Chapter 8

Performance pressure and paralysis by analysis: research and implications

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INTRODUCTION

> Human beings under pressure are wonderfully unpredictable; their nature is a puzzle to us all. . . When human beings are placed in an arena, and their hopes and fears exposed in front of thousands of observers, they are likely to do extraordinary things. This is especially true if someone has told them, 'Don't let us down now'.
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> (Patmore, 1986: 7)

By definition, elite athletes execute their chosen skills with a very high level of precision. Yet often these same athletes perform poorly in pressure situations. Performing poorly in spite of high motivation and incentives for success has been termed *choking under pressure*. There are numerous examples across sports in which performers fail at crucial moments to execute successfully skills that have been performed perfectly time and time again in practice situations: routine golf putts and rugby place-kicks are missed, basketball free throws hit the rim, tennis players serve double faults on critical points, and soccer penalty kicks are ballooned over the crossbar. A frequently cited example of *choking* is that of the golfer Greg Norman who led by six shots going into the final round of the 1996 US Masters, one of the four major golf championships. As the pressure of the final round built, Norman's lead was whittled away until, finally, there was an eleven-shot difference between his score (78) and that of the winner, Nick Faldo (67). Although such instances may grab the headlines, poor performance in pressure situations is far from unusual. For example, researchers have found that the probability of major-league baseball players scoring a hit was approximately twenty per cent lower when failure to do so would result in the end of that inning (i.e., there were already two outs). When the pressure to keep one's team in the inning is highest, the performance of the very best athletes may be lowest.

At the outset, it is important to highlight a difficulty faced by both researchers and coaches: how does one distinguish between normal or random fluctuations in performance and an abnormally poor performance? In Norman's case, his experience was clearly out of the ordinary. He was interviewed for *Golf Magazine* almost a year after the event and said 'Never in my career have I experienced anything like what happened . . . I was totally out of control. And I couldn't understand it'.

Although it might be convenient to label any instance of poor performance as a *choke*, meaningful scientific use of the term requires corroboration, either through introspective self-reports on the part of the athlete (such as by Norman above) or statistical analysis indicating that the observed poor performance is unlikely to be explained by random fluctuations in performance. This is especially important given that people can be poor judges of what random fluctuations in performance look like and are also not great at distinguishing between a chance occurrence of an event and genuinely unusual patterns. For example, researchers investigating the validity of the 'hot hand' in basketball (i.e., the notion that a player is more likely to make a given shot if it is preceded by a run of successful shots rather than by one or more misses) found little evidence to suggest it was a genuine phenomenon. Researchers compared the probability of NBA players being successful following a series of hits or misses and found that they were no more likely to be successful following one, two, or three previous hits than they were following a series of misses. In fact, when analysing the individual members of the Philadelphia 76ers basketball team, only one player appeared to be influenced by the outcomes of previous shots. But rather than having a *hot hand*, the player was more successful after one (71 per cent), two (73 per cent), and three (88 per cent) misses than he was after successful shots (57 per cent, 58 per cent, 51 per cent, following one, two, and three hits, respectively).

In this chapter we concentrate on instances of poor performance in sport and the implications for coaches and performers. We consider relatively short or acute instances of poor performance rather than more prolonged or chronic *slumps* in performance—as the causes of this latter class of performance failure are complex and multifaceted and do not necessarily stem from a heightened sense of perceived pressure or desire to perform at an optimal level. Along these lines, we also try to distinguish between random fluctuations in performance and pressure-induced failure. We apply the term *choking under pressure* only to those instances of less-than-optimal skill execution that have a clear connection to heightened importance and performance pressure in a given situation.

We present research that has attempted to uncover why choking occurs through examining ways in which pressure-filled situations change how individuals think about and attend to skilled performance. We believe that understanding *how* crucial moments affect the attentional processes supporting high-level skill execution can be used to develop training regimens and performance strategies designed to alleviate skill failure. In the first section of the chapter, we summarize what research tells us about the dangers of *thinking too much* when executing well-learned and highly practiced motor skills. We then consider factors that might moderate or trigger this process. In the second section, we consider the implications of this research for designing strategies to prevent skill breakdown under stress.

RESEARCH ON THE DANGERS OF THINKING TOO MUCH

Why does choking occur in well-learned and highly practiced skills such as the tournament-winning putt or the all-important penalty shot? Several researchers have suggested that pressure situations raise self-consciousness and anxiety about performing correctly. This focus on the self is thought to prompt performers to turn their attention inward to the specific processes of their performance in an attempt to exert more skill control than would be applied in a non-pressure situation. For example, the basketball player who makes eighty-five per cent of his/her free throws in practice may miss the game-winning foul shot because, in trying to ensure an optimal outcome, they monitor the angle of their wrist or the release point as they shoot the ball. After many thousands of hours of practice, these components of performance are not something that our basketball player would normally attend to. And, paradoxically, such attention is thought to disrupt well-learned performance processes that normally run largely outside conscious awareness—*paralysis by analysis*.

In support of the above ideas, work in our laboratories and others has demonstrated that, for well-learned and highly practiced skills, paying too much attention to task control and guidance (what we call skill-focused attention) may actually disrupt execution. Just as thinking about how and where we place our feet as we rush down the stairs may result in the disruption of well-learned walking movements and a fall, attending too much to skill processes that generally run off without conscious awareness can disrupt performance and cause skill failure in sport. For example, in one study in our laboratories, we asked skilled soccer players to dribble the ball through a series of pylons while paying attention to the side of their foot that most recently contacted the ball. This instruction was designed to draw attention to performance in a way that does not normally occur. Dribbling performance was worse (i.e., slower and more error prone) when the soccer players were asked to attend to performance in comparison with a condition in which they dribbled without any instructions. Similarly, in another study, when soccer players were asked to set themselves a goal to maximize success, those who chose to focus on elements of soccer technique (e.g. 'keep loose with knees bent') performed worse than normal.

Similar results have been reported in an investigation of baseball batting. When highly skilled university-level baseball players were asked to perform a hitting task and, at the same time, attend to a specific component of swing execution in a manner to which they were not accustomed, their performance suffered. Here, baseball players heard a randomly presented tone and were instructed to indicate whether their bat was moving downward or upward at the instant the tone was presented. Biomechanical swing analyses revealed that the observed performance failure was at least partially due to the fact that skill-focused attention interfered with the sequencing and timing of the different skill components involved in swinging.

The above research suggests that paying too much attention to highly practiced skills disrupts performance. However, it should be noted that skill-focused attention may sometimes be necessary, for example, when making changes to a well-learned technique. High-level performers will probably have to slow down and unpack automated processes in order to change their technique, which may result in temporarily poor performance (e.g. Tiger Woods' and Nick Faldo's less-than-optimal performance while making changes to their golf swings). Ultimately, of course, these changes are made so that skill execution more closely mirrors desired outcomes. A critical part of this process involves progressing to a level in which the newly learned technique can be performed automatically or with minimal conscious thought. This is far from easy when making fundamental changes. For example, it took the best part of three years for Faldo to retain and then surpass his previous level of performance after remodelling his swing. Others are less fortunate. In searching for more shot distance, the Australian golfer Ian Baker-Finch made changes to his swing and suffered a dramatic loss in form and confidence that eventually led him to withdraw from tournament golf. This was only five years after he won the British Open, arguably the most prestigious of the four 'major' championships.

TRIGGERS OF FAILURE

Now that we have attempted to describe why the failure of well-learned and highly practiced motor skills occurs in pressure situations, we turn to potential triggers of such failure.

Thinking and imaging failure

Although one might assume that people in general (and most certainly highly disciplined athletes) are good at controlling their thoughts and performance-related images, it turns out that athletes *do* report thinking about the possibility of skill failure. Moreover, research has demonstrated that athletes' images of failure and even the mere mention of choking can result in less-than-optimal performances.

One of the first studies to examine this idea investigated the impact of negative imagery on dart-throwing success. It was found that combining dart-throwing practice with negative imagery (i.e., imaging the dart landing near the edge of the board rather than in the center) led to a decrease in dart-throwing accuracy in comparison with combining dart throwing with positive imagery (i.e., imaging the dart landing near the center of the target). Additional evidence that pre-performance negative imagery can impair skill execution comes from recent studies exploring the effects of positive and negative imagery on golf putting. Golf putting accuracy declined when individuals employed negative imagery (e.g. thinking about missing the hole) prior to hitting the ball.

Thus, the ability to control one's thoughts and images prior to and during skill execution seems to be a crucial determinant of successful performance. Both negative self-talk and negative imagery immediately prior to performance may harm execution. Why? One possibility is that thinking about a negative outcome causes individuals to try and control their skill in an attempt to ensure that this negative performance outcome will not come to fruition. Ironically, as we have described above, such added control can backfire, disrupting well-learned and automated performance processes.

Audience factors

In the 1980s, the possibility that the crowd might trigger choking attracted considerable interest. Most intriguingly, psychologist Roy Baumeister proposed that, in critical matches, choking would be more likely when performing in front of a *supportive* audience. He hypothesized that the pressure of performing in front of home supporters who had high expectations of success would cause players to try to control aspects of their skills that are normally controlled subconsciously. That is, players would employ skill-focused attention in a manner that might disrupt or slow down automatic aspects of performance. To investigate this possibility, Baumeister and colleagues analyzed archival data on the home field advantage in the sports of NBA basketball and major-league baseball during world series or championship matches. Examining instances in which the home team was one game away from winning the series, they found that the home teams won just 38.5 per cent of decisive seventh games in baseball and just 37.5 per cent of basketball games in which they had a chance to clinch the championship. Analysis of player errors in baseball and free-throw percentages in basketball suggested that the results were mostly due to poorer home team performance rather than improvements on the part of the away teams.

Some researchers have questioned the generality of the home field *disadvantage* phenomenon by presenting evidence that it only applies to certain clubs. In addition, reanalysis of the baseball data to include the subsequent ten years, a period in which the home team won all of the decisive seventh games, indicated that the data in support of the home field disadvantage fell below the standard criteria for statistical significance. However, this reanalysis may have been confounded by a change to the rules. Nevertheless, other laboratory-based studies have demonstrated that the nature of an audience can indeed affect performance. For example, Baumeister and colleagues compared performance in front of supportive and neutral audiences in a video game task. They found that participants were more prone to focus on themselves and their skill execution in front of a supportive audience than a neutral audience. Participants also performed more slowly and with less accuracy in the supportive audience condition. In spite of this, individuals who performed in front of the supportive audience rated the experience as far less stressful than those who performed in front of the neutral audience. Thus, skill-focused attention need not necessarily be preceded by anxiety or perceived performance pressure.

MODERATORS OF SKILL FAILURE

Skill level and type

From one's reading of the chapter thus far it might be tempting to conclude that the *only* way in which a skill can fail under pressure is by performers attempting to monitor and control skill processes that should be left alone. However, although this may be the case for well-learned and highly practiced sport skills, this may not extend to all types of task or all skill levels. For example, novices asked to attend to how they were executing their skill in both a baseball batting task and a soccer dribbling task (the same tasks described earlier) did not show performance decrements in comparison with normal execution conditions. Unlike experts, novices just starting to learn a skill must pay attention to skill processes and procedures in order to ensure an optimal outcome. As a result, novices are not hurt by conditions that draw attention to performance—and, in fact, often improve with such added attention (although see Masters, Chapter 7).

Given that novice performance is not hurt when individuals are prompted to monitor execution, one might wonder whether novices are impacted by pressure at all. We have found some support for the idea that novice performers are not harmed by performance pressure in the same way that skilled individuals are. Individuals learned a golf putting skill to a high level and were exposed to a high-pressure situation both early and late in practice. Early in practice, pressure to do well actually facilitated performance. At later stages of learning, performance decrements under pressure emerged. This finding is consistent with the fact that most of the evidence for choking under pressure has been derived from highly skilled athletes.

Nonetheless, there are probably well-learned components of sport performance that still require a significant amount of attention and effort for optimal performance and thus may not be harmed when performers attempt to control execution. For example, strategizing, problem solving, and decision making (having to consider multiple novel options simultaneously and updating information in real time) can, at times, require considerable attention and memory resources (also see Farrow and Raab, Chapter 10, and McPherson, Chapter 11). These skills then may not fail when performers concentrate on what they are doing, but instead may fail if performers are distracted from the decision-making task at hand. This area is ripe for research, and we speculate that the time available for making decisions may be an important factor here. For example, if there is plenty of time to make a decision or plan a strategy, then pressure may have little impact on the quality of the final decision. In contrast, in skills requiring rapid decision making, it is possible that pressure to perform well will lead to slower, more analytical decision making that harms performance.

Dispositional self-consciousness

So far we have explored the idea that one way in which failure under pressure occurs is when performers attempt to control their skills consciously. Paradoxically, this can result in poorer levels of performance than if individuals had spent less time and effort thinking about skill execution. One obvious question is whether certain individuals are more likely to try consciously to control their movements than others. To explore this question, researchers have focused on an individual's level of self-consciousness, determined by responses to a scale in which they rated statements such as 'I'm aware of the way my mind works when I work through a problem', and 'I'm concerned about what other people think of me'. One proposal was that people who rated such items as characteristic of themselves (i.e., highly self-conscious individuals) should be less prone to choking because they would be more used to performing in the type of self-aware state that pressure creates. Conversely, others have argued that scoring highly on such items would indicate susceptibility to thinking too much, such that highly self-conscious individuals would be more prone to skill failure under stress.

Overall, the weight of evidence currently favors the latter prediction: highly self-conscious individuals appear more prone to skill failure, certainly in sport skills. Indeed, Rich Masters and colleagues devised the Reinvestment Scale specifically to predict the process of *reinvesting* conscious control in motor skills, incorporating many of the items used to assess self-consciousness. Researchers using this scale have indicated that high scores predict skill failure. And, research involving players from university squash and tennis teams has even indicated that high reinvestment scorers are rated by their team captains and presidents as being more prone to choking under pressure (see Masters, Chapter 7).

THEORY INTO PRACTICE: TECHNIQUES FOR PREVENTING PARALYSIS BY ANALYSIS

If thinking too much can disrupt the fluid, automatic qualities of a highly practiced skill, a key question is how to prevent this from happening. Clearly the solution is not easy because there remain many instances of poor performance under pressure. Nevertheless, there are a range of techniques that have proved effective in the laboratory setting and, although such studies are unlikely to recreate the levels of anxiety experienced in competition, they help provide the theoretical basis for interventions in the field. Broadly speaking, interventions can be divided into those that relate to how a skill is learned and those that focus on how to prevent failure when a high skill level has already been obtained.

Learning factors

The relationship between how a skill is learned and the likelihood of subsequent skill failure under stress is covered in more detail in Masters, Chapter 7. Here, we simply note that there is a growing body of research indicating that if performers can learn skills with minimal knowledge of the underlying rules related to the performance of the skill then such skills are less susceptible to breakdown under stress. This line of research has evolved to explore practical means of minimizing explicit problem solving during learning. These include attempting to minimize errors during learning and using analogies or *biomechanical metaphors* as a substitute for a number of explicit instructions given by a coach. The results to date indicate that skills acquired in these ways demand less attention, generate a smaller pool of explicit knowledge, and are more robust under psychological and physiological stress.

'Acclimatization' strategies

An alternative to changing the way we learn skills is to try to minimize the impact of factors that trigger conscious control processes or skill-focused attention. The logic behind acclimatization strategies is that exposing a performer to conditions that heighten self-awareness during training will acclimatize or adapt them to performing in that state. This, in turn, should inoculate the performer against the negative impact of situational pressures that heighten self-awareness. There are only a few studies exploring the efficacy of this approach to date. Nevertheless, there is some evidence from two separate studies of golf putting that participants who practiced the task while being videotaped subsequently performed better under pressure (induced by financial incentives and peer pressure) than did those who did not receive adaptation training. The participants receiving adaptation training were told that the videotape would be used to examine their movements as they learned the putting task.

It is also possible acclimatization training may serve another purpose in addition to, or instead of, adapting individuals to monitoring execution. Namely, it may adapt individuals to the pressure situation in general. To the extent that athletes become accustomed to performing under pressure, a high-stakes situation may not represent much that is new to them. And, in turn, when this type of situation arises, they may not feel as much pressure as non-adapted individuals, and sub-optimal skill execution may be avoided. Nonetheless, some caution should be expressed when attempting to generalize from the results of the above studies because they involved novice individuals trained to a high putting skill level, rather than expert players with several years of golf experience.

Minimize thinking time and pre-performance routines

The more time one has to execute a skill, the better the performance, right? We have all heard the adage 'haste makes waste'. But, is this really true, especially with respect to the performance of well-learned and highly practiced skills? If thinking too much about how to perform a skill disrupts performance, then having a lot of preparation time to think about a technical skill performed with a small margin of error might actually result in a worse rather than better performance.

Recently, Beilock *et al*. (2004) found that skilled golfers performed better when instructed to execute their putts as quickly as possible than they did when instructed to take as much time as needed. Thus golfers were more accurate when given minimal time to think about and prepare for the putt than when they were allowed to perform the task using as much time as they chose. It should be noted that Beilock's study used only short putts of up to 1.58 m. Whether it pays to minimize thinking time on more difficult putts that require the player to *read* the different slopes and judge the speed has yet to be established. Nonetheless, the finding lends support to anecdotal evidence from skilled golfers who believe that significantly reducing preparation time can improve accuracy. For instance, professional golfer Aaron Baddeley has a relatively short pre-putt routine in which he has a *four count* from the moment he grounds the putter to the moment he strikes the ball and is consistently rated as one of the best putters on the US tour.

The issue of preparation time is closely aligned with the routine pattern of thoughts and behaviors a performer engages in prior to executing their skill. In examining these routines, other researchers have found that the overall length of the routine is unimportant, as long as the relative frequency of different behavioral components of the routine remains consistent. Jackson analyzed pre-performance routine times of rugby union goal kickers during the World Cup and found no evidence that better kickers had shorter (or longer) routine times. Indeed, analysis of the data from each kicker revealed large individual differences in, for example, the time they stood still concentrating just before initiating their run-up. Some kickers spent just 4 or 5 s, while others spent over 20 s. In contrast to perceived wisdom, there was also no evidence that better kickers had more consistent routine times. Instead, routine time varied systematically with the difficulty of the kick: the more difficult the kick, the longer the players took standing over the ball before running up to take the kick. It seems that the critical thing for performers is to have a routine that enables them to execute the skill with a *quiet mind*. The total length (or indeed consistency) of the routine appears less important than having skills that facilitate this process. Toward this end, if stressful situations prompt performers to try and control execution in a way that alters their normal routine, then limiting the time available to do this (as Beilock and colleagues did) may help individuals get back to their well-practiced pre-shot routine.

Distraction strategies and visual cues

Attention directed internally toward monitoring the process of performance can cause a breakdown in the automaticity or fluency of that performance. But telling performers not to do this, rather like telling someone not to think of a pink elephant, is not particularly effective at suppressing the inappropriate focus of attention. There are, however, active focusing strategies that appear beneficial to performance. Again, researchers in this area have mainly focused on self-paced skills such as golf putting and basketball free throws and have proposed a five-step strategy or pre-performance routine that has proved beneficial to performance. The steps consist of readying (preparing for the act), imaging (visualizing the movement), focusing (on a meaningful cue), executing (with a quiet mind), and evaluating (the effectiveness of each of the previous steps). From an attentional perspective, the key steps are focusing, with effort, on an external visual cue, and executing as if on autopilot. The external visual focus might be the dimple pattern or manufacturer's name on a golf ball, or the seams on a rugby ball. For example, rugby union goal kicker Jonny Wilkinson focuses intently on the precise point of the ball that he wants to strike. This is combined with a very specific target focus in which, rather than focus on the posts, he aims to kick the ball to a particular person in the crowd.

Attentional cues have also been used to cure cases of the yips in golf. For example, verbal cues were used in an intervention for a golfer who had difficulty initiating his down swing, performing numerous false starts on the golf course in which he froze at the top of his back swing. The intervention that proved most effective was to have the golfer say a three-syllable word to match the timing or rhythm of his golf swing (the player used the song title 'Edelweiss' from *The Sound of Music*). Thus, the player said Ed-el-weiss to correspond to initiation of his back swing, the top of his back swing and the point of contact with the ball.

Recently, we have found that distracting performers from the process of execution is facilitative under pressure-inducing conditions. Specifically, we have demonstrated that the performance of skilled golfers under conditions designed to increase feelings of performance pressure and anxiety was actually improved when they were forced to perform a second task concurrently while putting. In one study, Beilock and colleagues had golfers listen to a series of words being played on a tape recorder. Every time they heard a specific target word, they had to repeat it out loud. The process of drawing golfers' attention away from their own performance benefited overall execution under pressure.

Overall then, there appear to be two elements to the successful use of verbal or visual cueing. First, the technique helps focus the performer's attention on a task-relevant activity (e.g. visual fixation on the target). Second, there appears to be an element that occupies the performer's mind such that it prevents or distracts them from focusing on the automated process of performance, allowing such skill processes to run off with minimal conscious involvement. In tennis, coach and author of the *Inner Game* series of books, Tim Gallwey, talked of this process when recommending a strategy in which he encouraged players to say 'bounce' at precisely the moment the ball landed on the tennis court, and 'hit' at the moment it made contact with the player's racquet.

Strategy focus

Many skills require effective decision making as well as technical precision. This is particularly true of *open* skills such as open court play in racquet sports, and open play in team sports such as soccer, basketball, and rugby. If skill failure is the result of trying to control well-learned processes involved in the execution of skills then focusing on *what to do* (strategy) rather than *how to do it* (technique) might help prevent skill failure. Moreover, because strategizing generally requires one to take in and think about multiple pieces of information at a time, this type of focusing may have the added benefit of improving one's decision-making process (see Farrow and Raab, Chapter 10, and McPherson, Chapter 11). Recently, Jackson and colleagues (2006) conducted a study in which skilled soccer players set themselves goals prior to completing a task involving dribbling the ball between a series of cones. The participants were told to choose a *process goal* that they felt would help maximize their success on the task. Results showed that some of the participants set themselves goals that related to the movements or technique required to perform the task well (e.g. 'keep loose with knees bent'), whereas others set themselves goals that related to more strategic or positioning elements of the task (e.g. 'keep the ball close to the cones'). Those who set themselves goals relating to movement or technique subsequently performed worse, whereas those who focused on strategy maintained the same level of performance. These findings were not affected by pressure: participants focusing on strategy still maintained their performance under high pressure, whereas those focusing on technique continued to perform more poorly. Again, this highlights the *paradox of control*: performers may focus on elements of performance they believe will help them to maintain or enhance that performance but which in fact can result in poorer performance.

CONCLUSION

There is a growing body of research examining attentional processes underlying skill failure. Evidence from a wide range of studies points to the idea that the failure of well-learned and highly practiced athletic skills occurs when performers try consciously to control elements of performance that normally run off automatically. This paradox of control, in which the desire to ensure that performance does not fail actually triggers skill failure, provides a challenge to performers and practitioners alike. We have given a brief summary of some of the research that examines this process and considered the implications of this work for the development of effective intervention strategies (see Figure 8.1). Of course, although science is useful for providing a theoretical framework for interventions, no single intervention strategy is likely to be effective for all performers and all skills. The challenge for the coach and sport scientist is how best to apply the principles from the lab to design interventions that prove effective in the field of competitive sport.

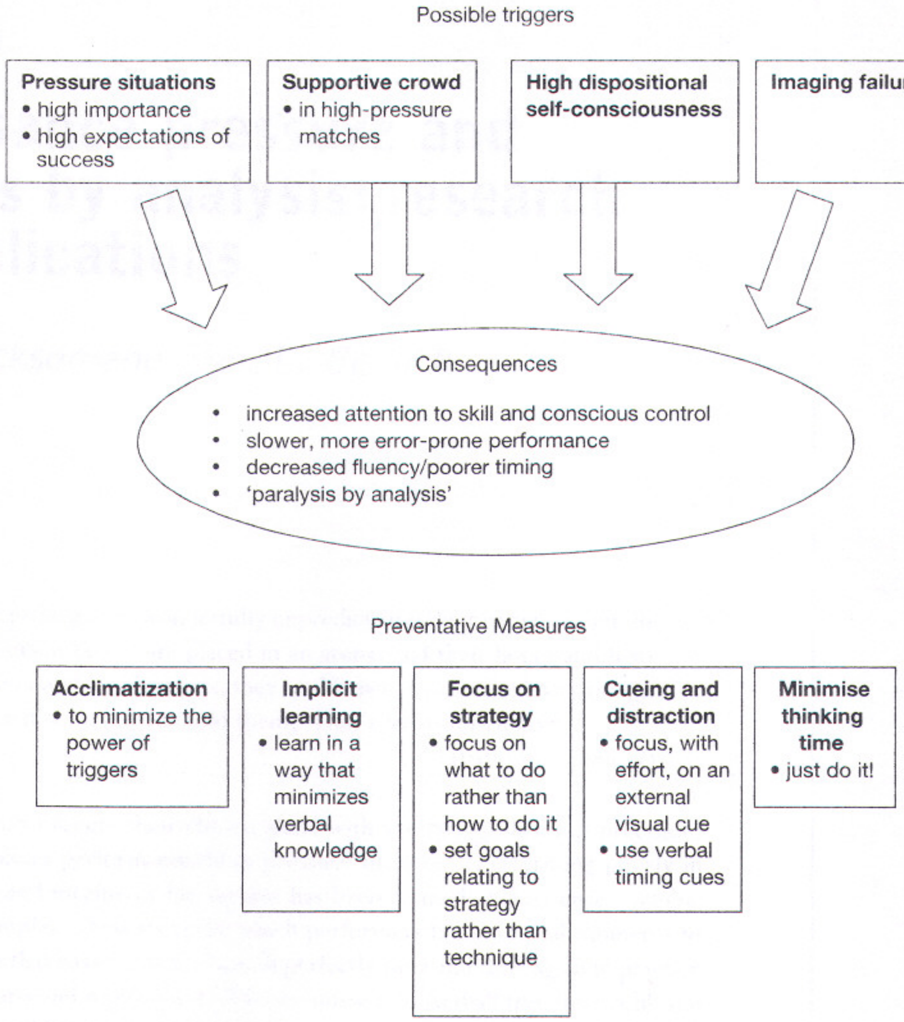

Figure 8.1 *Possible triggers of choking in well-learned skills and associated preventative measures.*