



**UNIVERSITY OF PADOVA**

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**Final dissertation**

**Choking under pressure:  
A systematic review of attentional theories in individual  
and team sport contexts**

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# Table of Contents

1. Introduction.....	1
1.1. Attentional Theories.....	1
1.1.1. Self-focus Theory.....	1
1.1.2. Reinvestment Theory.....	2
1.1.3. Distraction Theory.....	3
1.1.4. Processing Efficiency Theory, Attentional Control Theory, and the Integrated Model..	3
1.2. Novices versus professionals.....	4
1.3. Comparison of team and individual contexts.....	5
2. Methods.....	6
2.2. Eligibility criteria.....	6
2.3. Study selection.....	7
3. Results.....	12
3.1. Leading theoretical frameworks.....	12
3.1.1. Studies focusing on ACT.....	12
3.1.2. Studies focusing on Reinvestment Theory.....	14
3.2. Team Context versus Individual Context.....	17
3.2.1. Team Context.....	17
3.2.2. Individual Context.....	20
3.2.3. Comparing contexts.....	22
4. Discussion.....	24
4.1. Interpretations of the results.....	24
4.2. Theoretical considerations.....	25
4.3. Open or closed skills?.....	25
4.4. Limitations.....	26
4.5. Future directions.....	27
5. Bibliography.....	28

# ***1. Introduction***

Performance anxiety and choking under pressure has been a widely studied field of sport psychology research in the past decades. According to Derakshan and Eysenck (2009), anxiety is an aversive motivational state that occurs in situations where an individual perceives a high level of threat. Anxiety can seriously impair an athlete's ability to perform well. Baumeister (1984) refers to choking under pressure as a phenomenon in which pressure situation causes the athlete to perform worse than usual. Pressure is a factor or combination of factors that increases the importance of performing well under certain situations (Baumeister, 1984). Understanding the causes and outcomes of choking in athletic setting is essential for numerous reasons, including practical considerations like finding possible solutions, developing useful interventions, and educating athletes and coaches on how they can effectively manage this situation.

## ***1.1. Attentional Theories***

Multiple theories have emerged intending to explain the causes of choking under pressure. The first major directions in the research of attentional processes were the self-focus or skill-focus, and the distraction models. Both theoretical approaches focus on the assumption that anxiety derails motor performance by disrupting attentional processes (Beilock & Gray, 2007), and both are based on the premise that the quality of performance depends on the athlete's ability to focus attention to task-relevant stimuli and shift attention from task-irrelevant stimuli (Lewis & Linder, 1997). The two, however, fundamentally differ in their explanations of how this attention disruption occurs.

### ***1.1.1. Self-focus Theory***

According to the self-focus model, movements which would be automated in a normal situation, are disrupted when the individual focuses on skill execution (Beilock & Carr, 2001). This means that performance breaks down under pressure due to the conscious motor control the athlete exerts, leading to problems with the flow of movements. Self-focus theory, as discussed by Wilson et al. (2007), builds on the foundational stages of skill learning outlined by Fitts and Posner (1967), who defined that learning a skill begins with declarative knowledge, meaning

that a novice needs explicit encoding to memorize the movement. As the skill improves and the athlete achieves mastery in that movement, it becomes proceduralized and does not require conscious control. However, in pressure situations, the athlete might pay close attention to these automated movements, which ends in the disruption of the movement. Later, Beilock and Carr (2001) coined the explicit monitoring theory, which is essentially another term for self-focus theory: impaired performance occurs simply by paying attention to the movement itself, consciously monitoring and breaking down the movement into its steps, which causes disruption. Multiple studies have found evidence supporting this theory (Gray, 2004; Gucciardi and Dimmock, 2008). In an experiment conducted by Gucciardi and Dimmock (2008), in only the explicit knowledge condition did performance decline, when golf players were asked to break down the swing movement into components before putting.

### ***1.1.2. Reinvestment Theory***

Based on the self-focus theory and explicit monitoring theory, the theory of reinvestment proposes that individuals who consciously process and ‘reinvest’ previously automated movements and try to execute them in a step-by-step fashion will end up disrupting their own movements (Masters, 1992; Masters and Maxwell, 2008). While explicit monitoring theory states that paying attention to movements is enough for performance disruption, reinvestment theory takes it one step further by suggesting that individuals not only monitor but also consciously control their movements (Hill et al., 2010). The pressure that is present during a match or competition raises the athlete’s self-consciousness, leading to the reinvestment of explicit knowledge (Gucciardi et al., 2010).

As an attempt to build a reliable measure for this construct, Masters et al. (1993) developed the Reinvestment Scale, which is able to identify individuals who are more prone to reinvestment and predict poor performance. Two subscales were also developed: the Movement-Specific Reinvestment Scale (Masters et al., 2005), and later the Decision-Specific Reinvestment Scale (Kinrade et al., 2010). The Movement-Specific Reinvestment Scale (MSRS) is a self-report tool designed to assess the tendency for reinvestment in movement-specific situations (Masters et al., 2005) and includes two dimensions: Movement self-consciousness and Conscious motor processing. The Decision-Specific Reinvestment Scale (DSRS) is the modified version of the original RS, focusing on decision-specific contexts, and has two factors which are Decision reinvestment and Decision Rumination (Kinrade et al., 2010). Due to their demonstrated

validity and reliability (Laborde et al., 2015), they are widely used in research related to the theory of reinvestment.

In contrast to self-focus and reinvestment theories, distraction theory offers a different perspective on the attentional processes involved in choking under pressure.

### ***1.1.3. Distraction Theory***

Distraction theory suggests that when worry or self-doubt is present, it needs to be processed along with information necessary for skill execution (Hill et al., 2009). In 1971, Wine reviewed the existing literature about test-anxious individuals and concluded that worry in pressure situations diverts attention from relevant information to other mentally and attentionally demanding stimuli, causing a decrease in cognitive resources available for the task at hand, and therefore impairing performance. This other, irrelevant stimulus overwhelms the working memory, which does not have the sufficient capacity to deal with both the distracting thoughts and the relevant task (Wine, 1971). The task-irrelevant information is usually related to incentives, possible outcomes, negative thoughts, performance expectations, or presence of an audience (Gucciardi et al., 2010; Hill et al., 2009).

### ***1.1.4. Processing Efficiency Theory, Attentional Control Theory, and the Integrated Model***

Based on the distraction theory, the Processing Efficiency Theory (Eysenck & Calvo, 1992) states that the processing efficiency of the working memory is reduced due to worry in pressure situations. However, PET expands on the original distraction model and introduces the idea that it does not necessarily impair performance. Rather, under pressure situations, certain compensatory or task-related efforts are also be activated, which might or might not be enough to counterbalance the performance decline (Eysenck & Calvo, 1992). Worry in this model has two roles: interference with the capacity of the working memory, and motivation to overcome this state (Eysenck et al., 2007). Smith et al. (2001) tested the processing efficiency theory in team context with volleyball players. They found that on the same performance level, highly anxious players had higher mental effort ratings compared to low trait-anxious players. Murray and Janelle (2007) used event-related potentials and simulated driving task to investigate the

psychophysiological background of PET. Results showed that without notable alterations of performance, cognitive anxiety reduced processing efficiency (Murray & Janelle, 2007).

Moving one step further, in line with processing efficiency theory, attentional control theory highlights that anxiety allocates cognitive resources from the top-down goal-directed system, which is responsible for managing the task at hand, to the bottom-up stimulus-driven system which processes irrelevant stimuli (Eysenck et al., 2007). This irrelevant, threatening stimulus can be internal, like negative thoughts about the performance or external, for example the noise of the crowd. Evidence supporting ACT was found by Wilson et al. (2009), who examined the gaze behaviour and performance of football players during penalty kicks and found that highly anxious participants were more likely to fixate longer on the goalkeeper, the threatening stimulus, showing a dominantly stimulus-driven gaze behaviour.

Nieuwenhuys & Oudejans (2012), mainly relying on ACT, developed an integrated model recognizing separate operational levels (attentional, interpretational, and behavioural), where anxiety might manifest its impact on performance. It proposes the idea that motor performance can be impaired by anxiety biasing attention toward threats, leading to threat-related interpretations and avoidance behaviours, which all reduce the cognitive resources necessary for skill execution. According to the integrated model, performance is disrupted by insufficient task-focused attention, and distraction and self-focus are not necessarily competing mechanisms, but self-focus can be explained by distraction (Nieuwenhuys & Oudejans, 2012). Although the name suggests it is integrated, it has not been tested much in research, and might lack important notions, that are proposed by self-focus or reinvestment theories.

## ***1.2. Novices versus professionals***

The theories mentioned previously, and the related findings show how anxiety affects performance by changing how attention and mental resources are allocated. Self-focused attention is especially important during early phases of learning, while later the movements previously learned are done automatically. This means there is an importance in making a difference between novices and professionals in research, as experienced athletes and beginners might be using different tactics and cognitive strategies under pressure situations.

Further evidence suggests that novices perform differently from professional athletes, with novices performing relatively better under skill-focus condition (Beilock et al., 2002).

Researchers also found that while novices performed better with accuracy instructions, experts had a better performance under speed instructed condition (Beilock & Carr., 2004).

### ***1.3. Comparison of team and individual contexts***

Another factor of choking under pressure is the possible difference between individual and team sport contexts. When it comes to performing in pressure situations, the presence of others and the interplay between teammates or opponents must be regarded and taken into consideration. Previous studies comparing team and individual athletes have found differences in the levels of competitive anxiety (Kemarath et al., 2022) and visual skills (Mohammadi et al., 2016).

In team sports, athletes need to monitor multiple players at the same time, suggesting that self-focusing—hence disrupting the automaticity of movements—might be a more prevalent problem for individual athletes. This assumption, among other raised the central question of this thesis, whether there is a difference between individual and team sport settings in terms of attentional processes when it comes to choking under pressure. Through this systematic literature review, this thesis intends to find relevant patterns and determine if there is an observable difference.

## ***2. Methods***

For the sake of transparency, I followed the protocol of the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) for the systematic literature review. Following the methodological rules, the PRISMA method provided a basis for thorough literature research. In order to ensure reliability, clear inclusion criteria were established, based on which relevant works were found through an exhaustive search.

### ***2.1. Search strategy***

During the systematic literature search, relevant literature was searched using search engines and databases like Google Scholar, PubMed, and ScienceDirect, which provided broad access to important and relevant scientific articles and studies. During the search process, I used keywords that best reflected the topic, such as: "attentional theories", "choking under pressure", "team sport" and "individual sport". Using a combination of the keywords and Boolean operators made the search effective and clear.

### ***2.2. Eligibility criteria***

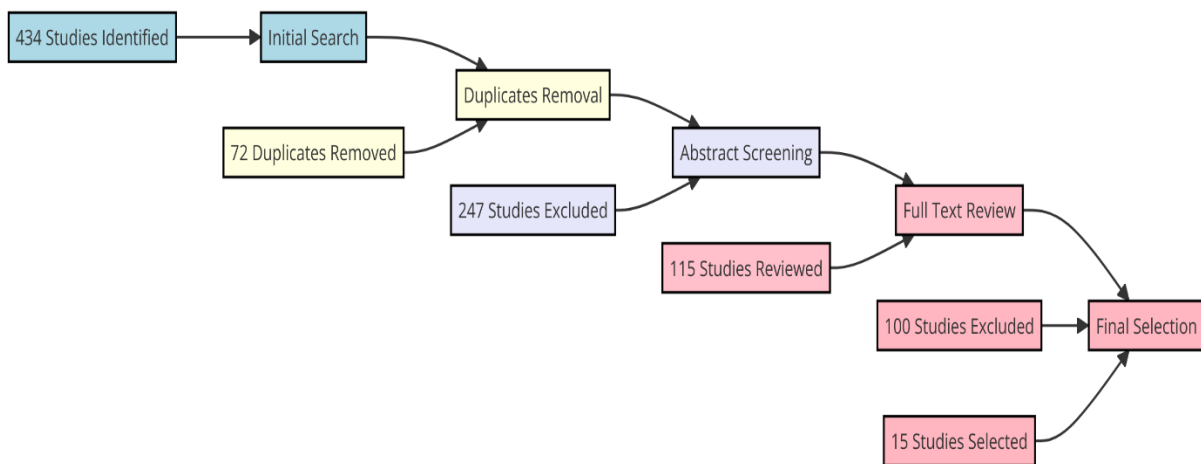
In order to include the most relevant and reliable findings, the following inclusion criteria were established prior to the selection of the studies:

1. The study includes participants who are elite-level, professional adult athletes.
2. The study must be empirical, including experimental, observational, or mixed methods studies.
3. The study explicitly investigates attentional processes, self-focus, distraction mechanisms, or choking under pressure in athletes from the perspective of attentional theories or models, specifically in the context of performance or competitive anxiety in sports.
4. The study involves individual and/or team sport athletes, and provide separate data for each group.
5. The study must have been published within the past 10 years, ensuring the relevance of findings.
6. The study is available in English.



### 2.3. Study selection

In the initial phase, I identified 434 potential studies through the Google Scholar, PubMed and ScienceDirect databases using different combinations of keywords. Out of these, I first removed 72 duplicates, thus obtaining the first list. After reading the abstracts more thoroughly, I excluded another 247 studies because they did not fit the previously defined eligibility criteria. After reading the full text of the remaining 115 studies, a further 100 studies had to be excluded from the final selection, leaving 15 studies that met the criteria. (Figure 1)



1. Figure: Study selection process according to PRISMA

This was followed by synthesizing the data, which was done by extracting the most important and relevant data from the studies, using them to discover the patterns and main findings which are explained in the next section. (Table 1)

	Title	Author(s)	Year	Theoretical framework	Team/ individual context	Main findings
1	Reinvestment in one versus one in-field and shoot-out field hockey performance	Hoskens, M. C. J., Uiga, L., Vellinga, R. H., & Masters, R. S. W.	2023	Reinvestment theory (MSRS, DSRS)	both	significant negative association between MSRS (CMP subscale) and shoot-out performance but not in-field performance. No significant associations were found for other

						reinvestment sub-scales
2	Examining Movement-Specific Reinvestment and the Yips in Professional Baseball	Gutierrez, M. B. A., & Vanguri PhD, L. A. T.	2023	Reinvestment theory (MSRS)	individual	significant differences observed in MSRS total score, MS-C score, and CMP score between yips-afflicted and non-afflicted groups
3	Performance and decision making of a complex skill under monitoring and outcome pressure conditions: Which of them can reinvestment predict?	Rad, M. S., Boroujeni, S. T., Jaberimoghaddam, A. A., & Shahbazi, M.	2022	Reinvestment theory (MSRS, DSRS)	individual	Performance suffered under monitoring pressure but not under outcome pressure. DRe predicted changes in decision speed under monitoring pressure. MSC predicted performance changes under monitoring pressure. CMP correlated with performance decrements under monitoring pressure, not outcome pressure.
4	Mindfulness, reinvestment, and rowing under pressure: Evidence for moderated moderation of the anxiety-performance relationship	Sparks, K. V., Kavussanu, M., Masters, R. S., & Ring, C.	2021	Reinvestment theory (MSRS)	individual	MSC negatively correlated with performance; CMP positively associated with perceived technical performance; Crabbers had higher CMP scores
5	Can you feel the pressure? Examining the effects of anxiety in elite netball shooters	Tong, G. T.	2019	PET/ACT	team	anxiety affects performance effectiveness but not performance accuracy, under high-pressure conditions; participants were able to maintain their shooting

						accuracy despite experiencing increased anxiety; they took longer to complete the task, anxiety may have impaired processing efficiency
6	Relations among reinvestment, self-regulation, and perception of choking under pressure	Iwatsuki, T., Van Raalte, J. L., Brewer, B. W., Petitpas, A., & Takahashi, M.	2018	Reinvestment theory (MSRS)	individual	CMP positively correlated with self-regulation factors, MSC correlated with perceived choking, self-efficacy negatively correlated with perceived choking
7	Choking under pressure in self-paced sport: revisiting the effects of attentional interference in preparation and execution	Roberts, L.	2018	self-focus/distractio	individual	the frequency of self-focus increased when golfers considered pressure-related failures in execution; both self-focus and distraction factors are connected to the choking of golfers, specifically worry about negative consequences and conscious control of movement
8	The impact of contextual information and a secondary task on anticipation performance: An interpretation using cognitive load theory	Runswick, O. R., Roca, A., Mark Williams, A., Bezodis, N. E., McRobert, A. P., & North, J. S.	2018	PET/ACT (integrated model)	individual	anxiety negatively affected processing efficiency and performance effectiveness; anxiety influenced mechanisms at the attentional level without impacting interpretational or behavioral mechanisms; context affected performance through mechanisms directly at the behavioral level

9	Relationships among movement reinvestment, decision-making reinvestment, and perceived choking	Iwatsuki, T., & Wright, P.	2016	Reinvestment theory (MSRS, DSRS)	both	CMP and MSC are positively correlated; individual and team → MSRS and DSRS were not significant, but individual scored higher on all four subscales; perception of choking: individual scored significantly higher and also had more negative evaluation of their own performance in high pressure situations
10	Self-focused attention and motor skill failure: The moderating role of action orientation	Gröpel, P.	2016	self-focus	individual	state-oriented players performed worse under self-focus condition compared to action-oriented players
11	Anxiety, anticipation and contextual information: A test of attentional control theory	Cocks, A. J., Jackson, R. C., Bishop, D. T., & Williams, A. M.	2016	PET/ACT	individual	in skilled players, processing efficiency decreased significantly under high-anxiety conditions while response accuracy remained unchanged
12	Attentional focus, perceived target size, and movement kinematics under performance pressure	Gray, R., & Cañal-Bruland, R.	2015	Attentional accentuation hypothesis, Explicit monitoring theory	individual	significant changes in heart rate, movement kinematics, and secondary task performance under pressure; pressure causes an inward shift in attention towards skill execution
13	Reinvestment, task complexity and decision	Kinrade, N. P., Jackson, R. C., & Ashford, K. J.	2015	Reinvestment theory (DSRS)	team	Performance decrements were observed under pressure with

	making under pressure in basketball					regard to response accuracy, moderated by task complexity; DSRS was a significant predictor of performance change under pressure; DRu was the only significant factor predicting changes in response time and accuracy
14	Is choking under pressure a consequence of skill-focus or increased distractibility? Results from a tennis serve task	Englert, C., & Oudejans, R. R.	2014	distraction	individual	anxiety negatively related to tennis serve accuracy, relationship mediated by distraction
15	A qualitative examination of choking under pressure in team sport	Hill, D. M., & Shaw, G.	2013	distraction	team	perceived antecedents of choking: high expectations, audience, individual responsibility, self-confidence, fatigue, actions of the opponent, mistakes, preparation; distraction by concerns about the outcome of the game or audience

### ***3. Results***

Upon analysing the studies, most of them were focusing on one of the two leading theoretical frameworks: Attentional Control Theory or Reinvestment Theory. There were 3 studies that relied on the former, however, most of the hypotheses were based on the latter theory. Before discussing the distinctions between team and individual contexts, the findings associated with these two theories are presented. Although the representation of these two theories is unbalanced, discovering the current trends is essential to put the findings in the right context and understand the comparison of individual and team sports.

#### ***3.1. Leading theoretical frameworks***

##### ***3.1.1. Studies focusing on ACT***

A total of three studies were focusing their research on Attentional Control Theory. In the following paragraphs, the findings supporting and contradicting ACT will be synthesized and evaluated.

Tong (2019) conducted an experiment with elite netball shooters as a part of a doctoral dissertation, to examine the fluctuations in shooting performance under different levels of anxiety. Another study was carried out by Runswick et al. (2018), with the focus on effects of anxiety and situation-specific context on perceptual-motor performance, in terms of attentional, behavioural, and interpretational processes. Using an in situ task, they examined the predictions of ACT by manipulating the situation-specific context and anxiety levels. Cocks et al. (2016) conducted research on skilled and less-skilled tennis players with the aim to test Attentional Control Theory.

All three studies had findings in support of Attentional Control Theory. In the study by Tong (2019), significant differences were found in state anxiety, heart rate, and task completion time between low and high-pressure conditions, however, no significant differences in performance accuracy were found between the two pressure conditions. Only under low pressure condition, concentration disruption predicted performance accuracy. According to Tong (2019) these findings suggest that participants were able to maintain their shooting accuracy despite experiencing increased anxiety. However, they took longer to complete the task, indicating that anxiety may have impaired processing efficiency (Tong, 2019). Runswick et al. (2018) found

that anxiety negatively affected processing efficiency and performance effectiveness. Results from Cocks et al. (2016) showed that processing efficiency decreased significantly under high-anxiety conditions while response accuracy remained unchanged. This decrease in processing efficiency suggested an increase in cognitive investment due to heightened anxiety. Furthermore, the study revealed differences in processing efficiency and response accuracy based on the availability of contextual information. Decreased processing efficiency was observed when postural cues were absent, indicating that inferring anticipatory responses without kinematic information is mentally demanding.

Some contradictions were also discovered, either in connection with ACT or with the methodological limitations. Tong (2019) attempted to manipulate anxiety levels with no spectators under low-pressure condition, and ten spectators under high-pressure condition. However, for professional netball shooters, ten spectators might not be enough to significantly elevate their anxiety levels. Conditions also differed based on the presence of a defender, in order to imitate the real-life aspect and dynamic nature, which is inherently part of the sport, yet one defender might not be enough to simulate a match situation, since several other factors such as physical fatigue, and other players were not included.

As ACT suggests, anxiety can shift the balance between goal-directed and stimulus-driven attentional systems, which might impair performance (Eysenck et al., 2007). It is essential to understand the joint effect as well as the individual impact of anxiety and situation-specific context. Runswick et al. (2018) manipulated anxiety levels through peer comparison, false feedback, and financial reward. This was assessed with objective and subjective measurements, and this type of holistic approach can lead to a better overall understanding of anxiety. However, situation-specific context was created by providing participants with information on field placing and game situations. Although including situation-specific context was meant to increase ecological validity, the manipulation did not significantly impact cognitive load (Runswick et al., 2018). Findings suggest that anxiety only influenced attentional, but not interpretational and behavioural processes. Situation-specific context also influenced performance independently of anxiety, meaning that it affected mechanisms directly at the behavioural level (Runswick et al., 2018). However, considering that the situation-specific context might not have been enough manipulation, that might have had an effect on the less clear impacts of behavioural and interpretational processes.

Both the findings by Tong (2019) and Cocks et al. (2016) suggest that athletes were able to maintain performance levels despite increased anxiety, which can lead to two different

conclusions. One reason could be that the athletes who participated were highly trained, and in line with the expectations of ACT, they could allocate the necessary resources to balance out the effects of choking; the other possible explanation is that anxiety manipulations were not adequate, regarding either quantity or quality, to induce anxiety. This highlights a shortcoming of these studies which needs to be overcome in the future for more reliable results.

### ***3.1.2. Studies focusing on Reinvestment Theory***

As it has been mentioned previously, most of the studies included in this literature review were focusing on reinvestment theory. There is a fundamental distinction between the two main components of reinvestment theory, which are movement-specific reinvestment and decision specific reinvestment. Based on this distinction, the following results were found in the studies.

#### **Movement-Specific Reinvestment**

Research was conducted with field hockey players, in shoot-out and in-field situations by Hoskens et al. (2023). They found negative association between conscious motor processing (CMP) and shoot-out performance, but not in-field situation, probably either because players need to monitor the opponents, teammates, and either environmental factors more during in-field situations, or because shoot-outs have direct impact on the game, thus they have put more psychological pressure on the player.

Rad et al. (2022) found that movement self-consciousness (MSC) could predict a decrease in performance under monitoring pressure condition, yet conscious motor processing showed no such association. The authors concluded that these results support the idea that MSC and CMP work independently. This conclusion appears reasonable considering that these two subscales measure two different processes, although they share some common elements. Rad and colleagues (2022) also acknowledged that in this study, reinvestment factors did not predict choking under outcome pressure, and CMP did not anticipate performance decrement under monitoring pressure and came to the conclusion that reinvestment is not necessarily the only mechanism of performance decrements under pressure (Rad et al., 2022).

Sparks et al. (2021) conducted a study in the context of rowing and reinvestment, in order to examine CMP and MSC separately in a real-life situation. The results showed that MSC was



negatively associated with actual competitive performance. CMP was found to be positively associated with perceived technical performance but not actual performance. In two rowers' cases, extreme levels of CMP were linked to catastrophic skill failure (crabbing), showing that automatic processes are disrupted by excessive conscious motor processing (Sparks et al., 2021) Findings of an experiment carried out by Iwatsuki et al. (2018) showed that there is a positive correlation between CMP and self-regulation factors, but not between CMP and perceived choking. On the contrary, MSC was significantly correlated with perceived choking but was not correlated with self-regulation factors. They also found that MSC was positively, but self-efficacy was negatively associated with choking under pressure. (Iwatsuki et al., 2018) These findings would suggest that moderate levels of CMP and high self-efficacy can be beneficial against choking under pressure, whereas high levels of MSC indicates higher susceptibility to choking.

With the aim of examining the phenomenon of the “yips” and its connection to movement-specific reinvestment, Gutierrez and Vanguri (2023) conducted a study as part of a doctoral dissertation with baseball players. “Yips” are the motor movement disruption that interrupt successful execution of motor skills that is already perfected by the athlete (Roberts et al., 2013). Based on the results, yips-affected participants showed higher levels of both MSC and CMP than non-affected participants. This suggests that yips-affected players are more likely to consciously monitor and control otherwise well-learned movements, causing disruptions under anxiety inducing conditions, which supports the validity of the MSRS scale as well (Gutierrez & Vanguri, 2023).

Iwatsuki and Wright (2016) investigated both movement reinvestment and decision-making reinvestment with athletes from different types of sports. Findings from their research suggest that CMP and MSC are positively correlated, suggesting that there is a degree of overlap between the two subscales. MSC was found to predict perceived choking, meaning that athletes who are preoccupied with their movement and how others see them are more prone to choking under pressure. (Iwatsuki & Wright, 2016)

Based on the findings about movement-specific reinvestment, it can be concluded that there is a complex interplay between movement self-consciousness and conscious motor processing, at least in terms of sports performance. While MSC was consistently shown to be associated with perceived choking (Iwatsuki et al., 2018), the relationship between CMP and performance is context-dependent (Hoskens et al., 2023; Rad et al., 2022; Sparks et al., 2021). This might

indicate that athletes' self-consciousness about their movement style has a direct link to choking under pressure (Iwatsuki & Wright, 2016), whereas CMP probably depends on the sport-specific demands (Hoskens et al., 2023; Sparks et al., 2021). The effects of conscious control of movement on performance were suggested by the association between CMP and self-regulation factors (Iwatsuki et al., 2018), as well as the link between extreme high level of CMP and catastrophic skill failure (Sparks et al., 2021). Yips affected players having higher MSC and CMP also indicates the possible negative effect of conscious control on well-learned and automated movements (Gutierrez & Vanguri, 2023).

### Decision Specific Reinvestment

Decision-specific reinvestment was also examined by Hoskens et al. (2023); however, they did not find association between decision-specific reinvestment and performance, neither in shoot-out, nor in in-field situations. They explained this by the fact that shoot-out situations usually require the player to make decisions before the actual shoot-out situation. (Hoskens et al., 2023)

Results from the table tennis experiment by Rad et al. (2022) showed that under both monitoring and outcome pressure conditions, decision-making accuracy and decision-making speed were significantly affected, with the former being significantly worse and the latter being significantly higher compared to low pressure conditions. The decision reinvestment factor of DSRS was able to predict changes in decision making speed under monitoring pressure condition, but not under outcome pressure. Its possible explanation is that the focus of attention has shifted from cognitive decision-making under outcome pressure. (Rad et al., 2022)

With the aim of examining choking susceptibility and the predictive validity of the DSRS, Kinrade and colleagues (2015) carried out an experiment with basketball players. DSRS, but not the original RS, was found to be a significant predictor of performance decrement under high-complexity task condition, which suggests that DSRS has a high predictive validity. Decision rumination, a subscale of DSRS, was able to predict accuracy under high-complexity condition and response time under low-complexity condition. However, the ecological validity of the experiment is limited, considering that players had to complete the task on computer, leaving out significant real-life and dynamic factors. (Kinrade et al., 2015)

In the study implemented by Iwatsuki and Wright (2016), CMP, a subscale of MSRS, was also positively correlated with both subscales of DSRS, suggesting that athletes who consciously

control movements are more likely to make decisions consciously and they might also be affected by previous poor decisions under pressure. (Iwatsuki & Wright, 2016)

The investigation of decision-specific reinvestment highlights the predictive value of the DSRS by showing how it can (in particular decision rumination) predict changes in performance under particular scenarios (Kinrade et al., 2015). Furthermore, the fact that decision-specific reinvestment does not always correlate with performance in all circumstances suggests that when athletes focus on decision-making processes, it may have a complex effect on their ability to execute the task under stress (Hoskens et al., 2023; Rad et al., 2022). It has been found that athletes who consciously control their movements are also more likely to make conscious judgments and to be affected by past mistakes while being under pressure (Iwatsuki & Wright, 2016), and this points to a more complex cognitive pattern that may explain the decline in sport performance under pressure situations.

### ***3.2. Team Context versus Individual Context***

The differentiation between team context happened based the experimental conditions of each study. For instance, even though football is considered a team sport for logical reasons, if the experiment was based on penalty kicks, it cannot be considered team context, since the dynamic nature and complexity of team sports is lacking in scenarios like this. This unfortunately resulted in a very unbalanced division, four studies in team context, 12 studies in individual context, and 2 studies comparing contexts. First, I will attempt to find patterns and themes among the findings in team context, then moving on to individual context, and finishing with a comparison of the findings.

#### ***3.2.1. Team Context***

Since literature that examined relationship between team sports (in team context) and attentional theories of choking under pressure is very limited, I decided to include a study by Hill and Shaw (2013), even though the year of publication falls outside the ten-year period. This seemed like a reasonable step, since this study is indeed relevant to the topic of this literature review. Perceived antecedents of choking were identified as high expectations, presence of audience, individual responsibility, levels of self-confidence, fatigue, actions of the

opponent, mistakes, and lack of preparation. Choking was also associated with distraction by concerns about the outcome of the game, which in most cases was the possible negative outcome, but the audience was also found to be a distracting factor. According to Hill and Shaw (2013), despite two participants reporting that their choking episodes were caused by self-focusing on movements, the majority of findings mainly supports the distraction theory. This conclusion is rather a direct interpretation of the data, but it should also be highlighted that choking under pressure is a more complex phenomenon deserving a broader interpretation. Besides, it is important to note that this was a retrospective study, raising the potential for biases. (Hill & Shaw, 2013)

A study that was already mentioned in connection with reinvestment theory, undertaken by Kinrade and colleagues (2015) was borderline accepted in the pool of studies for this literature review. The reason is that even though participants were professional basketball players, and the experimental condition was related to basketball, as the task was to make accurate and fast judgments in real-life and dynamic scenarios, the experimental condition did not include actual movements but watching videos which might raise questions about the ecological validity. However, since literature is limited in studies simulating the dynamic nature of team sports, it seemed necessary to include the findings of Kinrade et al. (2015). One of the findings is related to task complexity: only under the more complex task condition did the researchers observe a decline in performance, from low to high pressure. This finding is applicable to the dynamic nature of team sports presents a wide range of complex decision-making scenarios. But the main theoretical framework in this study was reinvestment theory and testing the validity of the DSRS scale. An important finding in the context of team sports was that decision rumination (a subscale of DSRS) significantly predicted poorer decision-making accuracy under pressure in more complex tasks. Considering this and how contagious these thoughts are in a team, a team player's rumination about past mistakes and the fear of possible other errors disrupts the whole team's cohesion under pressure situation. Furthermore, as rumination essentially means that worrisome and threatening thoughts disrupt performance (under complex decision-making task), these findings are also potential implications for the attentional control theory, which proposes that these repetitive thoughts consume cognitive resources, leaving none for task-relevant processing. (Kinrade et al., 2015)

The effects of anxiety in netball shooting were investigated by Tong (2019) with implications of ACT. The results showed that concentration disruption was significantly associated with performance under only low pressure, but not under high pressure. As the pressure manipulation

was found to be sufficient, the reason behind this can be explained by the ACT. Attentional Control Theory suggests that athletes with high trait anxiety have enough motivation under high pressure situations to allocate cognitive resources to task-relevant cues, while under low pressure, this might not be true (Eysenck et al., 2007). Furthermore, Tong (2019) included two other conditions, which are either “no defender” or “one defender”. The outcomes of the experiment indicated no significant effect of the presence of one defender. According to Tong (2019), the players who participated were used to playing against defenders, which explains the results. While the aim was to simulate a competitive situation, the presence of one defender may not be enough, since real game includes other factors like multiple players, crowd noise, or fatigue.

Boyce et al. (2021) conducted interviews with team sport athletes, based on the previous study by Hill and Shaw (2013), to assess both choking and clutch experience, as well as the perceived effects of the team when facing pressure situations. The main findings related to anxiety and choking include the importance of pre-performance routines and habits to manage pressure, as well as the role of coaches, teammates, and training environment was acknowledged. According to Boyce et al. (2021), emotional contagion can have both positive and negative impacts, the former meaning encouragement and reassurance by teammates. On the other hand, perceived mistakes can also be passed from one another, breaking the focus in teammates. This was suggested by the researchers to underpin distraction theory, as players lose focus, and instead are concerned with the mistake and frustration of the other teammate. Support for self-focus theory was also demonstrated, considering that most participants admitted that the breakdown of movements led to mistakes. (Boyce et al., 2021)

Integrating these findings is not easy, considering the very differences between them. Hill and Shaw (2013), and then later Boyce et al. (2021) both found that self-focus and distraction theories work together, although both studies concluded that distraction was more often observed among participants. In both studies, self-focus was reported by some participants physically manifested, as they tried to consciously control movements, which resulted in movement disruption. Distraction was observed in more participants' interviews, which was due to potential negative outcome of the game (Hill & Shaw, 2013), or because of the prior mistakes made by a teammate, causing frustration and loss of focus (Boyce et al., 2021). Rumination about past mistakes was not only found as a factor by Boyce et al. (2021). Kinrade et al. (2015) found that decision rumination, which is a subscale of Decision-Specific Reinvestment Scale, was a significant predictor of poorer performance in team settings, one

mistake possible causing the break of team cohesion. This effect was also suggested by Kinrade et al. (2015) and that rumination on worrisome thoughts might not only support reinvestment theory, but attentional control theory, as it means players are allocating cognitive resources on these thoughts instead of focusing on the game. ACT was also investigated by Tong (2019), finding that concentration disruption was only significant under low-pressure, implying that a certain level of motivation is needed for highly anxious individuals to allocate cognitive resources.

General limitations across the studies were the lack of ecological validity, since simulating the actual team context, or a competitive setting, and controlling them, is definitely a difficult task, however it would be necessary in order to imitate a dynamic environment more accurately. Kinrade et al. (2015) discussed that the task complexity they used might not be sufficient to imitate real-life settings. Tong (2019) also acknowledged that their experimental design was not completely able to simulate the actual competitive pressure. The retrospective nature of studies by Hill and Shaw (2013) and Boyce et al. (2021) can also introduce potential bias, as participants' memories might not be as accurate as expected.

### ***3.2.2. Individual Context***

Three of the included studies based on individual experimental situations had implications related to self-focus and distraction theories, with varying results. In a study conducted by Gröpel (2016), basketball players were classified as state-oriented or action-oriented based on a self-report scale. Under enhanced self-focus condition, the accuracy of free throws by state-oriented participants decreased significantly, contrary to those participants in the action-oriented group, whose performance was not affected, and did not differ from the baseline condition. These results show that action-oriented players, who can disengage from monitoring their own movements are less likely to ruminate and disrupt automated movements, whereas state-oriented players have a narrower focus of attention (Gröpel, 2016). Gray and Cañal-Bruland (2015) conducted their experiment with golfers and used an external and a skill-focused secondary task. The choke group had increased accuracy during the skill-focused secondary task, but had decreased accuracy during the external secondary task, suggesting that they had an inward focus during skill execution. Englert and Oudejans (2014) however raised attention to the fact that most studies concerned with attentional theories manipulated attentional focus and distraction experimentally, highlighting possible issues regarding their

ecological validity. To overcome this problem, they examined both focus of attention and distraction and how these predicted performance under pressure. The significant negative correlation between anxiety and serve accuracy was mediated by distraction but not self-focus, which supports the distraction theories of choking under pressure (Englert & Oudejans, 2014). The distinct outcomes of the aforementioned experiments point to the fact that self-focus and distraction theories are not enough by themselves to explain the complexity of the choking phenomenon. According to Roberts (2018), a factor analysis revealed that both self-focus and distraction factors are connected to the choking of golfers, specifically worry about negative consequences and conscious control of movement were found to be important aspects.

Most results regarding choking under pressure and reinvestment theory which were measured with individual situation tasks were based on the Movement-Specific Reinvestment Scale. Gutierrez and Vanguri (2023) divided the participants into yips-afflicted and non-afflicted groups and measured their movement self-consciousness (MSC) and conscious motor processing (CMP), both of which were higher in the yips-afflicted group than the non-afflicted group. In the study conducted with rowers by Sparks and colleagues (2021), MSC was negatively correlated with performance and perceived tactical performance. As rowers have to make tactical decisions during a race, poorer tactical performance might be related to higher MSC. On the contrary, CMP was shown to be positively correlated with perceived technical performance, however, extreme levels of CMP were also associated with crabbing (Sparks et al., 2021). In line with these findings, Iwatsuki et al. (2018) showed that MSC was positively correlated with perceived choking, while CMP was positively correlated with six self-regulation factors (planning, self-monitoring, effort, self-efficacy, reflection, and evaluation). Rad et al. (2022) measured both DSRS and MSRS in their study under monitoring and outcome pressure situations. Results pointed out that MSC predicted changes in performance under only monitoring pressure. The accuracy of decision making declined under outcome pressure, which as the authors suggested might be a sign of outcome pressure acting as a distracting factor, meaning that athletes who focus on the incentives might be distracted by these thoughts under pressure situation (Rad et al., 2022). The decision reinvestment subscale of DSRS predicted the change of decision speed under monitoring pressure. As the findings suggest, MSC was positively linked to performance decrements, and was also found to be related to poorer and slower decision making (Rad et al., 2022; Sparks et al., 2021), meaning that the MSRS and DSRS scales are interconnected.

Two of the included individual context studies made implications for the Explicit Monitoring Theory or the Attentional Control Theory. Runswick and colleagues (2018) found that anxiety negatively affected processing efficiency and performance effectiveness. Context manipulations did not affect reported cognitive anxiety, but it did affect the number of times no contact was made with the ball, suggesting that anxiety influenced the movements of participants directly without impacting interpretational mechanisms (Runswick et al., 2018). Cocks et al. (2016) found that processing efficiency was more significantly impacted by anxiety than response accuracy, and that anxiety had a negative effect on skilled players' performance and by reducing the ability of using contextual information for direction judgements.

### ***3.2.3. Comparing contexts***

Two studies were found that are focusing on the comparison of individual and team contexts. Hoskens et al. (2023) studied the shoot-out and in-field performance in field hockey. Findings revealed a negative association between movement specific reinvestment, in particular conscious motor processing and shoot-out performance. No association was found between movement specific reinvestment and in-field performance, and no associations between decision specific reinvestment and performance. These results suggest that in-field situations require more attentional switching, reducing the potential cognitive resources needed for conscious motor processing, while shoot-out situations require more focused attention from the athlete. Situational demands were shown to have different effects on the allocation of attentional resources.

In another study conducted by Iwatsuki and Wright (2016), team or individual sport athletes completed only the MSRS and DSRS measurement scales. The comparison between individual and team sport athletes showed that MSRS and DSRS were not significant, although individual sport athletes scored higher on all four subscales. The authors also found that the perception of choking under pressure has a significant difference between the two groups, with individual sport athletes scoring significantly higher. This group also had more negative evaluation of their own performance in high pressure situations. (Iwatsuki & Wright, 2016)

The limited sample sizes and the small number of different sports included make it difficult to draw conclusions about possible differences between team and individual sport contexts. One implication that can be derived from these two studies is that different demands posed by



different situations do exist, but it needs be studied more closely and precisely, including more sports and athletes.

## ***4. Discussion***

### ***4.1. Interpretations of the results***

The findings of this literature review suggest that attentional disruptions manifest differently in team and individual sports contexts. In individual settings, performance disruption is mostly due to self-induced pressures and excessive self-focus, which intervened with automated movements. In team sports, interaction with teammates and the pressure of decision making played a larger role. Still, there is no conclusive evidence that one theory or another is more relevant in team or individual settings. When in-field and shoot-out situations were compared to each other in field hockey (Hoskens et al., 2023), it was concluded that in-field situations demand more decision-making, thus require more cognitive resources. This aspect needs to be further studied because it might be indicative of a possible difference based on particular situational challenges.

Differences between team and individual athletes were found, in terms of the tendency to reinvest (Iwatsuki & Wright, 2016). Individual players were more likely to score high on the subscales measuring reinvestment, as well as negatively evaluate their own performance. These results might show that there is a likelihood that perceived responsibility is shared and distributed among teammates, and that since there are more people to pay attention to, this might reduce the probability of reinvesting attention into already automated movements.

The lack of studies conducted in team settings became apparent during the literature search process. Unfortunately, the low number of studies made it difficult to draw conclusions about the attentional processes that are involved when a team player is choking under pressure. The ones that were included were also questionable in terms of their ecological validity, however, replicating a team context is difficult by nature, inducing anxiety and measuring it is even harder. Yet, it would be important to develop methodologies with more validity that can accurately simulate the dynamic situations of a match to better understand the unique processes that characterizes the attention of a team player.

Another particular finding needs to be mentioned here. Cocks and colleagues (2016) conducted their study with two groups of tennis players: one skilled group, and one less-skilled group. Their results suggest that there was a significant difference between the two groups regarding the effects anxiety had on their performance. This means that the differentiation between novice and professional players is essential in order to reliably examine choking under pressure.

Considering the inconclusive findings, distinction between team and individual sports might not be the appropriate categorization here. Because even though there is a clear cut between whether volleyball or golf is a team or an individual sport, there are sports which are played individually but still involves an opponent (e.g. tennis).

## ***4.2. Theoretical considerations***

Based on the synthesized findings, both reinvestment theory and attentional control theory have been supported by different studies. Yet, in most cases they seemed to lack certain concepts inherent to the other. In one specific instance, Kinrade et al. (2015) found that decision rumination leads to team breakdown and performance disruption. This was also concluded by Iwatsuki and Wright, as results showed that previous poor decisions affected performance negatively. An interesting notion made by the authors was that decision rumination as a factor could also be regarded as a kind of distraction. This distracting thought might be taking away attentional resources from the task at hand, which is a central concept of ACT. This suggests that there is a need for an integrated attentional model in the research of choking under pressure.

As it has been mentioned in the introduction of the theoretical background, Nieuwenhuys & Oudejans (2012) have developed an integrated model, mainly grounded on attentional control theory. Reinvestment Theory specifically addresses the tendency of athletes to consciously control their movements in a step-by-step manner under pressure, which leads to performance decline. ACT does not explore this depth of motor control disruptions. This, as well as other important notions are missing from the integrated model by Nieuwenhuys & Oudejans (2012).

Nevertheless, constructing a unified framework of the attentional processes behind choking under pressure, that can be applied to all instances, sports, and athletes is a difficult task. Perhaps considering these differences should be a first step, while also integrating the main ideas of both reinvestment and ACT.

## ***4.3. Open or closed skills?***

Perhaps a better distinction would be whether a sport mainly involves open and closed skills. There are sports that are more automated and mostly have closed skills. Sports with a preponderance of open skills are considered quite unpredictable and are in an ever-changing

environment, while those with a preponderance of closed skills are not as dependent on the environment and usually include sequential movements (Poulton, 1957). For example, a gymnastics or figure skating routine is a sequence of previously learnt elements, performed in the same exact order every time, and is mostly based on closed skills. There is not much decision making to do during the routine, which leaves room for more self-focus or reinvestment. On the other hand, there are sports that require decision making under pressure situation, and hence involve open skills, like most ball sports. During a football match, players have to make decisions and think about different tactics based on the current situation. In martial arts, the athlete needs to pay attention to their opponent and react accordingly.

This distinction can be a good basis for an integrated theoretical framework as well. Considering the amount of open and closed skill that is necessary for a given sport, it could be a spectrum, with one end for the most open skill-based sports (e.g. football), and another end for the most closed skill sports (e.g. archery). While athletes who do sports that include more automated movements are more likely to reinvest their knowledge consciously and explicitly monitor their own movements, other athletes who need to make decisions but focus on task-irrelevant information might have impaired or slower processing because of less available cognitive resources. Developing a holistic model based on this continuous distinction would fill a gap in the literature and would have important practical implications as well. However, for the development of such an integrated theory, more empirical research is necessary.

#### ***4.4. Limitations***

There are certain limitations to this thesis that need to be addressed. First of all, although there were plenty of studies that were focusing on individual context, the lack of experimental data from team settings made it difficult to draw general conclusions. The ones that exist unfortunately also lack the necessary amount of ecological validity, as it is very difficult to replicate real-life team scenarios. Furthermore, the narrow focus of this review was crucial to achieve meaningful results, but different age groups, as well as participants on different proficiency levels need to be further examined.

#### ***4.5. Future directions***

In future research, the questions should be raised: How do open and closed skill sports affect the attentional processes and anxiety levels of athletes during competitions? Does any of the theories hold the same predictive power in open skills sports as it does in closed skill sports? In order to test these questions, comparative studies should be done comparing open and sport skills sports under pressure situations, and field studies during actual competitions or closely simulated settings. Moreover, using advanced technologies such as eye-tracking and wearable physiological monitors can provide more objective measurements about attentional shifts and anxiety responses. Integrating these findings into a holistic model will not only advance theoretical understanding but also help develop targeted interventions to improve athletic performance across different sports.

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