has been investigated relative to each of those three dimensions, examining the primarily psychological attributes (of players) that lend themselves to choking more than others, describing biofeedback mechanisms (training systems) through Galvanic Skin Response (GSR) training (psychophysiology) and how biofeedback systems can be developed and incorporated into training programs to help improve autonomic regulation, decrease anxiety during competition and improve performance reliability at critical moments in games, and providing data that indicates that decreased performance due to stress is a universally documented phenomenon from the amateur to the professional level.

Keywords: Choking, Biofeedback, Galvanic Skin Response, Hockey

INTRODUCTION

Hockey, as a highly competitive sport, exemplifies how fast-paced and high-speed teams engage in play that features continuous motion with quick transitions from offense to defense and consistent physical contact throughout the game. Thus, to compete well, an athlete must demonstrate not only the physical fitness components necessary to perform well during competition but they will also require technical motor skill proficiency, tactical awareness, physical endurance and unwavering mental discipline. (Baker et al., 2003). Athletes are consistently required to perform precise and well-coordinated motor movements, while simultaneously processing dynamic environmental information, such as the positioning of teammates, the aggressive movements of opponents, and game-specific tactical demands (Baker et al., 2003). Because of the way hockey is played, it is very likely to break down under pressure. High-pressure situations are inherent to the sport, typically arising during critical match phases such as penalty corners, shootouts, power plays, and end-game scenarios where outcomes are highly consequential. During these moments, athletes experience heightened evaluative stress, increased self-awareness, and intensified emotional arousal, all of which elevate the risk of 'choking' (Baumeister, 1984). Choking is a significant and suboptimal performance execution by an experienced athlete (Baumeister, 1984), with a severe disruption of automatic motor processes (Beilock & Carr, 2001), which finally narrows down the attentional focus of an otherwise brilliant athlete (Hill, Cheesbrough, Gorczynski, & Matthews, 2010), but all under pressure situation. Errors committed during these phases such as mistimed tackles, inaccurate shots, or poor decision-making can have immediate and substantial consequences for match outcomes, further amplifying perceived pressure on the individual and the collective (Hill et al., 2010).

Research examining stress and anxiety in team sports suggests that high-pressure environments impair perceptual–cognitive functioning and motor execution. Anxiety interferes with visual attentional control, which in turn results in ineffective information scanning and compromised anticipatory decision-making (Wilson, Vine, & Wood, 2009). In hockey, where the ability to scan quickly is an important factor for success, these sorts of limitations make it much more difficult for athletes to perform effectively. In addition to this disruption, increased physiological arousal will also interfere with timing and coordination of fine motor skills, which forces athletes to provide conscious oversight over movements that should otherwise be performed automatically (Murray & Janelle, 2007). This alteration is consistent with the choking self-focus theory, which states that the attempt to consciously control a skill that one already knows how to do will produce a technical error (Masters, 1992). Hockey, unlike many individual sports, has an interpersonal component, so when one member of a team makes an error, other players can immediately experience a “cascade” effect resulting in poor team performance. Several factors, such as emotional contagion, decreased collective efficacy, and breakdowns in communication, may contribute greatly to team failure (Morgan et al.). According to Wergin, Mallett and Beckmann (2022), immediate declines in team sports are typically conceived as “collective collapses,” with shared characteristics such as a swift onset and emotional escalation.

Choking was initially conceptualized as a counterintuitive consequence in which growing motivation ironically hinders execution (Baumeister, 1984). There is evidence from actual performance that choking is not anything as simple as a consequence of anxiety, but rather an intricate malfunction in the systems whereby we sometimes automaticise our performances to prevent failure under low-pressure situations (Beilock & Carr, 2001). Empirical evidence that helps explain the choking phenomenon comes from two psychological perspectives; the Self-Focus perspective wherein higher levels of pressure enhance self-priming and make athletes oversensitive about their movements leading them to try to consciously control motor skills which in nature are automatic, and the Distraction perspective whereby anxious-induced worry breach on working memory directing attentional process away from task-relevant cues. Qualitative work suggests that performance below anticipated levels, termed “choking,” results from perceived loss of control and debilitating anxiety (creating fear: in the form of a negative appraisal), while optimal performance results from positive evaluation of fear and sense of control (Boyce and Jackson, 2021).

The presence of an audience is a primary driver of situational pressure. Analysis of Major League Baseball data (2015-2018) found negative causal effects of audience size on the probability of a successful bat for all athletes (Wen-Jhan, 2021). Similarly, archival National Hockey League data confirms that professional, highly skilled athletes exhibit performance decrements during high-stakes game moments (Depken, Sonora, & Wilson, 2012). Vulnerability to pressure is not uniform; it is determined by a multifactorial interplay of personality traits, resilience, and self-efficacy (Ayranci & Aydin, 2025). Specific dispositional traits predict performance under pressure. Neuroticism negatively predicts performance in high-pressure decision-making tasks, as it likely taxes cognitive resources such as working memory (Byrne, Silasi-Mansat, & Worthy, 2015). Additionally, fear of negative evaluation (FNE) reflects an athlete’s apprehension about judgment, which exacerbates stress when outcomes are highly visible (Mesagno, Harvey, & Janelle, 2012). About 35% of the diversity in choking susceptibility can be accounted by physical trait anxiety and private self-consciousness (Wang, Merchant, Morris, & Gibbs, 2004).

Anxiety and competitive pressure are mediated by psychological resilience (Li, Moritz, & Liu, 2025). It’s interesting to note that there was no statistically significant difference in self-reported mental toughness between “choking susceptible” and “non-susceptible” performers in a study of N=415 athletes using a Mann-Whitney U test (Thiessen, Blacker, & Sullivan, 2024). On the other hand, strong “movement self-consciousness” (reinvestment) indicates a greater probability of feeling as though one has “choked,” but self-efficacy serves as a buffer (Iwatsuki et al., 2018). Simultaneous entry multiple regression revealed that the perception of choking was substantially influenced by low self-efficacy and excessive worry about impressions in their sample of N=160 collegiate tennis players. The ways that pressure affects performance vary among people with different emotional awareness levels. Athletes with reduced emotional awareness may maintain performance under pressure despite high anxiety, while those with typical awareness show declines following self-control tasks (Gakh et al., 2025). Additionally, cognitive appraisal theories indicate that appraising pressure as a “threat” rather than a “challenge” increases susceptibility.

The Psychophysiological Dimension: The Role of GSR

Performance failures are generally the result of autonomic dysregulation. Decision-making and attentional control among hockey players is influenced by extended durations of physical exertion, as well as psychological stresses, which stimulate hypothalamic-pituitary-adrenal (HPA) axis activation and increase sympathoadrenal (SNA) activation (Hatfield, Landers & Ray, 2009). The Galvanic Skin Response (GSR) is a physiological marker of emotional and arousal level due to the eccrine sweat glands being exclusively innervated by the sympathetic nervous system. GSR can be used as an objective measure of arousal, emotional or arousal due to its relative resistance to conscious manipulation (Dawson, Schell & Fillion, 2007). Empirical associates exist for performance failure (choking due to pressure) and elevated & poorly regulated GSR; registered increases in EDA are common among athletes who "choke" at key moments in the game (Nieuwenhuys & Oudejans, 2012). Competent athletes usually have more adaptive phasic responses, which are marked by quick activation and effective recovery, and lower tonic GSR levels (Blumenstein, Bar-Eli, & Tenenbaum, 2002). In contrast, less skilled or anxiety-prone athletes show maintained elevations in electrodermal activity, indicating poor autonomic regulation and increasing vulnerability to technical errors.

Biofeedback training enables individuals to gain voluntary control over typically unconscious physiological processes through real-time feedback (Schwartz & Andrasik, 2017). Structured biofeedback programs have demonstrated significant benefits. A 12-week program for N=21 junior archers (Age 15.0+/-1.7 years) showed a significant interaction for GSR reduction ($p<0.05$) using mixed factorial ANOVA (Sut Txi, Hashim, & Krasilshchikov, 2020). Biofeedback significantly improved concentration and shooting efficiency ($p<0.01$) in N=30 players over a 10-day period (Paul, Garg, & Sandhu, 2012). Combined biofeedback and neurofeedback interventions also outperformed control groups (Shokri & Nosratabadi, 2021). A pilot application of 10 sessions (10 minutes each) of GSR BFT proved effective for managing the psychological states of elite tennis and squash players (N=8) (Park, Hwang, & Lee, 2020). GSR biofeedback improved serve accuracy and mental skills adherence among elite junior male athletes (Galloway, 2011). Effectiveness is often optimized when BFT is combined with other psychological techniques. For example, athletes using GSR BFT interspersed with imagery or rest (N=27) regained physiological control and reached resonance frequency more quickly than those using continuous BFT ($p<0.05$) (Ferguson, Hall, & Divine, 2020). Additionally, 15-minute VR-based mindfulness breathing exercises with integrated biofeedback prevented performance declines in N=18 basketball players and N=16 football players during penalty and free-throw tasks (Wagner & Wiczorek, 2024). The consequences of choking go well beyond the outcome of the game. Short-term effects include a decline in performance standards and unpleasant emotion, according to phenomenological research of N=11 intermediate golfers (mean handicap 10.91+/-3.98). Long-term effects may be "highly destructive," which lead to reduced self-esteem and withdrawal from the activity (Hill et al., 2019). Lemmer (2015) developed the Duckworth/Lewis system, a cricket metric that employs run rates and resources to differentiate between "panic" and "normal" choking based on curve slope ratios. These results reveal how complicated choking is and how crucial it is to use biofeedback therapies, which can definitely turn theoretical knowledge into real-world strength for athletes who play sports in team.

Competitive hockey: Empirical gaps and research imperatives

Choking under pressure has been widely studied in individual sports, yet there remains a limited understanding of how it occurs and can be managed in team sports such as hockey. The majority of existing research has concentrated on individual performance settings such as tennis serves, golf putts, or shooting tasks where outcomes depend on a single performer (Beilock & Gray, 2007). As a result, the theoretical frameworks, assessment approaches, and intervention strategies related to choking have largely been developed within individual performance contexts, which restricts their direct applicability to team-based sports (Mesagno & Hill, 2013).

In team sports, how well you play is always fluctuating and depends on a mixture of mental and emotional processes. In these instances, interpersonal dynamics, emotional contagion, collective pressure experiences, and individual choking tendencies may precipitate sudden performance failures (McEwan & Beauchamp, 2014). Even though this is complicated, not much attention has been given to finding athletes who are more likely to choke in teams or to making treatments that help them deal with stress in a way that meets their psychophysiological demands. This is a big gap in the research, especially for fast-paced team sports like hockey, where remaining focused, making immediate decisions, and controlling ones emotions are all necessary for best performance.

Also, in that we see an increase in recognition of psychophysiological indicators' importance for the study of pressure related performance breakdowns, research into physiological control interventions in team sport athletes is still very much in its infancy (Pusic, Schuck, Williams, 2023). We note that the galvanic skin response is a very reliable and sensitive indicator of the sympathetic nervous system's arousal and stress reaction (Boucsein, 2012). What we do not have though is large scale empirical study of it as a performance improvement tool in high pressure situations especially among those athletes which tend to choke out in team sports. Also it is the case that most of what we have done with GSR has been in the assessment phase rather than the intervention phase which in turn has limited its use in the field of sport psychology practice (Jiménez-Morgan Hernández-Panas, 2020).

Wergin and colleagues (2022) reported this issue out and put forth the case for looking at the philosophical, theoretical, empirical, and practical connections between individual choking and poor performance in team sports. They noted that although it appears we are seeing the same basic issues and causes play out in individual chokes and in total sport team collapse we still do not have a large body of research which looks at that. Also, they put forth that which is needed is research looking at intervention strategies which address individual vulnerability as well as larger team level issues and which brings choking research to bear on sports like basketball, football and hockey.

This literature review reports that performance breakdown under pressure is a key issue which causes large and sudden drops in athletic achievement. Choking is a result of a complex interaction of which skill is not the issue but rather the play of psychological pressure, cognition, and dysregulated psych bio responses. In high stake competition we see that which are prone to choking exhibit raised anxiety, over thinking, and poor autonomic function (Beilock Carr, 2001; Nieuwenhuys Oudejans, 2012). These reactions impair motor coordination, attentional control, and perceptual accuracy, resulting in less-than-ideal performance. In this regard, biofeedback training has shown promise as a means of reducing choking tendencies, especially when it comes to autonomic regulation-focused therapies like Galvanic Skin Response biofeedback. Biofeedback helps athletes acquire self-regulation techniques that improve emotional control, attentional stability, and overall performance consistency under pressure by giving them real-time feedback on their physiological arousal (Blumenstein et al., 2002; Paul et al., 2012). Evidence from empirical studies reveals that biofeedback training can limit excessive sympathetic activation, improve recovery from stress, and foster resilience during performance moments which are crucial , making it a potentially effective intervention for athletes which are choking-susceptible.

Research on choking and biofeedback therapies in team sports like hockey is conspicuously lacking, despite the theoretical and practical relevance of these findings. The psychophysiological features of pressure-induced performance failures have not received enough attention in previous research, which has mostly concentrated on individual sports or the tactical and physical aspects of team performance (Wergin et al., 2022). Given the frequency of high-stakes situations like penalty corners, shootouts, and crucial game phases, hockey's high-intensity, fast-paced, and decision-demanding nature provides an ideal setting for investigating the interaction between choking susceptibility and physiological regulation.

In general, research consistently demonstrates that competitive environments elicit greater electrodermal activity compared to practice environments, signifying elevated social evaluation, perceived pressure, and significance of outcomes. Before competition, athletes confronted with critical performance conditions exhibit increased baseline Galvanic Skin Response levels, signifying anticipatory anxiety and heightened readiness states (Kizildag, Tanyeri, & Guler, 2022). An objective and sensitive measure of sympathetic nervous system arousal, galvanic skin response offers important information on athletes' stress and anxiety reactions during competition (Boucsein, 2012). Investigations indicated that heightened and inadequately regulated GSR correlates with anticipatory anxiety, attentional disruption, and performance failure under pressure, especially in high-stakes competitive settings (Nieuwenhuys & Oudejans, 2012). Athletes who are prone to choking tend to have higher tonic GSR levels and less flexible arousal patterns, which makes it harder for them to control their movements and make decisions. GSR monitoring offers a dependable psychophysiological metric for identifying arousal dysregulation and performance vulnerability under pressure in high-tempo team sports such as hockey, characterized by significant social and situational stressors (Pusic et al., 2023).

In the void left by research which is sparse we see that there is a great need for more study which looks at how biofeedback training plays out with hockey players at risk of choking. Also this research will put forward valuable information to coaches, sport psychologists, and practitioners which they can use to improve athlete performance under stress which in turn will improve the theory we have of choking in team sports. This area of research also has in it the chance to put forth evidence-based therapies which support performance stability and resilience in high pressure competitive settings which in turn address both individual predisposition and team performance issues. Also, we see from our review of the literature that choking is a large factor in terms of athletes' which see a drop off in performance and that GSR biofeedback training may be that which turns the tide in this issue. The scarcity of research on hockey as a sport in relation to these factors is evident. Hence, it is crucial to conduct studies on choking under pressure in connection with biofeedback training, especially within the context of hockey as a sport.

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