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**Raoul R. D. Oudejans, Anne Spitse,
Elmer Kralt and Frank C. Bakker**

Abstract

Musicians often play under circumstances in which pressure may lead to anxiety and performance deterioration. Theories suggest that a drop in performance is due to a shift in focus of attention towards task-irrelevant information. In this study, we asked music students to report what they think and where they focus attention in three situations: when they play under pressure (Study 1; $n = 81$), the moment just before choking under pressure and when they try to recover after a mistake (Study 2; $n = 25$). Focus of attention was examined using retrospective verbal reports and point-spread distributions. Besides a notable focus on music-related information (36.9%), music students reported a considerable number of worries and disturbing thoughts (26.1%) during playing under pressure (Study 1). Just before choking, they showed even more worries and disturbing thoughts (46.4%) at the cost of music-related focus (21.1%) (Study 2), as also confirmed by the point-spread distributions. During recovery after a mistake, attention was mainly focused on music-related information (53.0%) and less on thoughts that give confidence (18.5%) and physical aspects (16.6%). It is advisable to help music students with improving their performance, for example, by attentional control training or providing training with elevated levels of anxiety.

Keywords

attention, choking under pressure, music performance anxiety, stage fright, stress

Musicians often perform under circumstances in which performing well is important, such as in front of a large audience or during an audition. Playing under such pressure may lead to performance anxiety or stage fright (Fehm & Schmidt, 2006; Kenny & Osborne, 2006;

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Papageorgi, Creech, & Welch, 2013), which may pose a serious problem for performance. When people have to perform under pressure, performance is often accompanied by changes in attention that are related to the anxiety that is evoked by the pressure (e.g., Duke, Cash, & Allen, 2011; Eysenck, Derakshan, Santos, & Calvo, 2007; Kenny, 2005, 2011; Oudejans, Kuijpers, Kooijman, & Bakker, 2011; Wan & Huon, 2005). When the pressure leads to performance deterioration, often referred to as choking under pressure (e.g., Baumeister, 1984; Beilock & Carr, 2001; Geukes, Mesagno, Hanrahan, & Kellman, 2012), the decrease in performance is also often related to these changes in attention. More specifically, there is evidence to suggest that choking under pressure is due to an anxiety-induced shift in attention from task-relevant information towards task-irrelevant information (e.g., worries and disturbing thoughts; Kenny, 2011; Oudejans et al., 2011), which is in line with recent theories on anxiety and performance (for cognitive performance, see Eysenck et al., 2007; for perceptual-motor performance, see Nieuwenhuys & Oudejans, 2012).

Generally, for optimal performance in high-achievement settings such as sport and performing arts, it is essential to optimally focus attention on task-relevant information such as the target in far-aiming tasks (e.g., bulls-eye in darts, the rim in basketball) or the music in music performance (Buma, Bakker, & Oudejans, 2015; Kenny, 2011), rather than on task-irrelevant information, that is, information that is not required for optimal task execution. Anxiety is known to lead to higher distractibility in an attempt to identify information related to the possible threat that causes the anxiety (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Nieuwenhuys & Oudejans, 2012). As a result, when anxiety is increased, attention may shift from task-relevant to threat-related, yet task-irrelevant, information which in turn leads to a decrease in performance, as has been shown in several earlier studies on, for instance, dart throwing, police handgun shooting, and penalty shooting in football (e.g., Nibbeling, Oudejans, & Daanen, 2012; Nieuwenhuys & Oudejans, 2011; Wilson, Wood, & Vine, 2009; Wood & Wilson, 2011).

It is clear from work by Van Zijl and Luck (2013) that a musician's focus of attention also has an impact on performance. Insight into the changes in attention during moments of increased pressure is therefore necessary to provide musicians with advice concerning their attention or help them with proper (training) interventions to prevent undesirable attention changes under pressure. In the present study, we attempted to gain such insight by asking students of an academy of music three questions:

1. Where do you focus your attention when performing under pressure?
2. Where do you focus your attention when things go wrong, that is, just before choking under pressure?
3. Where do you focus your attention when trying to regain control and to recover from choking so as to continue playing as well as possible?

Using retrospective verbal reports, Buma et al. (2015) showed that when performing under pressure, musicians in an elite orchestra mainly focused attention on "music" (i.e., about 50% of the statements were music-related). In addition, attention was focused on physical aspects (e.g., on breathing, 20%) and thoughts that give confidence (e.g., "I trust that I will do well", 17%). The three remaining categories together (worries/disturbing thoughts, narrow focus, and other) captured less than 15% of the statements. The low number of worries and disturbing thoughts was unexpected and in contrast with the 25.8% of worries that elite athletes reported (Oudejans et al., 2011) and the general idea on performing under pressure in music (e.g., Kenny & Osborne, 2006; Osborne & Kenny, 2008; Steptoe & Fidler, 1987).

As the elite musicians in the study of Buma et al. (2015) had over 20 years of experience at the highest level, their findings cannot be automatically generalized to students of an academy of music, that is, to musicians playing at a high level but who are not yet elite. There is consensus in the literature that “music” provides the main source of task-relevant information (Buma et al., 2015; Kenny, 2011), so we expect that for students, just like for elite musicians, “music” will also be an important focus of attention. In addition however, we expect more worries and disturbing thoughts in students than in the elite musicians studied by Buma et al. (2015).

As for the second question, the findings of Buma et al. (2015) pertain to situations in which musicians perform under pressure, but are still playing well. When musicians choke, performance is far from optimal. This raises the question of how focus of attention differs between a pressure situation and a pressure situation that precedes choking. In the area of perceptual-motor tasks and sports, thoughts and worries about performance (e.g., about consequences of performance failure) are prominent just prior to choking (e.g., Hatzigeorgiadis & Biddle, 2001; Oudejans et al., 2011; Wilson & Smith, 2007). In students of a music academy we also expect a considerable number of worries right before choking and an increase of these thoughts relative to a pressure situation in which choking is not (yet) at hand.

As the current study aims to provide a basis for advice or interventions for good musicians concerning their attention under pressure, it is also important to know what students do in order to regain control and get back on track once choking has occurred. Where do they focus their attention then? (Question 3).

In sum, to optimize training interventions for music students, it is crucial to gain insight into their thoughts and focus of attention during performing under pressure. Therefore, the main aim of the current study was to map these thoughts and focus of attention. In Study 1, we examined what music students think and where they focus their attention during playing under pressure. Do they also focus on music? Do they have many worries? In Study 2, we examined what they think and where they focus just before choking under pressure as well as just after choking in an attempt to get back on track after a mistake. To allow comparison with the results of Buma et al. (2015), the verbal report form of their study was replicated as closely as possible in Study 1.

Study 1

Method

Participants. A total of 81 music students (46 men and 35 women) at a top level international academy of music participated in the study (53 followed the classical music program and 28 the jazz music program). The mean age of the participants was 23.5 years ($SD = 3.20$) and the mean playing experience was 13.4 years ($SD = 3.97$). Their musical instruments were strings (47), woodwinds (11), brass (10), vocals (8) and percussion (5). Of the participants, 54 followed the bachelor study program and 27 the master study program. Altogether, the participants had 27 different nationalities. Anonymity of the participants was ensured.

Procedure. In several classes of the academy of music, the experimenters briefly introduced the purpose of the study to the students. The students who agreed to participate then provided informed consent and completed the English or Dutch version of the verbal report form. At the end of the form, participants could indicate whether they agreed to participate in a follow-up study by providing their email address.

Verbal report form. The participants first provided some demographic data, such as age, gender and study program. Next, identical to the study of Buma et al. (2015), the following scenario was described on the form:

Undoubtedly there are moments in which you are under great pressure to play well and in which you cannot afford to make any mistakes. Think for instance of those moments in which you are the only musician playing or when an error made by you would be clearly audible; moments at which all eyes are on you, like during an important audition.

Subsequently, two questions were asked: "At these stressful moments, where does your focus of attention go? Can you explain in a few sentences where you call your attention to and/or what you think about?" Having answered these questions, two additional questions were asked: "Is your attention always focused on the same thing or does it differ in accordance to the specific situation? Can you briefly explain your answer?" These questions were also identical to those of Buma et al. (2015).

Analysis. Answers to the questions were analysed separately by two experimenters. Both experimenters selected statements from the verbal reports that they judged to be suitable for categorization. As in Buma et al. (2015), answers to the first two questions were combined with the answers to the two additional questions. The analysis resulted in one list of statements for each of the experimenters. These lists showed an inter-observer reliability of 80.5%. To come to consensus, differences in statements between the lists were discussed by the two experimenters after which a final list of 369 statements was produced.

The statements from the final list were categorized into the six categories distinguished by Buma et al. (2015). These categories were: (1) "Focus on physical aspects"; (2) "Thoughts that give confidence"; (3) "Worries and disturbing thoughts"; (4) "Music-related focus"; (5) "Narrow focus"; and (6) "Other". Again, both researchers categorized the statements independently of each other with an inter-observer reliability of 87.8%. Independent Mann-Whitney U tests were used to examine significant differences between different subgroups based on gender and study program for the percentages of statements in the six categories. As recommended by Field (2009) and Tomczak and Tomczak (2014), effect sizes for these non-parametric tests were computed in the form of correlation coefficients with $r = .10$, $.30$, and $.50$ representing, small, medium and large effects (Field, 2009), respectively.

Results

The 81 participants generated 369 statements in total, on average 4.56 statements per participant. Per participant, we computed the percentages of statements given in each of the six categories. Per category, these percentages were averaged over all participants, as presented in Table 1. It appeared that the focus of attention in music students during playing under pressure was mostly on music-related information (36.9%), worries and disturbing thoughts (26.1%) and physical aspects (16.2%). Thoughts that give confidence (8.3%), a narrow focus (3.5%) and other (9.1%) were categories containing considerably fewer statements.

Most of the percentages were not normally distributed. Therefore, gender and study program differences in percentage of statements per category (Table 2) were examined using non-parametric Mann-Whitney U tests. Women reported more worries and disturbing thoughts than men, $U = 550.0$, $Z = -2.57$, $p = .01$, $r = .29$. Furthermore, men reported more music-related focus than women, $U = 477.5$, $Z = -3.15$, $p = .002$, $r = .35$. No other significant

Table 1. Mean (SD) of percentages per category during playing under pressure ($N = 81$).

Category	Percentages
Focus on physical aspects; e.g., "I focus on my breathing"	16.2 (24.5)
Thoughts that give confidence; e.g., "I will finish the piece successfully"	8.3 (16.2)
Worries and disturbing thoughts; e.g., "I don't want to make a mistake"	26.1 (30.8)
Music-related focus; e.g., "I try to enjoy the music"	36.8 (29.8)
Narrow focus; e.g., "I focus on one element at the time"	3.5 (9.7)
Other; e.g., "My concentration is gone"	9.1 (17.3)
Total	100

Table 2. Mean (SD) percentages separated for gender and study program per category.

Category	Gender		Study program	
	Men $n = 46$	Women $n = 35$	Bachelor $n = 54$	Master $n = 27$
Focus on physical aspects	15.5 (23.8)	17.1 (25.8)	15.2 (24.8)	18.1 (24.2)
Thoughts that give confidence	7.5 (16.0)	9.4 (16.6)	7.9 (17.5)	9.2 (13.3)
Worries and disturbing thoughts	18.0 (25.4)	36.7 (34.3)**	26.3 (31.6)	25.7 (29.7)
Music-related focus	46.2 (31.9)**	24.6 (21.5)	38.2 (30.9)	34.2 (27.7)
Narrow focus	2.9 (9.2)	4.2 (10.4)	2.5 (8.3)	5.3 (11.9)
Other	9.9 (15.3)	8.0 (19.9)	9.8 (18.6)	7.5 (14.8)

** $p < .01$.

differences were found for gender, $Us \geq 694.0$, $Zs \leq -1.294$, $ps \geq .196$. No differences were found between bachelor and master students, $Us \geq 639.0$, $Zs \leq -1.370$, $ps \geq .171$.

Discussion

The aim of Study 1 was to map the thoughts and focus of attention in music students during playing under pressure using a retrospective verbal report method. As predicted, focus of attention in music students was mainly on music-related information (36.9%) and on worries and disturbing thoughts (26.1%). Focus on physical aspects (16.2%) was the third category. These three categories together captured almost 80% of the statements. The remaining 20% of the statements were categorized into the other three categories: thoughts that give confidence, narrow focus, and other.

As in Buma et al. (2015) most statements were in the music category, although the percentage was lower for students (36.9%) than for elite musicians (47.9%). Focus on physical aspects (16.2% for students vs. 20.5% for elites), narrow focus (3.5% vs. 3.7%) and other (9.1% vs. 5.3%) differed only marginally. However, the percentages statements in the category of worry and disturbing thoughts were considerably higher for students (26.1%) than for elite musicians (5.8%), while in the category thoughts that give confidence, these percentages were lower for students (8.3%) than for elite musicians (16.8%). So students seem to have more worries and fewer thoughts that give confidence than elite musicians. The number of worries of the students seems to be in line with the general impression from the literature on music performance anxiety (e.g., Kenny & Osborne, 2006; Osborne & Kenny, 2008; Steptoe & Fidler, 1987) as well

as the 25.8% of worries that elite athletes reported to experience under pressure (Oudejans et al., 2011). A possible explanation for the small number of worries reported by the elite musicians in the study of Buma et al. (2015) may be that these musicians had very much experience (on average, 24 years of experience) of playing at the highest level and belonged to the top echelon of international musicians. The idea that much experience may reduce the number of worries and increase thoughts that give confidence while performing under pressure is indirectly supported by the findings of Papageorgi et al. (2013), who showed positive effects of experience on the perceived impact of anxiety on performance.

Besides mapping the thoughts and focus of attention in music students, an exploratory analysis was done with respect to difference in gender and study program. There were no significant differences between bachelor and master students. Yet, women had more worries and disturbing thoughts than men during playing under pressure (36.7% vs. 18.0%). This is in line with the current literature about worries reported by women and men in general (McCann, Stewin, & Short, 1991; Robichaud, Dugas, & Conway, 2003) and the finding that female musicians report more performance anxiety than men (Huston, 2001; Kenny, 2006; Osborne & Kenny, 2008; Papageorgi et al., 2013; see also Kenny & Ackermann, 2015). That women paid more attention to worries and disturbing thoughts was apparently at the cost of attention for music-related information as the women reported significantly less statements in this category (24.6%) than men (46.2%). As for the comparison with the elite musicians examined by Buma et al. (2015), music-related attention of the men in the current study was close to that of the elite musicians (47.9%). Still, the men had more worries and disturbing thoughts (18.0%) than the elite musicians (5.8%). Buma et al. did not investigate differences between men and women.

Thus, so far we have established that compared to elite musicians, music students, both male and female, tend to have more worries and disturbing thoughts (at the cost of music-related attention for the women) when they play under pressure. Still, not every pressure situation leads to choking, that is, to worse performance. This raises the question whether focus of attention is different when choking actually occurs. According to recent theoretical accounts about the relationship between anxiety and perceptual-motor performance, performance degradation under pressure (i.e., choking) is often due to shifts in attention from task-relevant information (e.g., music-related information) towards task-irrelevant information (e.g., worries and disturbing thoughts) (Nieuwenhuys & Oudejans, 2012). Therefore, we expect to find (even) more worries and disturbing thoughts in music students just prior to choking and less attention to music-related information. Furthermore, we also wanted to learn where students focus their attention to get back on track after a mistake, thus once choking has occurred. These questions (Questions 2 and 3 from the introduction) were addressed in Study 2.

Study 2

Method

Participants. Participants who provided their email address during Study 1 were invited for Study 2. In total, 44 music students received an invitation, of which 29 eventually responded (11 male and 18 female; 24 classical music program, 5 jazz music program). Some did not complete all questions leading to slightly different numbers of participants in the results section. The mean age of the participants was 24.2 years ($SD = 3.39$) and their mean playing experience was 13.9 years ($SD = 5.09$). Their musical instruments were strings (12), woodwinds (8), brass (4) and vocals (5). Sixteen of the participants followed the bachelor study program and 13 followed the master study program. Altogether, the participants had 14 different nationalities.

Procedure. A short reminder about the purpose of the study was sent by email to the participants. Furthermore, some information about the questionnaire they were asked to complete was sent along with the link to the digital questionnaire. Depending on the language in which they had completed the verbal report form in Study 1, participants received a link to the English or Dutch questionnaire.

Questionnaire. The participants were asked to fill in their names for administrative purposes and were ensured that their answers would be analysed and reported strictly anonymously. Next they were asked to complete a verbal report form. The first lines on the form described a scenario referring to playing under pressure and were the same as the first sentences on the form in Study 1. Then the instruction read:

In the form you completed a few weeks ago we asked you about what you think of during playing under pressure. Fortunately, often the pressure has no negative effect on your performance. However, sometimes it leads to an unsatisfactory performance, like playing the wrong notes. Just before you make a mistake due to the pressure, where does your focus of attention go? Can you explain in a few sentences where you call your attention to and/or what you think about?

We refer to this part of the study as *Verbal report Choking*.

Second, the participants were asked to divide 100 points over the six categories utilized in Study 1. This method is derived from the point-spread method (Loch, Carr, & Warkentin, 1992; Ruta, Garrat, Leng, Russell, & MacDonald, 1994). The six categories were listed in a table and the participants were asked to spread 100 points over the six categories (see the Supplementary material). Each category could get as few or as many points as the participant wanted, as long as the total would be exactly 100 points. The participants were first asked to give an estimation of how their thoughts and focus of attention are divided among the six categories *when playing well under pressure* (further referred to as *Point-spread Pressure*). Next they did the same but now for situations *just before choking under pressure* (further referred to as *Point-spread Choking*) (see full instructions in the Supplementary material).

Finally, the participants were asked what they do to get back on track after making a mistake, again by writing down where they call their attention to and/or what they think about (further referred to as *Verbal report Recovery*).

Analysis. The answers to *Verbal report Choking* and *Verbal report Recovery* were analysed independently by two experimenters (just as in Study 1). For *Verbal report Choking*, the lists from both experimenters showed an inter-observer reliability of 85.0%. For *Verbal report Recovery*, the lists from both experimenters showed an inter-observer reliability of 84.2%. To come to consensus, differences in statements between the lists were discussed by the two experimenters after which a final list of statements was produced for each verbal report. The statements from the final lists were categorized independently by the two experimenters into the six categories utilized in Study 1. Inter-observer reliabilities were 88.1% and 87.1% for *Verbal reports Choking* and *Recovery*, respectively.

Point-spread Pressure and *Point-spread Choking* allowed within-subjects comparisons using Wilcoxon signed-ranks tests between playing well under pressure and just before choking.

For comparisons between the verbal reports about playing under pressure in general (from Study 1; further referred to as *Verbal report Pressure*), just before choking (*Verbal report Choking*) and getting back on track after making a mistake (*Verbal report Recovery*), Friedman's Analyses of Variance (ANOVAs) were used to examine differences in percentages per category for each

verbal report. Post hoc pairwise comparisons were done using Wilcoxon signed-ranks tests using Bonferroni correction ($p < .0167$ considered significant). As recommended by Field (2009) and Tomczak and Tomczak (2014), effect sizes for these non-parametric tests were computed in the form of correlation coefficients with $r = .10$, $.30$, and $.50$ representing, small, medium and large effects (Field, 2009), respectively.

Results

Verbal report Choking. A total of 26 participants completed the *Verbal report Choking*, thereby generating 101 statements. Table 3 shows the mean percentages per category.

Just before making a mistake due to pressure, the focus of attention was almost 50% on worries and disturbing thoughts. A Mann-Whitney U test was used to examine differences between men and women in percentages of worries and disturbing thoughts. Although women showed a higher mean percentage of worries and disturbing thoughts, this difference was not significant, $U = 55.0$, $Z = 1.18$, $p = .239$, $r = .23$. In fact, neither of the categories showed a difference between men and women, $Us \geq 63.0$, $Zs \leq 1.374$, $ps \geq .169$.

The category “other” captured an unexpected high percentage of statements (27.0%), yet the majority of these statements were in fact about a loss of focus or concentration. Examples are “My concentration is gone” and “I disassociate from the flow of the music”. These statements, thus, also indicate that focus of attention tends to float away just prior to choking.

Point-spread method. In *Point-spread Pressure* and *Point-spread Choking*, the participants gave an estimation of how their thoughts and focus of attention were divided among the six categories when playing well under pressure and just before choking under pressure, respectively. Table 4 shows the

Table 3. Mean (SD) percentages per category for men and women and overall just before choking under pressure ($N = 26$).

Category	Percentages		
	men ($n = 9$)	women ($n = 17$)	overall
Focus on physical aspects	0.0	4.1 (9.7)	2.7 (8.0)
Thoughts that give confidence	2.8 (8.3)	1.0 (4.0)	1.6 (5.8)
Worries and disturbing thoughts	33.8 (42.3)	53.0 (29.1)	46.4 (34.6)
Music-related focus	27.8 (33.3)	17.5 (33.6)	21.1 (33.2)
Narrow focus	3.7 (11.1)	0.0	1.3 (6.5)
Other	31.9 (30.5)	24.3 (17.9)	27.0 (22.7)

Table 4. Mean points (SD) and differences per category during playing well under pressure (*Point-spread Pressure*) and just before choking (*Point-spread Choking*) ($N = 25$).

Category	Point-spread Pressure	Point-spread Choking	Difference
Focus on physical aspects	16.3 (10.8)	13.4 (14.8)	−2.9
Thoughts that give confidence	16.6 (14.2)	9.9 (14.2)	−6.8
Worries and disturbing thoughts	9.2 (14.1)	39.3 (25.5)	30.1
Music-related focus	40.8 (23.0)	15.6 (18.8)	−25.2
Narrow focus	11.4 (11.4)	9.2 (11.1)	−2.2
Other	5.7 (5.7)	12.6 (16.8)	7.0

results of the analysis of these point-spread questions, which were answered by 25 participants. Wilcoxon signed-ranks tests revealed that from playing under pressure to choking, there was a significant decrease of 6.8 points in “Thoughts that give confidence”, $Z = 2.03, p = .043, r = .29$, a significant increase of 30.1 points in “Worries and disturbing thoughts”, $Z = 3.93, p < .001, r = .56$, and a significant decrease of 25.2 points in “Music-related focus”, $Z = 3.80, p < .001, r = .54$. Differences in the other categories were not significant, $Z_s < 1.85, p_s > .07$.

Verbal report Recovery. In total, 28 participants completed the *Verbal report Recovery*, generating 93 statements. Table 5 shows the mean percentages per category overall, and for men and women separately. Neither of the categories showed significant differences between men and women, $U_s \geq 69.0, Z_s \leq 1.446, p_s \geq .148$. For both men and women, it appeared that to get back on track after a mistake, focus of attention was mostly on music-related information (overall 53.0%; e.g., “I try to put my heart into the music” and “I try to continue telling the story”). Focus of attention was partially on thoughts that give confidence (18.5%; e.g., “I think: Ignore, you cannot do anything about it anymore”) and physical aspects (16.6%; e.g., “I focus on my breathing”).

Verbal reports Pressure, Choking and Recovery. Differences in mean percentage per category among *Verbal reports Pressure* (Study 1), *Choking* and *Recovery* were examined with Friedman’s ANOVAs. Table 6 shows the mean percentages per category during these moments for the 25 participants who had answered all questions. There were significant main effects of Verbal Report on the percentages in the categories focus on physical aspects, $\chi^2(2) = 15.71, p < .001$, thoughts that give confidence, $\chi^2(2) = 8.604, p = .014$, worries and disturbing thoughts, $\chi^2(2) = 24.182, p < .001$, music-related focus, $\chi^2(2) = 13.279, p = .001$ and other, $\chi^2(2) = 17.159, p < .001$. There was no significant main effect for narrow focus, $\chi^2(2) = 5.154, p = .076$.

Pairwise comparisons using Wilcoxon signed-rank tests with Bonferroni correction showed less focus on physical aspects just before choking than when playing under pressure, $Z = 3.41, p = .001, r = .48$, and during recovery, $Z = 2.50, p = .012, r = .35$. There was no difference in focus on physical aspects between playing under pressure and during recovery, $Z = 0.61, p = .542, r = .01$. Furthermore, there were fewer thoughts that give confidence just before choking than during recovery, $Z = 2.96, p = .003, r = .42$, while the difference between before choking and when playing under pressure, $Z = 2.26, p = .024, r = .32$, and when playing under pressure and during recovery, $Z = 1.54, p = .124, r = .22$, did not reach significance. Next, there were significantly more worries and disturbing thoughts playing under pressure, $Z = 3.52, p < .001, r = .50$, and just before choking, $Z = 3.74, p < .001, r = .53$, than during recovery. The

Table 5. Mean (SD) of percentages per category for men and women and overall during recovery after a mistake ($N = 28$).

Category	Percentages		
	men ($n = 11$)	women ($n = 17$)	overall
Focus on physical aspects	14.9 (24.8)	17.6 (29.1)	16.6 (27.1)
Thoughts that give confidence	27.4 (32.1)	12.7 (18.2)	18.5 (25.1)
Worries and disturbing thoughts	0.0	1.5 (6.1)	0.9 (4.7)
Music-related focus	50.5 (29.8)	54.6 (32.1)	53.0 (30.7)
Narrow focus	0.0	5.2 (11.9)	3.2 (9.5)
Other	7.1 (16.6)	8.3 (18.2)	7.9 (17.3)

Table 6. Mean (*SD*) of percentages per category during playing under pressure, just before choking and during recovery (*N* = 25).

Category	Verbal report pressure	Verbal report choking	Verbal report recovery
Focus on physical aspects**	17.9 (20.5)	1.5 (5.1)	16.6 (27.5)
Thoughts that give confidence*	9.8 (17.7)	1.7 (5.9)	19.4 (25.9)
Worries and disturbing thoughts**	30.0 (31.5)	46.9 (35.3)	1.0 (5.0)
Music-related focus**	33.1 (25.7)	21.9 (33.6)	54.0 (32.3)
Narrow focus	4.7 (8.2)	1.3 (6.7)	2.2 (7.9)
Other**	4.6 (9.0)	26.7 (23.1)	6.8 (16.0)

* $p < .05$; ** $p < .01$.

difference between worries during playing under pressure and before choking did not reach significance, $Z = 2.09$, $p = .037$, $r = .30$. More music-related focus was found during recovery than when playing under pressure, $Z = 2.66$, $p = .008$, $r = .38$, and just before choking, $Z = 2.80$, $p = .005$, $r = .40$. The difference in music-related focus between playing under pressure and the moment just before choking did not reach significance, $Z = 1.53$, $p = .126$, $r = .22$. Finally, percentages in the category “other” were significantly higher at the moment just before choking than when playing under pressure, $Z = 3.73$, $p < .001$, $r = .53$, and during recovery, $Z = 2.87$, $p = .004$, $r = .41$. There was no significant difference in this category between playing under pressure and recovery, $Z = 0.31$, $p = .760$, $r = .04$.

Discussion

While Study 1 focused on thoughts and attention of music students under pressure, in Study 2, we explored thoughts and attention of music students just prior to making a mistake (i.e., prior to choking), and after a mistake to get back on track once choking had occurred. As predicted it appeared that just prior to choking music students, both men and women, had more worries and disturbing thoughts. In addition, they had less attention for music-related information. Verbal reports as well as the point-spread method confirmed the prediction, and the outcomes are in line with theories on anxiety and (perceptual-motor) performance in which it is argued that anxiety causes shifts in attention from task-relevant information towards task-irrelevant information (Eysenck et al., 2007; Nieuwenhuys & Oudejans, 2012). More attention to task-irrelevant worries and disturbing thoughts at the cost of task-relevant music-related attention can lead to undesirable music performance, such as making mistakes. During recovery attentional balance seems restored with much attention to music-related information (53% of the statements in the verbal reports), and a considerable focus on physical aspects (17%) and thoughts that give confidence (18.5%). Focus on worries and disturbing thoughts was negligible.

General discussion

The aim of our two studies was to map the thoughts and focus of attention in music students regarding playing under pressure, choking under pressure, and recovering from choking. The results of Study 1 and Study 2 combined offer a coherent pattern. Music students focus their attention in pressure situations on music, and on worries and disturbing thoughts. Just before choking, focus of attention is shifted from music-related information to even more focus on

worries and disturbing thoughts. Thus, just before choking under pressure, worries and disturbing thoughts occur at the cost of music-related focus. In attempts to return to a normal level of playing, attention is redirected towards music and away from worries. In Study 2, both methods applied – verbal report and point-spread method – led to this conclusion.

In several ways, the findings of Study 1 correspond to those of Buma et al. (2015) with elite musicians. Most important, for elite musicians as well as students of a music academy, music-related focus appears to be the first priority when performing under pressure. Statements like “I try to enjoy the music” and “I try to carry forward the idea of the composer” illustrate this focus. However, in contrast to elite musicians, the music students also showed a considerable percentage of worries and disturbing thoughts (26.1% vs. 5.8%) such as “I don’t want to make a mistake” and “I think: Why does that person move her feet all the time?” The relatively high percentage of worries and disturbing thoughts in the music students is in agreement with findings in several other studies on music and other performance areas (Kenny & Osborne, 2006; Osborne & Kenny, 2008; Oudejans et al., 2011; Steptoe & Fidler, 1987).

The notable focus on worries and disturbing thoughts may also explain why music students focused less on “thoughts that give confidence” compared to elite musicians (8.3% vs. 16.8%). Examples of statements in this category were “I will finish the piece successfully” and “Just go for it!” These thoughts can be considered as “positive self-talk”, which are statements people make to themselves to help “staying focused, not to dwell on past mistakes or project far in the future” (Hatzigeorgiadis, Theodorakis, & Zourbanos, 2004, p. 138). One of the functions of positive self-talk is to influence attentional focus (Hardy, 2006; Hatzigeorgiadis et al., 2004).

The percentage of worries and disturbing thoughts in the verbal report data was even larger at the moment just before choking under pressure compared to playing under pressure in general, although the difference was not significant. Furthermore, a considerable larger percentage of statements was found in the category “other”, of which the majority was about a “loss of focus”. Along with a decrease in focus on physical aspects, thoughts that give confidence and music-related information, these statements indicate that music students have less attention on task-relevant information at the moment just before choking. In other words, it seems that choking under pressure in music students occurs when they are distracted and the main part of their focus shifts to task-irrelevant information. This is in line with the literature on choking. As explained in the introduction, during playing under pressure, musicians can experience feelings of anxiety. This anxiety can lead to a shift in attention from task-relevant towards task-irrelevant information leading to a drop in performance (Eysenck et al., 2007; Lehmann, Sloboda, & Woody, 2007; Nibbeling et al., 2012; Nieuwenhuys & Oudejans, 2012; Oudejans et al., 2011).

When choking under pressure occurs (e.g., a mistake is made), it is essential to get back on track as soon as possible. It seems that music students barely focus on task-irrelevant worries and disturbing thoughts during such a recovery phase. Moreover, music-related focus increases drastically. To a lesser extent, the focus on physical aspects and thoughts that give confidence also increase. It seems that the latter three changes in focus together seem to be task-relevant and have an important role in recovering performance after a mistake. On top of that, during recovery music students seem to spread their focus of attention in a comparable way as the elite musicians under pressure in general (Buma et al., 2015). Apparently elite musicians have learned, over their extensive careers (over 20 years in the study of Buma et al., 2015), to stay focused on task-relevant information when playing under pressure. In addition, they manage to suppress task-irrelevant attention on, for instance, worries and disturbing thoughts despite the pressure. To find out if and how the focus of attention of music students changes over time, a longitudinal study is recommended.

Interventions for music students to reduce or prevent the negative impact of pressure and anxiety on performance could focus on reducing or dealing with anxiety. Such an approach has been shown to have potential (Kenny, 2005, 2011; Nicholls & Polman, 2007; Smith & Smoll, 2004). Still, taking away the pressure at an elite level seems unrealistic as the importance of good performance will always be substantial, just as the risk on worries and disturbing thoughts that consume attention at the cost of attention for task-relevant information. Alternatively, interventions could focus on maintaining the proper attentional balance also under pressure (e.g., Kirchner, 2011).

There is already evidence that focus of attention can be trained. Van der Loo (2008) found positive effects of attentional control training on stage fright and on the focus of attention in music students. After the training, focus was less self-centred (i.e., directed to the musician himself) and more on task-relevant information. Furthermore, Hoffman and Hanrahan (2012) found that anxiety decreased and performance level was enhanced after their training sessions. A similar performance enhancement was also found in aiming tasks when subjects were taught to fixate their gaze sufficiently long on the target (e.g., Vine, Moore, & Wilson, 2011; Wood & Wilson, 2012). Results of these studies indicate that focus of attention can be trained, resulting in an efficient focus of attention during playing under pressure. Therefore, we recommend to subject music students that have problems with focusing attention on task-relevant information to such training programs, and teach them to focus attention on music-related information.

A different way to help students with performing under pressure may be rehearsing with induced anxiety. It appeared that after training with elevated levels of anxiety earlier drops in performance could be prevented under high anxiety in sports-related tasks (Oudejans & Pijpers, 2009, 2010) as well as in a shooting task performed by police officers (Nieuwenhuys & Oudejans, 2011). In the latter study, improved performance was accompanied by restored visual attention to the target. These findings suggest that training with anxiety provides a helpful method for preventing choking under pressure during an important performance. Music students can also implement elevated levels of anxiety in their rehearsal (e.g., by playing in front of an audience, recording the rehearsal with a camera, and letting experienced critics judge the rehearsal). By doing so, music students may learn to perform with anxiety and reduce chances of choking under pressure. The potential of such training in music is shown by Williamon, Aufegger, and Eiholzer (2014), who tested how simulated performance environments are experienced by music students. Williamon et al. showed that performing with a simulated audience or simulated panel of expert judges led to realistic experiences and levels of anxiety comparable to those during a real audition. Since music students already reported their need for support in learning to deal with anxiety (Fehm & Schmidt, 2006), it is recommended to examine if such training interventions are indeed helpful, also in improving music performance.

Note that there were also several limitations. First, data were obtained using retrospective self-report, with its obvious limitations, such as problems with precise recall of situations under pressure. Second, and relatedly, participants were asked to imagine themselves in a scenario when playing under pressure while they were detached from the actual playing environment, which may also have affected their recall. However, music students have relevant experience with situations in which they have to play under pressure such as regular auditions and performances, so it may be expected that in general terms participants were able to relate to the situation sketched. Third, to gain insights into thoughts and attention of musicians during performance there are not many alternatives, although it would be good in future studies, to try to replicate our findings using verbal reports immediately after performances, both after playing well and after choking under pressure. Fourth, we tested a relatively low number of participants, especially in Study 2, and as the data were not normally distributed we had to resort to

non-parametric testing. Fifth, the study focused on (shifts of) attention during performance as a potential mechanism to explain choking under pressure. Although focus of attention on music-related information is definitely important for performing under pressure, and it is likely that a lack thereof may result in choking, we should bear in mind that we did not demonstrate causal relationships. Moreover, note that performance deterioration under pressure will most likely be a result of an interaction between various personal (e.g., individual differences), cognitive (e.g., focus of attention, memory) and situational factors (e.g., audience presence, value attributed to performance). All in all, it is obvious that we have to handle the results with some caution and that definite conclusions cannot be drawn. Nevertheless, combining the results of Study 1 and Study 2 and those of Buma et al. (2015) with elite musicians leads to a rather consistent pattern of results. Still, if interventions are advised that teach students to focus attention on music-related information, studies into the effects of those interventions are required. Furthermore, “music-related” remains a rather broad concept. Future studies are needed to further specify what music-related information is.

To conclude, it was found that music students show a notable music-related focus and a considerable percentage of worries and disturbing thoughts during playing under pressure in general. This percentage of worries and disturbing thoughts seems to increase at the moment just before choking under pressure, indicating that music students are distracted from focusing on task-relevant information just before making a mistake. To recover after this mistake, music students try to direct their focus back to the music. To a lesser extent, they also focus on physical aspects and induce thoughts that give confidence. Since worries and disturbing thoughts frequently occur during playing under pressure and just before choking under pressure, it seems that progress can be made in the performance of music students. It is advisable to help music students with improving their performance, for example, by attentional control training or providing training with elevated levels of anxiety.

Ethical approval

Ethical approval for this project was given by the ethics committee of the Faculty of Human Movement Sciences, Vrije Universiteit Amsterdam [ref number 2012-38].

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