Towards a Better Understanding of Performance Under Pressure: A Longitudinal Field Experiment Among Ballet Dancers

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Preface

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Disclaimer

A thesis is an aptitude test for students. The approval of the thesis is proof that the student has sufficient research and reporting skills to graduate, but does not guarantee the quality of the research and the results of the research as such. The thesis is therefore not necessarily suitable to be used as an academic source to refer to. If you would like to know more about the research discussed in this thesis and any publications based on it, to which you could refer, please contact the supervisor mentioned.

Abstract

In high-pressure situations, athletes aspire a maximized overlap between potential and actual performance. However, under pressure they are often not able to perform to their potential, witnessing performance losses. Cognitive distraction presumably plays a predictive role, thereby. Putatively reducing such distraction, mental practice may enhance athletes' performance under pressure. A longitudinal field experiment, including eight measurement time points covering baseline, intervention, and control conditions plus pressure versus non-pressure contexts, tested this moderated mediation. The sample consisted of 25 amateur ballet dancers (92% female; M = 24.36 years) from a Dutch ballet school. Against anticipations and past research, the applied mental practice intervention remained ineffective and a mediated perceived pressure-cognitive distraction-performance link was not supported. Potential reasons for these findings are considered, including a) sampled dancers not experiencing performance losses in high-pressure situations, b) participants' independent, study-unrelated visualization tendencies, c) sub-optimal implementation of the administered intervention. The outcomes' theoretical and practical implications, the study's strengths and limitations, and future research directions are discussed.

Keywords: performance, perceived pressure, cognitive distraction, mental practice, classical ballet dance, longitudinal field experiment

Towards a Better Understanding of Performance Under Pressure: A Longitudinal Field Experiment Among Ballet Dancers

Observable performance ranks among the most important behavioral outcomes for athletes across sport disciplines, holding the potential to decisively impinge on their athletic goal pursuit, achievements, and individualized development (Lerner & Lerner, 2007; Moran & Toner, 2017b; Raysmith et al., 2019; van Yperen, 2021). Consequently, athletes often aspire a maximized overlap between their potential and actual performance, particularly in high-pressure situations (e.g., competitions, public performances; see Beilock et al., 2017; Browne & Mahoney, 1984; Lochbaum et al., 2022; van Yperen, 2022a, 2022b). However, precisely in those contexts athletes are oftentimes not able to perform to their potential, exhibiting considerable declines in performance (Gray, 2020; Mesagno & Hill, 2013). These performance losses presumably rest upon athletes' reaction to the high-pressure situation (Jamieson, 2017). That is, under perceived pressure their attentional focus apparently shifts to task-irrelevant cues, away from the performance task at hand (Mesagno & Beckmann, 2017). The resulting increased cognitive distraction (Araújo et al., 2020; Gray, 2020; Moran, 1996), then, undermines their actual performance (Beauchamp et al., 2023; Baumeister, 1984; Mesagno et al., 2015a; Roberts et al., 2019). Yet, such pressure contexts inevitably belong to athletic careers, regardless of athletes' expertise (Roberts et al., 2019). Therefore, it is essential to counteract perceived pressure's adverse impact on athletes' cognition to maintain typical performance standards. For this purpose, mental practice appears particularly valuable. It was not only corroborated to robustly enhance athletes' actual performance (Driskell et al., 1994, Gröpel & Mesagno, 2019; Ladda et al., 2021; Toth et al., 2020). Preliminary empirical evidence also points to its potential to reduce cognitive distraction (Gröpel & Mesagno, 2019; Weinberg, 2008). The present study strived towards investigating the relationship between perceived pressure and performance within the popular, yet hardly explored sport of classical

ballet. Apart from the well-established direct associations between the main concepts of interest, a rarely scrutinized research model comprehensively capturing their interplay within a moderated mediation was examined.

Theoretical and Scientific Background

Exploring this research model requires clarifying its core concepts' meaning. In sport science and athletic practice, *performance* not only represents the mere engagement in a sport-related task[1] within the context of a particular athletic discipline (Browne & Mahoney, 1984). It also involves the diverse cognitive-behavioral responses generated throughout task engagement that lead to particular outcomes (e.g., win, loss, personal record, required time; Beauchamp et al., 2023; Lochbaum et al., 2022). Accordingly, it indirectly captures the quality of the exercise's completion (Raysmith et al., 2019). Therefore, athletic performance is considered multi-dimensional, being shaped by differing influential factors (e.g., physiological, psychological, technical; Moran & Toner, 2017a; Lerner & Lerner, 2007). But what determines athletes' performance in high-pressure situations?

Performance as a Function of Perceived Pressure and Cognitive Distraction

Past scientific theory and research proposed two concepts playing a key role in answering this question. The first one, *perceived pressure*, rests upon differentiating between a pressure situation and pressure reaction (Moran & Toner, 2017b). This means that not the external performance context, but rather an athlete's subjective interpretation of those objective circumstances gives rise to experiencing pressure (Jamieson, 2017; Jamieson et al., 2012, 2013). According to the appraisal theory of emotion (Lazarus, 1991; Lazarus & Folkman, 1984) or the biopsychosocial model of challenge and threat (e.g., Blascovich, 1992; Blascovich & Tomaka, 1996; Tomaka et al., 1993), people likely put themselves under

[1] A sport-related task could, for example, be a specific movement or movement sequence. In the investigated realm of classical dance this could be a single pirouette up to an entire choreography.

pressure if perceiving a discrepancy between situational demands and personal capabilities, especially if the former exceed the latter. In sport, the resulting pressure perceptions might arise when performing in competitive or evaluative contexts, in front of an audience, expecting performance-contingent rewards or punishments, or ascribing high personal relevance to performance outcomes (Gröpel & Mesagno, 2019).

Perceived pressure was substantiated to adversely impact on athletes' performance (Beauchamp et al., 2023; Beilock et al., 2017; Gray, 2020; Moran & Toner, 2017b). That is, despite their capability[2] and motivation to perform optimally, athletes tend to exhibit considerably lower performance levels under pressure. This phenomenon, termed choking under pressure, was corroborated across sport disciplines plus performers' ages and expertise levels (Gröpel & Mesagno, 2019; Mesagno & Hill, 2013; Roberts et al., 2019).

A second factor similarly affecting athletic performance is *cognitive distraction*. It implies a vulnerability of athletes' attention to interference by internal (e.g., emotions, thoughts) or external (e.g., environment, noise) distractors (Roberts et al., 2019). Correspondingly, it describes a shift of performers' attentional focus from the task at hand to task-irrelevant cues (Browne & Mahoney, 1984; Moran & Toner, 2017c).

The resulting decreased task focus and loss of concentration were shown to relate negatively to performance across a multitude of athletic tasks and disciplines (Beauchamp et al., 2023; Moran, 2014; Moran & Toner, 2017c; Wulf & Lewthwaite, 2020). Accordingly, cognitive distraction was increasingly considered as a second predictor of deteriorated performance under pressure within scientific theory and investigations (Baumeister, 1984; Englert & Oudejans, 2014; Gröpel & Mesagno, 2019; Mesagno et al., 2015a; Roberts et al., 2019).

[2] An athlete's capability to perform could be estimated considering their individual skill level and usual performance standard (Gröpel & Mesagno, 2019; Mesagno & Hill, 2013; Roberts et al., 2019).

Apart from their well-established, predominantly separately examined impacts on athletic performance, perceived pressure and cognitive distraction turned out to be associated as well. Thereby, a heightened amount of perceived pressure appears to come along with increased cognitive distraction as an athlete's reaction to the high-pressure situation (Araújo et al., 2020; Browne & Mahoney, 1984; Gray, 2020; Jamieson, 2017; Moran, 1996; Moran & Toner, 2017b, 2017c; Roberts et al., 2019). These patterns of previous research findings raise the question whether perceived pressure and cognitive distraction function as independent predictors of actual performance in pressure contexts or whether they potentially shape this outcome synergistically. Attention- and distraction-based theories of choking under pressure, in fact, entail the idea of perceived pressure exerting its adverse effects on athletic performance indirectly by stimulating heightened cognitive distraction (Gray, 2020; Gröpel & Mesagno, 2019; Mesagno & Beckmann, 2017). Despite a lack of causal understanding and need for clarifying explorations (Beauchamp et al., 2023; Roberts et al., 2019), hardly any investigations addressed this opportunity of cognitive distraction mediating the negative pressure-performance link by now (e.g., Englert & Oudejans, 2014). Therefore, the present study intended to foster closing this knowledge gap, testing a fully mediated perceived pressure-cognitive distraction-performance relationship.

Mental Practice as a Means to Enhance Performance

Building upon these theoretical deliberations, it is most relevant for the individual athlete's real-world success to become able to manage task-irrelevant distractions and maintain established performance levels in high-pressure situations (Janelle et al., 2020; Mesagno & Mullane-Grant, 2010). Thus, it is crucial to identify interventions effectively helping athletes to do so (Lochbaum et al., 2022).

One such technique is *mental practice*, the process of cognitively rehearsing an action without executing the associated overt physical movements (Driskell et al., 1994). Across

various sport disciplines and skill levels (Simonsmeier et al., 2021; Taktek, 2004; Weinberg, 2008), mental practice was demonstrated to robustly maintain or enhance athletes' actual performance under pressure (Toth et al., 2020). Additionally, primary evidence suggested mental practice to possibly reduce cognitive distraction (Gröpel & Mesagno, 2019; Moran, 2009) as it appeared to facilitate mental skills like concentration (Simonsmeier et al., 2021; Taktek, 2004, Weinberg, 2008).

Yet, it remains unclear how mental practice's impact on sport performance comes about. Although scientific knowledge indicates direct positive effects of mental practice on athletes' cognition and performance separately, hardly any studies explored how these beneficial outcomes might be intertwined in high-pressure contexts (e.g., Guillot & Collet, 2008). Therefore, the present study examined a mental practice intervention's potential to negatively moderate the positive association between perceived pressure and cognitive distraction, thereby preventing performance decrements.

The PETTLEP Model. A well-established framework for mental practice interventions is the PETTLEP approach (Holmes & Collins, 2001). This model was developed to foster high-quality, impactful mental imagery interventions, providing an evidence-based guideline for their design (Collins & Carson, 2017; Smith et al., 2007). Based on the theoretical concept of functional equivalence (e.g., Finke, 1979; Jeannord, 1994), the PETTLEP model assumes that imagery practices should simulate actual performances as vividly as possible to optimize their efficacy in promoting real-world performance (Wakefield et al., 2013). To ensure maximized resemblance, seven distinct components should be considered when mentally practicing a performance. Those pertain to the performance's unique physical (e.g., physiological responses), environment- (e.g., noise), task- (e.g., movement), timing- (e.g., real-time), and learning-related (e.g., skill level) plus emotional and

perspective (e.g., through own eyes) characteristics (Smith et al., 2007; Wakefield et al., 2013).

This framework was applied across numerous sport disciplines and other applied settings (e.g., Battaglia et al., 2014; Smith et al., 2007; Smith et al., 2020; Wright & Smith, 2009), reliably facilitating measurable performance improvements (Collins & Carson, 2017; Wakefield et al., 2013; Wakefield & Smith, 2012; Wright et al, 2014). Whereas previous PETTLEP-derived interventions tended to be strongly individualized, regularly adapted, and rather time- and effort-intensive (Wakefield & Smith, 2012; e.g., Battaglia et al., 2014), the present study strived to test a more general format of PETTLEP-based mental practice. While still enabling personalized visualization, it aimed at an expanded scope of such intervention's application within a large number of athletes due to minimized preparatory, concomitant, or posterior investments.

A Novel Context of Investigation

A group of athletes only infrequently targeted within research regarding choking or performance enhancement are classical ballet dancers (Pavlik & Nordin-Bates, 2016). Yet, regularly facing high-pressure situations like public performances, these athletes could substantially benefit from interventions helping them to perform to their potential. Similarly, whereas scientific attention majorly focused on highly skilled expert performers, recreational athletes were hardly addressed (e.g., Röthlin et al., 2016). However, regardless of skill level, all athletes likely face personally pressuring performance contexts throughout their athletic career (Roberts et al., 2019). Therefore, they all should be entitled to receive evidence-based interventions effectively reducing cognitive distraction and maintaining their performance level under perceived pressure. In line, mental skills training was found to be highly valuable for athletes across all experience and performance levels (Driven to Peak Consulting, 2020;

Jaenes et al., 2021). Against this backdrop, the present investigations specifically focused on the target group of amateur classical ballet dancers.

The Present Study

The present study explored the link between non-professional ballet dancers' perceived pressure and performance. It was hypothesized that the more pressure dancers experience, the more cognitive distraction emerges, and the lower dancers' performance level. Hence, an indirect negative relationship between perceived pressure and performance was proposed, fully mediated by cognitive distraction. Furthermore, it was assumed that the more mental practice dancers engage in, the less cognitive distraction arises under pressure, and the higher performance levels are reached. Thus, mental practice was anticipated to moderate the association between perceived pressure and cognitive distraction, positively impinging on actual performance as a PETTLEP-based intervention. A visual overview of the main concepts and their anticipated interrelations is provided in Figure 1.

Method

Participants

A power analysis was conducted prior to sampling and data collection to determine an adequate sample size for the research project (see Appendix A; Faul et al., 2007, 2009). The program G*Power 3.1 was used, considering the intended main analysis approach of a mixed analysis of variance (ANOVA). This resulted in a suggested sample size of at least 16 participants.

Based on the power analysis' outcomes, 28 amateur ballet dancers[3] from a Dutch dance school practicing for and eventually performing a public dance performance were recruited. Three of these 28 participants needed to be excluded because they did not complete

[3] Amateur ballet dancers were defined as dancers engaging in the sport as a recreational, but not a vocational activity.

the first questionnaire[4], resulting in a final sample of $N = 25$. On average, participants were $M = 24.36$ ($SD = 5.48$) years old and active in the ballet sport for $M = 16.48$ ($SD = 6.87$) years. Females accounted for 92% of the sample and males for 8%. Moreover, 88% of all participants were Dutch and 12% of other nationalities, entailing a distribution of native languages of 88% Dutch, 4% English, and 8% other. Participants' occupational status ranged from 8% high-school students, 52% university students, 36% employed, and 4% other.

Procedure

Preparation

The study itself started by acquiring ethical approval from the Ethical Committee of the Faculty of Behavioural and Social Sciences at the University of Groningen (Dos.nr. PSY-2122-S-0136). Subsequently, the sampling procedure began. People from six distinct ballet classes of a Dutch dance school practicing for and eventually performing a public dance performance were approached for this purpose. The ballet dancers were informed about the study and, in case they agreed to participate, their email addresses recorded[5]. Participants were also assigned an individual research number[6] and provided with a research flyer, summarizing the study's details and enlisting the researchers' contact information (see Appendix B). Requirements for participation were being at least 16 years old, an amateur ballet dancer, and having had at least one year of ballet dance practice. No incentive for participation was offered other than the opportunity to get a summary of the results after the study finished.

Data Collection

[4] Completing the first questionnaire was a requirement as informed consent and demographic data were asked for within.
[5] Noting participants' email addresses was necessary to provide them with the respective digital research questionnaires throughout the study.
[6] The research numbers assisted in organizing the obtained data across the study's eight measurement points.

Upon completing the sampling procedure data collection started, lasting a period of five weeks. Eight measurement points (T1 to T8) were scheduled across baseline, intervention, and control conditions as well as training and public performance situations, implying the study design to resemble a longitudinal field experiment[7]. More detail about the study's exact timeline and the respective measurement points' contexts (i.e., baseline, control, or intervention and pressure or non-pressure) provides Table 1.

Baseline Procedure. For the baseline condition (i.e., T1 to T3) participants were required to attend their dance classes as usual. They were asked to undergo their common warm-up phase and dance choreography rehearsal. With the conclusion of their dance practice, participants were sent an online self-questionnaire together with a reminder of their individual research number via email. Within the first questionnaire, participants were required to indicate their research number first. Then, some questions ensuring the fulfillment of participation requirements appeared. This was followed by informed consent, being an adapted version of the one applied by Sanders (2020). After active agreement to participate, some questions regarding participants' habitual employment of visualization in the ballet context were displayed. The questions were randomly ordered and administered for controlling reasons. Questions in a random order concerning both perceived pressure and cognitive distraction followed. Afterwards, performance self-evaluation was asked for with the questions once again being randomly ordered. Finally, the questionnaire closed with some demographic assessments like gender, nationality, native language, and occupational status. The content and order of the questionnaires administered at the other two baseline measurement points (i.e., T2 and T3) were similar, though without the questions regarding

[7] A longitudinal framework was specifically decided on to increase the study's power regardless of potential difficulties reaching multiple participants.

participation requirement, informed consent, habitual employment of visualization in the ballet dance context, and the demographic assessments.

Experimental Procedure. Succeeding the baseline condition (i.e., T1 toT3), the study's experimental conditions were implemented (i.e., T4 to T8). The six participating dance groups were randomly distributed to either the intervention or control condition after T3 for this purpose. This engendered three of the six ballet classes to belong to the intervention condition, resulting in a group size of $n = 14$. The other three ballet classes constituted the control group, accounting for a sample size of $n = 11$.

Within the intervention condition participants were required to attend their dance practice and the public performances as prescribed by the dance school. They were asked to 1) engage in some warm-up practices, 2) complete the intervention task, 3) rehearse respectively eventually perform their choreography in front of a public, and 4) fill out an online questionnaire ensuing their dance class or public performance. Thereby, the intervention task was equal across the remaining five measurement points. It consisted of a short written script inspired and adapted from both the one used by Smith and Holmes (2004) and by Smith and colleagues (2020). Based on the PETTLEP approach, this script instructed participants of the intervention group to imagine their dance performance as vividly as possible (see Appendix C). For the questionnaires the same ones as administered at baseline conditions T2 and T3 were used. The only addition was some manipulation checks in random order after the questions concerning participants' self-evaluated performance. Regarding the questionnaire of T8, a further amendment was the inclusion of a debriefing on the last page, explaining the study's purpose and expectations.

The control condition resembled the intervention one, overall. The only distinction was the administration of a filler task instead of the intervention one. Hence, participants of the control group were asked to participate in their dance practice and the public

performances as determined by the dance school. During their dance classes and on the days of their public performances they were required to 1) engage in some warm-up, 2) complete the filler task, 3) rehearse respectively eventually perform their choreography in front of a public, and 4) fill out an online questionnaire ensuing their dance class or public performance. The filler task, thereby, took the form of a short story by Chan (2018) separated into five parts, with each part ending with a question that instructed participants to reflect on a specific story component (see Appendix C). The parts were provided one after another across the remaining control measurement points. This implied participants of the control condition only to have read the complete short story after T8. The questionnaires were the same as administered in the intervention condition.

Manipulation Check

The success of the mental practice intervention was checked through six items picking up phrases from the intervention script at all intervention respectively control conditions (i.e., T4 to T8). Since the script built upon the PETTLEP approach, the six questions (see Appendix D) focused on distinct aspects of the model. For example, the item stem *when I received the imagination instructions…* was displayed with items like *…I envisioned my emotional reaction to dancing the choreography (e.g., excitement, nervousness, stress, etc.)*. The answer format resembled a five-point Likert scale, ranging from 1 (*strongly disagree*) over 3 (*neither agree nor disagree*) to 5 (*strongly agree*). This entailed higher scores corresponding to elevated mental practices. To get measurement point specific indices of participants' PETTLEP-based mental practice, the six manipulation check items were averaged pertaining to the respective measurement points. Cronbach's alpha ranged from .73 (T5) to .89 (T4). A general mental practice index across measurement points was calculated by averaging the six manipulation check items across all measurement points. Cronbach's alpha of the 5 x 6 = 30 items reached .95.

Measures

Similar to the manipulation check being performed via self-questionnaires, the study's other variables were, likewise, assessed by means of some self-questionnaires. For each measure, missing values were filled in with the measurement point specific average of the respective item.

Perceived Pressure

To measure participants' perceived pressure, three adapted items of the Cognitive-Somatic Anxiety Questionnaire were administered (see Appendix D, DeGood & Tait, 1987). Relying on the item stem *while performing the ballet choreography…* questions like …*I felt under pressure* were asked. The answer format took the form of a five-point Likert scale, ranging from 1 (*not at all*) over 3 (*a moderate amount*) to 5 (*a great deal*). Accordingly, higher scores resembled heightened pressure experiences. To yield a measurement point specific perceived pressure index, the three perceived pressure items were averaged measurement point respective. Cronbach's alpha ranged from .74 (T2) to .93 (T3). A general perceived pressure index was calculated by averaging all perceived pressure items across all measurement points. For these 8 x 3 = 24 perceived pressure items Cronbach's alpha equaled .93.

Cognitive Distraction

Also for the assessment of participants' cognitive distraction, the Cognitive-Somatic Anxiety Questionnaire was applied (DeGood & Tait, 1987). Three items of the scale were extracted and adapted for this purpose (see Appendix D). The phrase *while performing the ballet choreography…* represented the item stem, being accompanied by items like *…I found it difficult to concentrate*. A five-point Likert scale functioned as the answer format, ranging from 1 (*not at all*) over 3 (*a moderate amount*) to 5 (*a great deal*). Again, this implied higher scores to indicate enhanced cognitive distraction. For measurement point specific cognitive

distraction indices, the three cognitive distraction items concerning the respective measurement points were averaged. Cronbach's alpha ranged from .65 (T1) to .89 (T3). A general cognitive distraction index irrespective of measurement points was calculated by averaging all cognitive distraction-focused items across measurement points. Cronbach's alpha of these 8 x 3 = 24 cognitive distraction items reached .90.

Performance

Participants' performance was measured through six items created from published criteria used in official dance auditions and competitions (see Appendix D; Cab Calloway School of the Arts, 2021; Royal Academy of Dance, 2020; Scottish Qualification Authority, 2017; Victorian Curriculum and Assessment Authority, 2012). For instance, items like *Physical Instrument: How was my alignment/posture, turn out, feet, and port de bras?* were displayed. The answer format resembled a five-point Likert scale with response options from 1 (*terrible*) over 3 (*average*) to 5 (*excellent*). Correspondingly, higher scores indicated better performance from a self-evaluative perspective. To calculate measurement point pertaining performance indices, the six items respective to measurement points were averaged. Cronbach's alpha ranged from .58 (T2) to .91 (T4). A further general performance index across measurement points was calculated by averaging all performance items irrespective of measurement points. Cronbach's alpha of the 8 x 6 = 48 performance items resembled .95.

Results

Descriptive Statistics

A summarized overview of the entire descriptive data is presented in Table 2 and 3. Thereby, the previously created general indexes across measurement points were used as the basis for calculations. The primarily inspected bivariate intercorrelations between these main variables of interest (i.e., perceived pressure, cognitive distraction, performance, and mental practice) predominantly corroborated the proposed research model's predictions (see Figure

1)[8]. Specifically, the independent variable of perceived pressure significantly positively correlated with the hypothesized mediator of cognitive distraction (r = .57, p < .01), which in turn exhibited a significant link to the outcome of performance in the anticipated negative direction (r = -.57, p < .01). These patterns of correlations portended the link between perceived pressure and performance to be mediated by cognitive distraction as predicted. Nevertheless, participating dancers' pressure perception unexpectedly showed a non-significant negatively directed association with the dependent variable of performance (r = -.27, p = .19). The assumed moderating effect of mental practice on the connection between pressure perception and cognitive distraction was largely substantiated by the zero-order correlations. Mental practice was significantly negatively associated with cognitive distraction as anticipated (r = -.40, p < .05) and depicted a considerable significant link to the outcome of performance in the expected positive direction (r = .76, p < .01). However, only a non-significant correlation with the predictor of perceived pressure emerged, yet displaying the hypothesized negative direction (r = -.18, p = .38).

Table 2 also shows that dancers' age was significantly negatively associated with the major variables of mental practice (r = -.47, p = .02) and performance (r = -.50, p = .01). Additionally, the tendency to independently visualize ballet movement sequences at home (visualization home) was significantly negatively related to cognitive distraction (r = -.45, p = .03) and positively to performance (r = .43, p = .03). The conduction of the same behavior during (visualization during training) and after training sessions (visualization after training) both were significantly positively linked to mental practice (r = .55, p < .01; r = .56, p < .01). Visualizing choreographies prior to public performances (visualization public performance), likewise, showed a significant negative relationship with perceived pressure (r = -.50, p = .01) and cognitive distraction (r = -.45, p = .02).

[8] All analyses associated with the present investigated research model were based on two-sided tests.

One-way ANOVAs (see Table 3) revealed no links between participants' gender, nationality, native language, and occupational status, on the one hand, and any of the main variables of interest, on the other. Therefore, solely participants' age and self-assessed amount of visualization home, visualization during training, visualization after training, and visualization public performance were included as covariates throughout the remaining analyses.

Manipulation Check

To check the applied experimental manipulation's success (i.e., intervention versus filler task), one-way ANOVAs were conducted. It was inspected whether differences in participants' engagement in mental practice as a pre-performance routine emerged between the two groups at both T4 (i.e., non-pressure context) and T5 to T8 (i.e., pressure contexts). Contrary to expectations, the intervention and control group did not differ in their average amount of mental practice, neither at T4 ($F(1, 24) = 2.94$, $p = .10$) nor at T5 ($F(1, 24) = .34$, $p = .568$), T6 ($F(1, 24) = 1.80$, $p = .19$), T7 ($F(1, 24) = .58$, $p = .46$), or T8 ($F(1, 24) = 2.76$, $p = .11$). In correspondence, the anticipated between-group differences also did not emerge for the general mental practice index across these five measurement time points ($F(1, 24) = 2.14$, $p = .16$). Therefore, it was concluded that the applied intervention did not work and the manipulation remained non-successful.

Yet, exploratory inspections of contrasts revealed that, in line with expectations, participants having received the intervention task, on average, scored non-significantly higher ($M = 3.64$, $SD = .43$) on the mental practice manipulation check across the five measurement time points (i.e., T4 to T8) than those having obtained the filler task ($M = 3,18$, $SD = 1.09$). The same non-significant tendency held true when inspecting each non-pressure (i.e., T4) and pressure (i.e., T5, T6, T7, and T8) context separately.

Testing the Intervention's Effect

Despite the failure of the manipulation check, it was tested whether the two experimental conditions (i.e., intervention versus control) as well as time[9] had an effect on participants' perceived pressure, cognitive distraction, and performance. All three two-way mixed ANOVAs included participants' group membership as a two-level between-subject factor. Time was treated as an eight-level (i.e., T1 to T8) within-subject factor with repeated measurements on perceived pressure, cognitive distraction, and performance, respectively. Additionally, the established covariates were included. Checking the data's congruence with the statistical assumptions underlying mixed ANOVAs confirmed the data's adequacy for this analysis approach (see Appendix E).

Main Analyses

Perceived Pressure. In line with the manipulation check, yet still against primary expectations, the between-subjects factor of experimental condition exerted no significant effect on dancers' perceived pressure ($F(1, 18) = .12$, $p = .73$). That is, the two groups of participants seemingly did not differ on their average scores on perceived pressure across all eight time points. However, in correspondence with the anticipated directions, exploratory pairwise comparisons revealed that the intervention group ($M = 2.28$, $SD = .14$) witnessed marginally and non-significantly less perceived pressure than the control group ($M = 2.36$, $SD = .16$). Moreover, the experimental manipulation unexpectedly did not interact with the within-subject factor of time ($F(7, 126) = 1.28$, $p = .26$). Also contrary to anticipations, time did not show a significant effect on perceived pressure across both experimental conditions ($F(7, 126) = 0.60$, $p = .76$).

Cognitive Distraction. Running the same two-way mixed ANOVA with cognitive distraction as the dependent variable yielded similar findings. The impact of participants'

[9] Not time in itself, but rather performance contexts varying over time were anticipated to show an impact on participants' perceived pressure, cognitive distraction, and performance.

group membership on their average cognitive distraction was non-significant ($F(1, 18) = .10$, $p = .76$). Exploratory pairwise comparisons showed that both groups reported an almost identical mean degree of cognitive distraction (intervention: $M = 1.68$, $SD = .10$; control: $M = 1.73$, $SD = .11$) across all eight measurement time points. Furthermore, the experimental manipulation again did not interact with the within-subject factor of time to shape participants' cognitive distraction ($F(6.69, 1) = 1.10$, $p = .37$). Also, across both groups of participants, the main effect of time on cognitive distraction was non-significant ($F(6.69, 1) = 1.18$, $p = .32$).

Performance. Reiterating the same two-way mixed ANOVA a third time including performance as the dependent variable resulted in similar patterns of outcomes. The between-subject factor and, thus, the experimental manipulation did not have the expected significant influence on participants' performance ($F(1, 18) = 1.89$, $p = .19$). Hence, the two groups of dancers seemingly did not differ on their average evaluations of their own dance performance across the eight measurement time points. Yet, in accordance with the experiment's preliminary propositions, exploratory pairwise comparisons pointed out that those dancers within the intervention condition, on average, rated their performance slightly better ($M = 3.64$, $SD = .08$) than those within the control condition ($M = 3.47$, $SD = .09$). Additionally, group membership again did not interact with the within-subject factor of time to regulate participants' self-assessed performance ($F(6.45, 1) = 1.27$, $p = .27$). Across experimental conditions, the effect of time on self-rated performance only almost reached significance ($F(6.45, 1) = 1.95$, $p = .07$).

Exploratory Analyses Without Covariates

For exploratory purposes, the same three two-way mixed ANOVAs were rerun without the previously identified potential covariates. These analyses brought about one particular alteration in results. The within-subject factor of time had a significant main effect

on each of the three dependent variables, hinting at significant differences in all participants' average perceived pressure ($F(7, 161) = 6.75$, $p < .01$), cognitive distraction ($F(5.681, 1) = 2.57$, $p = .02$), and self-rated performance ($F(4.88, 1) = 10.54$, $p < .01$) across time points. Follow-up pairwise comparisons, then, clarified at which of the eight measurement time points exactly participants reported significantly different as well as higher or lower mean degrees of perceived pressure, cognitive distraction, and performance. The associated variation in average ratings on each dependent variable over time combined with an indication of those means (i.e., T1 to T8) significantly differing from each other is visualized in Figures 2, 3, and 4, respectively.

Inspecting the three bar graphs revealed participants across both experimental conditions to apparently have experienced rather low average amounts of perceived pressure and cognitive distraction. Simultaneously, participants provided relatively high average performance ratings over time. These homogeneous tendencies in means emerged irrespective of predetermined changes in external pressure situations.

Testing the Research Model

Besides testing the experimental intervention's impact over time, the accuracy and validity of the proposed model of a moderated indirect effect of perceived pressure on dance performance (see Figure 1) was examined. For this purpose, a moderated mediation analysis with the identified covariates was carried out by means of the PROCESS macro as a software add-on in SPSS[10]. Specifically, PROCESS "Model 7" (Hayes, 2022) was utilized, applying a 95% confidence interval resting upon 5000 bootstrap samples. The data's adequacy for this analysis approach was verified by checking its congruence with the associated statistical assumptions (see Appendix E).

[10] The statistical analyses rested upon the general indexes pooling all measurements across measurement points. Despite different pressure contexts and experimental conditions underlying these indexes, this approach was valid as the intervention testing revealed no differences with regard to the variables of interest across experimental groups and time.

Main Analyses

Testing the model of a moderated mediation produced results that were in line with those obtained from the preceding analyses. Corresponding with the intervention's consistently non-significant impact on both the manipulation check and the three core variables of perceived pressure, cognitive distraction, and performance, a moderating effect of the experimental manipulation (i.e., mental practice) on the link between perceived pressure and cognitive distraction was not substantiated. Consequently, a reduced model across both experimental conditions was examined, exclusively testing the mediated relationship of perceived pressure to performance via cognitive distraction while controlling for the covariates. For that purpose, PROCESS "Model 4" (Hayes, 2022) was used, applying a 95% confidence interval resting upon 5000 bootstrap samples.

Testing this reduced model of a mediation (see Table 4 and Figure 4) unexpectedly did not confirm the proposed research model's associated suppositions. Perceived pressure exhibited no significant negative effect on performance, neither directly (c' = -.04, p = .78) nor indirectly via cognitive distraction (ab = -.07, 95% CI [-.28, .05]). Likewise, cognitive distraction did not function as a significant negative predictor of performance (b = -.24, p = .29). Only a marginally significant positive link between perceived pressure and cognitive distraction emerged (a = .30, p = .06). The mediation model as a whole reached significance (R^2 = .54, $F(7, 17)$ = 2.89, p = .04), though. Taken together, these results hardly empirically substantiated the full mediation hypothesized within the proposed research model (see Figure 1) and portended by the zero-order correlations (see Table 2). Nevertheless, each relation between the three key concepts displayed the anticipated direction.

Exploratory Analyses Without Covariates

Subsequent exploratory analyses reiterated the model testing by means of PROCESS "Model 7" and "Model 4" (Hayes, 2022) without the formerly established covariates. The

moderated mediation analysis yielded no substantially different results, still not empirically corroborating the proposed research model as a whole (see Figure 1). In contrast, rerunning the test of the reduced model of a mediation generated considerable changes in computational outcomes and inferential conclusions (see Figure 5). The proposed research model's supposition of a full mediation was empirically supported with perceived pressure exhibiting a significant negative effect on performance only indirectly via cognitive distraction (ab = -.23, 95% CI [-.46, -.06]), but not directly (c' = .05, p = .70). Correspondingly, perceived pressure turned out to function as a significant predictor of cognitive distraction (a = .43, p < .01) which, in turn, significantly negatively impacted on performance (b = -.53, p < .01). The mediation model as a whole reached significance again (R^2 = .33, $F(2, 22)$ = 5.33, p = .01).

Discussion

The present study explored the relationship between perceived pressure and performance within non-professional classical ballet. Two major assumptions were scrutinized: a fully mediated association between perceived pressure and performance, emerging indirectly via cognitive distraction, and a moderating influence of mental practice on the association between perceived pressure and cognitive distraction (see Figure 1).

A longitudinal field experiment, experimentally manipulating dancers' mental practice engagement, yielded no empirical support for the proposed interrelations. In line with the experimental groups not differing in reported mental practice at any time point, the implemented PETTLEP-based mental practice intervention turned out ineffective. That is, it failed to exert notable effects on dancers' perceived pressure, cognitive distraction, and performance, speaking against a moderating impact. Model testing did not substantiate mental practice's role as a moderator either. Similarly, no evidence was found for the perceived pressure-performance relationship emerging indirectly via cognitive distraction.

These results left the proposed research model without empirical support, neither corroborating the expected mediation nor moderation. Yet, although remaining non-significant across analytical approaches (i.e., intervention testing, model testing), the outcomes showed tendencies in anticipated directions. Moreover, explorative analyses not accounting for participants' age and study-independent visualization tendencies surprisingly confirmed a full mediation between perceived pressure, cognitive distraction, and performance across both experimental groups. These patterns also mirrored in the correlations between the four main variables (i.e., mental practice, perceived pressure, cognitive distraction, performance). Whereas zero-order correlations predominantly underpinned their interrelations as proposed, partial correlations controlling for the identified confounding variables still pointed within expected directions, but majorly turned non-significant.

Theoretical Implications

These findings strongly disagreed with past scientific theory and research. Previous investigations corroborated direct associations between a) perceived pressure and performance (e.g., Beauchamp et al., 2023; Gray, 2020), b) cognitive distraction and performance (e.g., Moran, 2014; Wulf & Lewthwaite, 2020), and c) perceived pressure and cognitive distraction (e.g., Araújo et al., 2020; Jamieson, 2017). Certain theories and primary evidence portended these established connections to form a mediation (e.g., Englert & Oudejans, 2014; Mesagno & Beckmann, 2017). Furthermore, mental practice's power to obviate performance losses under pressure was consistently verified (e.g., Simonsmeier et al., 2021; Toth et al., 2020). Preliminary evidence even hinted at its potential to reduce cognitive distraction (e.g., Gröpel & Mesagno, 2019; Moran, 2009). Consistently, PETTLEP-derived mental practice interventions were substantiated to beneficially impact on athletes' performance in high-pressure situations (e.g., Battaglia et al., 2014; Smith et al., 2020). This

evidence base, however, was not confirmed within amateur ballet dance throughout the present study.

Three explanations could account for these unexpected results. First, participants possibly did not experience the assumed increases in perceived pressure, perhaps not appraising the encountered performance situations as pressuring. Correspondingly, the expected rise in cognitive distraction and lowered performance levels would remain absent. The observed mean tendencies[11], non-significant perceived pressure-performance relationship, and ineffective mental practice intervention portend this supposition. Consequently, ballet dancers might react to pressure situations in a more effective, performance-facilitating way compared to other athletes. Future research needs to clarify whether dancers demonstrate a general tendency towards certain pressure reactions and how they differ from other athletes in this regard.

Believing that amateur ballet dancers are resistant to performance decrements under pressure seems inappropriate, though, because dancers were shown to display choking as well (e.g., Fryer, 2018). Therefore, second, participants potentially already engaged in a technique helping them to maintain their performance level under pressure. Specifically, their study-independent visualization tendencies not only had a notable impact on analytic results, possibly having provoked the anticipated relationships' absence. They maybe already beneficially impinged on dancers' perceived pressure, cognitive distraction, and performance in high-pressure situations, mirroring in the observed mean tendencies. Correspondingly, as mental practice represents a particular visualization type (Driskell et al., 1994), the applied PETTLEP-based mental practice potentially did not add anything to participants' regular visualization, thus remaining ineffective[12]. Therefore, it is essential to clarify how exactly

[11] To recall, despite an ineffective intervention, all participants homogeneously reported rather low amounts of perceived pressure and cognitive distraction and rated their own performance rather high over time.
[12] In fact, scientific knowledge revealed the importance of visualization not to be specific to the current sample. Imagery appears to be a crucial part of dancers' training, being applied across ages and skill levels, to lower

dancers' regular visualization affects their performance under pressure. Moreover, dancers' imagery use should be considered throughout future investigations, potentially posing a boundary condition for other interventions' effectiveness.

Third, aiming at a PETTLEP-derived mental practice intervention applicable to a wide range of dancers, a rather general intervention instruction was administered via written script. However, previous PETTLEP-based practices tended to be specifically tailored to the individual athlete, being updated based on personal needs over time (Wakefield & Smith, 2012; e.g., Battaglia et al., 2014; Smith et al., 2020). Scientific reviews, likewise, recommended such individualization of mental practice interventions (Collins & Carson, 2017; Cooley et al., 2013). Furthermore, mental practice's beneficial impact on athletic performance was shown to be intensified if providing instructions via audio (Smith & Holmes, 2004; Wakefield & Smith, 2011). Correspondingly, the implemented intervention might have been too unspecific, impersonal, and sub-optimally administered to exert notable impacts. Future explorations should reinvestigate PETTLEP-based mental practice's potential to enhance dancers' performance under pressure with an optimized administration, especially because experts considered the PETTLEP model potentially useful for dancers (Pavlik & Nordin-Bates, 2016).

Practical Implications

Each delineated explanation of the obtained findings entails different implications for how to assist amateur ballet dancers in alleviating performance losses under pressure. The first rationale (i.e., dancers not experiencing performance losses under pressure due to absent increases in perceived pressure) renders any intervention with this purpose redundant. Following this argumentation, dancers' performance should be enhanced by techniques

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arousal and improve performance, and more frequently and regularly relative to other athletes (see Goldschmidt, 2002; Muir et al., 2018; Nordin & Cumming, 2005, 2008; Overby et al., 1998; Pavlik & Nordin-Bates, 2016; Warburton et al., 2013)

focusing on other concepts than athletes' pressure perception. To exemplify, mindfulness, video modeling, behavioral coaching, and biofeedback were shown to promote dancers' performance across contexts (Moyle, 2016; Quinn et al., 2020; Quinn et al., 2022; Raymond et al., 2005). Likewise, performance-enhancing efforts could concentrate on dancers' team coherence (e.g., within training class), their practice engagement, or their dance enjoyment as each of these appeared to impinge on athletes' performance (see Ball & Carron, 1976; Schmidt et al., 2005). Future research may identify additional target concepts.

Contrastingly, the second rationale (i.e., participants' study-unrelated visualization already helping them to maintain performance levels under pressure) calls for sharing techniques other than mental practice with dancers prospectively enhancing their performance beyond their regular visualization. Exemplary alternative interventions are pre-performance routines and trigger words, both corroborated to maintain or improve athletic performance under pressure, presumably by favorably influencing athletes' cognitive distraction (Beckmann & Gröpel, 2017; Broomhead et al., 2012; Cotterill, 2017; Cotterill et al., 2010; Crews & Boutcher, 1986; Gröpel & Mesagno, 2019; Harle & Vickers, 2001; Jackson & Baker, 2001; Lonsdale & Tam, 2008; Mesagno et al., 2008, 2015b; Rupprecht et al., 2021; Shaw, 2002). Nevertheless, both strategies' ultimate impact within the specific target group of amateur ballet dancers remains to be specified by future studies.

Rather than demanding interventions other than mental practice, the third rationale (i.e., sub-optimal implementation of the administered intervention) implies a PETTLEP-derived mental practice intervention to still be expedient to prevent amateur ballet dancers from choking under pressure. Yet, it should be more individually tailored and more nuanced than the one administered within the present study and implemented via audio (see Smith et al., 2007; Smith & Holmes, 2004; Wright & Smith, 2009).

Strengths and Limitations

When drawing inferential conclusions regarding the present study, several strengths and limitations merit consideration.

Design

The design of a longitudinal field experiment constituted a notable strength of the present explorations. Following the same participants across numerous time points and performance contexts (i.e., baseline, intervention, and control condition; pressure versus non-pressure situations) ensured analytic results to rest upon a solid base of measurement responses and resulting data. Furthermore, longitudinal investigations are considered most appropriate for validly grasping the (causal) sequence of events or identifying time- or context-bound variations (Agresti, 2018). Additionally, having been embedded in the field setting, the study's outcomes gained ecological validity and relevance for real-world practice.

Sample

Two further strengths regarded the recruited sample. Participating dancers were randomly allocated to experimental conditions within the unit of their training group, facilitating a strict separation of the intervention and control group. This way, participants were prevented from gaining knowledge about the other group's tasks and drawing inferences about the study's premises that could have biased responses[13]. As baseline comparisons revealed no significant differences between the two groups on the four main variables of interest, potential group-inherent characteristics differentiating certain training groups from others were ruled out. Thus, participants' group-based distribution to experimental conditions seemed suitable, not endangering the measurements' (internal, construct, and external) validity and reliability.

[13] It would have been feasible for dancers to learn about the two experimental conditions and become familiar with the intervention script or filler task via their ballet dance colleagues if the conditions were not distributed between training groups, thus based on group membership, but between individual participants.

Moreover, the sample turned out strongly representative of the general population of classical ballet dancers, indicating gathered data to be highly externally valid. That is because classical ballet is predominantly practiced by females and only a very low percentage of all ballet dancers manages to become professionals (Zippia, 2022). Therefore, as the recruited sample majorly involved females and was restricted to non-professional ballet dancers, it seemed to adequately represent the ballet dance population[14].

Nevertheless, the rather small sample size of 25 dancers, ultimately, posed a relevant limitation. This number of participants aligned with the a priori conducted power analysis and, hence, sufficed to reach a power of .80 throughout intervention testing. However, subsequent model testing demanded a different sample size to reach equal power. A post hoc power analysis (see Appendix A) revealed the analytic outcomes regarding model testing only having a power of .46. This fairly low power value requires consideration when interpreting the findings, potentially constituting an additional explanation for the proposed research model and its assumed variable interrelations to remain unsupported. Replicating the present study with a higher number of participating dancers might result in diverging outcomes, possibly being in stronger correspondence with established theory and past research.

Assessment

The assessment approach applied to gauge the four main variables of interest implied both a strength and limitations. On the one hand, the measurement instrument of self-report questionnaires allowed for grasping participants' unique perceptual perspective (see Morling, 2012). As perceived pressure and cognitive distraction represented subjective, individually varying experiences (Moran & Toner, 2017b, 2017c), such subjective responses were most valid for capturing these constructs.

[14] The only limitation concerning the sample's representativeness was that the majority of participants were of Dutch nationality. However, classical ballet is educated and practiced worldwide. Consequently, gathered data appear highly representative for Dutch amateur ballet dancers, whereas potential minor variations between nationalities should be borne in mind when translating the obtained results to ballet dancers from other countries.

On the other hand, these subjective self-ratings might have been less appropriate for validly measuring performance. That is because evaluating one's own performance may likely be subject to various biases (e.g., socially desirable responses, overestimating own abilities, mingling actual and desired performance; see Hogan, 2015). Thus, performance ratings could be exaggerated, not displaying participants' actual performance accurately. More valid performance assessments could, for instance, be acquired via peer-reports (Kolar et al., 1996), whereby ballet teachers, training group members, or external spectators could rate dancers' performance. Future investigations are recommended to replicate the present research gauging actual performance more objectively via external raters[15].

Another assessment-related limitation concerned all main variables' retrospective measurement. These retrospective self-reports potentially provoked biased indications as such ratings tend to be less accurate and more extreme than experiential sampling within targeted situations. A memory-experience-gap is considered as the underlying reason (Ellison et al., 2020; Neubauer et al. 2020), hinting at another possible explanation for the non-substantiated propositions. Nevertheless, simultaneously performing ballet movements and filling in administered questionnaires would have been impossible and disruptive within the present study, introducing a biasing cognitive distraction in itself. Future studies should reinvestigate the proposed research model, avoiding the biasing impact of retrospective evaluations and performance-interfering measurements.

Conclusion

Against theory- and evidence-based expectations, no empirical evidence for a negative relationship between perceived pressure and performance was found within amateur classical ballet. Neither the well-established direct nor anticipated indirect adverse link between

[15] In the present study, involving external raters assessing the amateur dancers' performances across multiple measurement points would have been beyond the research project's resources and scope. Correspondingly, self-ratings were chosen to measure participants' performance.

perceived pressure and performance was corroborated. Likewise, PETTLEP-based mental practice' potential to effectively circumvent performance losses under pressure by reducing cognitive distraction remained unsupported. Possible explanations for these outcomes might be a) sampled dancers not experiencing heightened perceived pressure, neglecting the need for interventions obviating performance losses under pressure, b) participants' study-unrelated visualization tendencies already exerting a performance-facilitating impact, leaving the implemented mental practice intervention without additional value and calling for alternative interventions, c) a sub-optimal implementation of the administered intervention, recommending its further application with minor adaptations, and d) methodological issues. Each rationale suggests that the assumed interrelations between perceived pressure, cognitive distraction, performance, and mental practice are still plausible, demanding future research to shed light on the validity of a moderated mediation model of performing under pressure.

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Table 1

Timeline of the Study with the Contexts of the Respective Measurement Points

	Condition			
Measurement Point	Control Group	Intervention Group	Context	Chronological Classification[a]
T1	Baseline Condition	Baseline Condition	Training	Week 1
T2	Baseline Condition	Baseline Condition	Training	Week 2
T3	Baseline Condition	Baseline Condition	Training/Pressure	Week 2
T4	Control Condition	Intervention Condition	Training	Week 4
T5	Control Condition	Intervention Condition	Training/Pressure	Week 5
T6	Control Condition	Intervention Condition	Pressure	Week 5
T7	Control Condition	Intervention Condition	Pressure	Week 5
T8	Control Condition	Intervention Condition	Pressure	Week 5

Note. The term 'Training' refers to data collection with regard to performance during the rehearsal periods. The term 'Pressure' refers to data collection with regard to performance during the public dance performances. The term 'Training/Pressure' refers to data collection with regard to performance during rehearsal periods on stage with all dance groups together.

[a] The duration in-between measurement points ranged equally for all participants from minimum half a day to maximum two weeks. This irregular measurement distribution was inevitable due to the participants' dance practice and public performance schedule.

Table 2

Descriptives of the Main Variables of Interest and some Potential Covariates

Variable	Range	*M*	*SD*	Pearson Correlation							
				2	3	4	5	6	7	8	9
1. Mental Practice[a]	1–5	3.44	0.80	-.18	-.40*	.76***	-.47*	.36	.55**	.56**	-.01
2. Perceived Pressure[a]	1–5	2.32	0.58	—	.57**	-.27	-.12	-.17	-.02	-.04	-.50*
3. Cognitive Distraction[a]	1–5	1.70	0.44		—	-.57**	.27	-.45*	.10	-.26	-.45*
4. Performance[a]	1–5	3.57	0.37			—	-.50*	.43*	.36	.36	.21
5. Age	17–37	24.36	5.48				—	-.20	-.34	-.57**	-.19
6. Visualization Home	1–5	3.04	1.10					—	-.08	.45*	.04
7. Visualization During Training	1–5	3.76	1.30						—	.27	-.17
8. Visualization After Training	1–5	3.08	1.00							—	.29
9. Visualization Public Performance	1–5	3.88	1.05								—

Note. ‘Visualization Home’ refers to participants’ tendency to visualize ballet exercises or choreographies at home independently of the present study. ‘Visualization During Training’ refers to participants’ tendency to visualize ballet exercises or choreographies during their training sessions independently of the present study. ‘Visualization After Training’ refers to participants’ tendency to visualize ballet exercises or choreographies after their training sessions independently of the present study. ‘Visualization Public Performance’ refers to participants’ tendency to visualize ballet exercises or choreographies before performing in front of an audience independently of the present study.

[a] The average of the variable across measurement points was taken as the basis of the calculations.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3

Group Differences with Regard to the Study's Main Variables of Interest

Variable of Interest	Group		Sum of Mean Square	*df*	Mean Square	*F*	*p*
Perceived Pressure[a]	Gender	Between Groups	0.00	1	0.00	0.01	.93
		Within Groups	8.04	23	0.35		
		Total	8.05	24			
	Nationality	Between Groups	0.27	1	0.27	0.80	.38
		Within Groups	7.78	23	0.34		
		Total	8.05	24			
	Native Language	Between Groups	0.38	2	0.19	0.55	.58
		Within Groups	7.66	22	0.35		
		Total	8.05	24			
	Occupational Status	Between Groups	1.32	3	0.44	1.38	.28
		Within Groups	6.72	21	0.32		
		Total	8.05	24			
Cognitive Distraction[a]	Gender	Between Groups	0.00	1	0.00	<0.01	>.99
		Within Groups	4.55	23	0.20		
		Total	4.55	24			
	Nationality	Between Groups	0.00	1	0.00	<0.01	.99
		Within Groups	4.55	23	0.20		
		Total	4.55	24			

	Native Language	Between Groups	0.05	2	0.02	0.12	.89
		Within Groups	4.50	22	0.21		
		Total	4.55	24			
	Occupational Status	Between Groups	0.34	3	0.11	0.57	.64
		Within Groups	4.21	21	0.20		
		Total	4.55	24			
Mental Practice[a]	Gender	Between Groups	0.57	1	0.57	0.88	.36
		Within Groups	14.90	23	0.65		
		Total	15.47	24			
	Nationality	Between Groups	1.12	1	1.12	1.80	.19
		Within Groups	14.35	23	0.62		
		Total	15.47	24			
	Native Language	Between Groups	1.53	2	0.77	1.21	.32
		Within Groups	13.94	22	0.63		
		Total	15.47	24			
	Occupational Status	Between Groups	1.21	3	0.40	0.60	.63
		Within Groups	14.26	21	0.68		
		Total	15.47	24			
Performance[a]	Gender	Between Groups	0.10	1	0.10	0.68	.42
		Within Groups	3.23	23	0.14		
		Total	3.32	24			

Nationality	Between Groups	0.33	1	0.33	2.51	.13
	Within Groups	3.00	23	0.13		
	Total	3.32	24			
Native Language	Between Groups	0.33	2	0.16	1.21	.32
	Within Groups	3.00	22	0.14		
	Total	3.32	24			
Occupational Status	Between Groups	0.29	3	0.10	0.66	.59
	Within Groups	3.04	21	0.15		
	Total	3.32	24			

Note. [a] The average of the variable across measurement points was taken as the basis of the calculations.

Table 4

Mediation Model Predicting Performance with Perceived Pressure via Cognitive Distraction as a Mediator

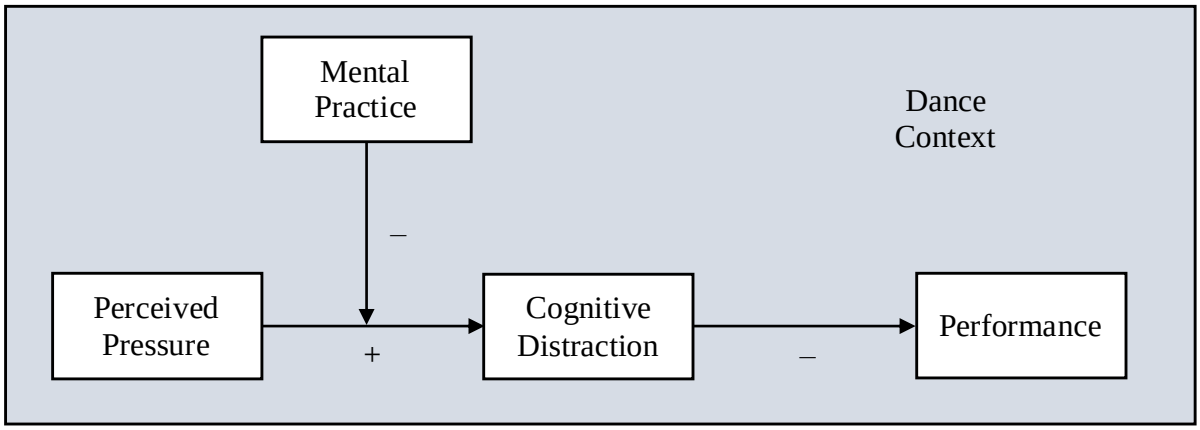
Parameter	Coefficient	*SE*	*t*	*p*
Constant	4.08	1.00	-4.08	<.001
Perceived Pressure[a]	-0.04	0.15	-0.28	.781
Cognitive Distraction[a]	-0.24	0.21	1.10	.288
Age	-0.02	0.02	1.55	.140
Visualization Home	0.11	0.08	1.35	.195
Visualization During Training	0.08	0.06	1.41	.175
Visualization After Training	-0.06	0.09	0.62	.547
Visualization Public Performance	0.03	0.09	0.29	.773

Note. The model controls for age and the tendency of participants to visualize ballet exercises independently of the study. 'Visualization Home' refers to participants' tendency to visualize ballet exercises or choreographies at home independently of the present study. 'Visualization During Training' refers to participants' tendency to visualize ballet exercises or choreographies during their training sessions independently of the present study. 'Visualization After Training' refers to participants' tendency to visualize ballet exercises or choreographies after their training sessions independently of the present study. 'Visualization Public Performance' refers to participants' tendency to visualize ballet exercises or choreographies before performing in front of an audience independently of the present study.

[a] The average of the variable across measurement points was taken as the basis of the calculations.

Figure 1

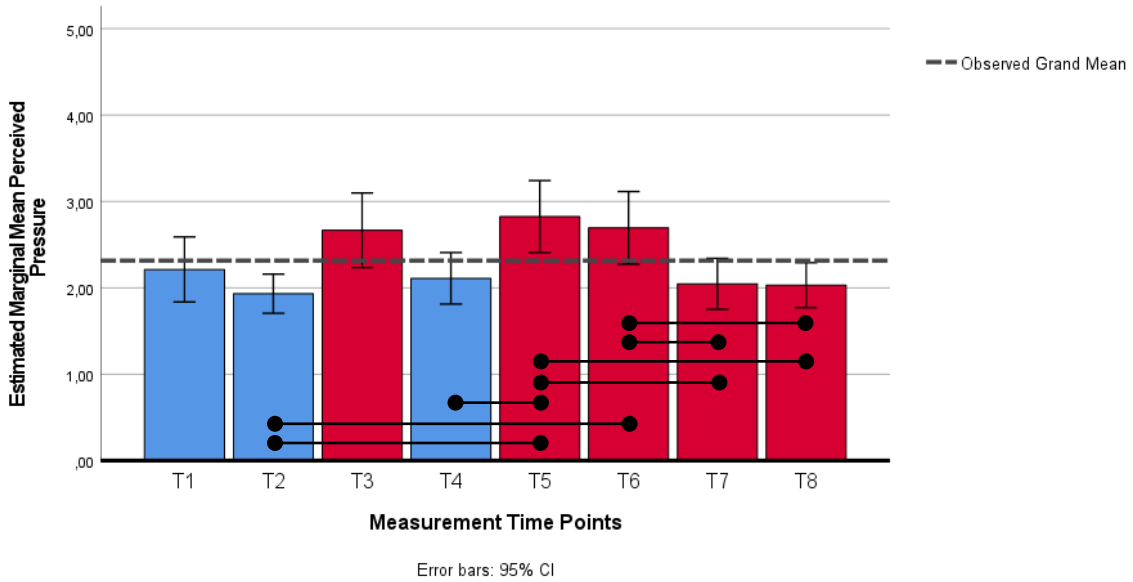
Higher Level Research Model



Note. The present study's main variables of interest and their anticipated interrelations are portrayed by visually separated boxes and arrow orientations. Signs thereby specify the direction of the expected association.

Figure 2

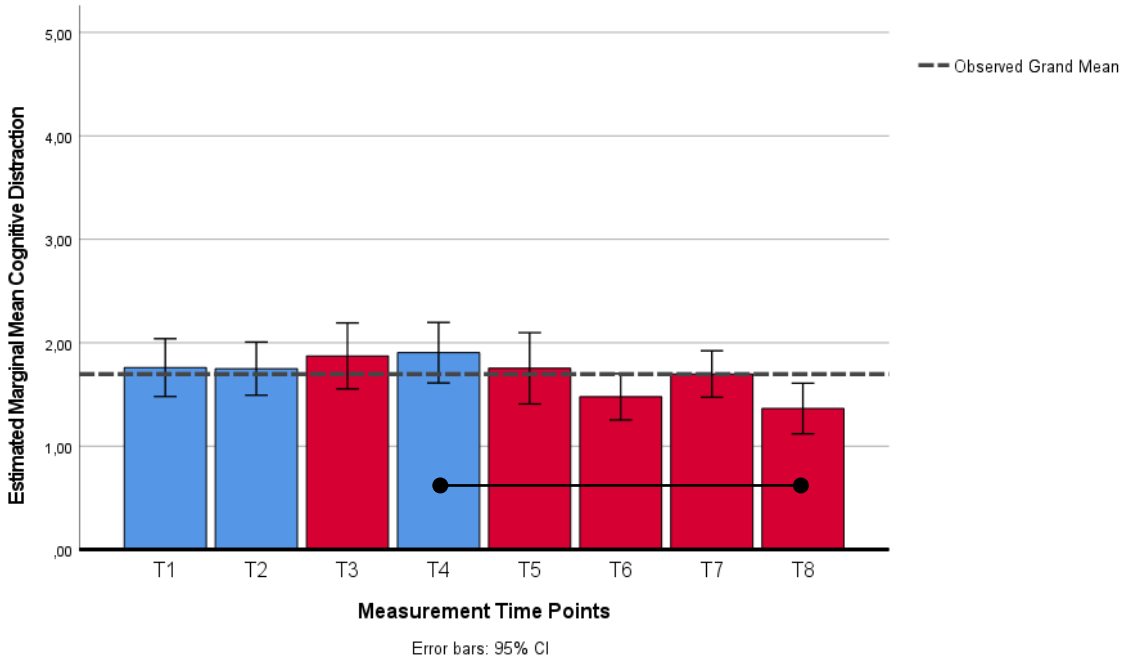
Participating Dancers' Average Amount of Perceived Pressure Across Conditions and Time



Note. Blue bars refer to non-pressure contexts. Red bars refer to pressure contexts. Horizontal lines ending with a dot indicate significant differences at $p < .05$ concerning perceived pressure levels across measurement points.

Figure 3

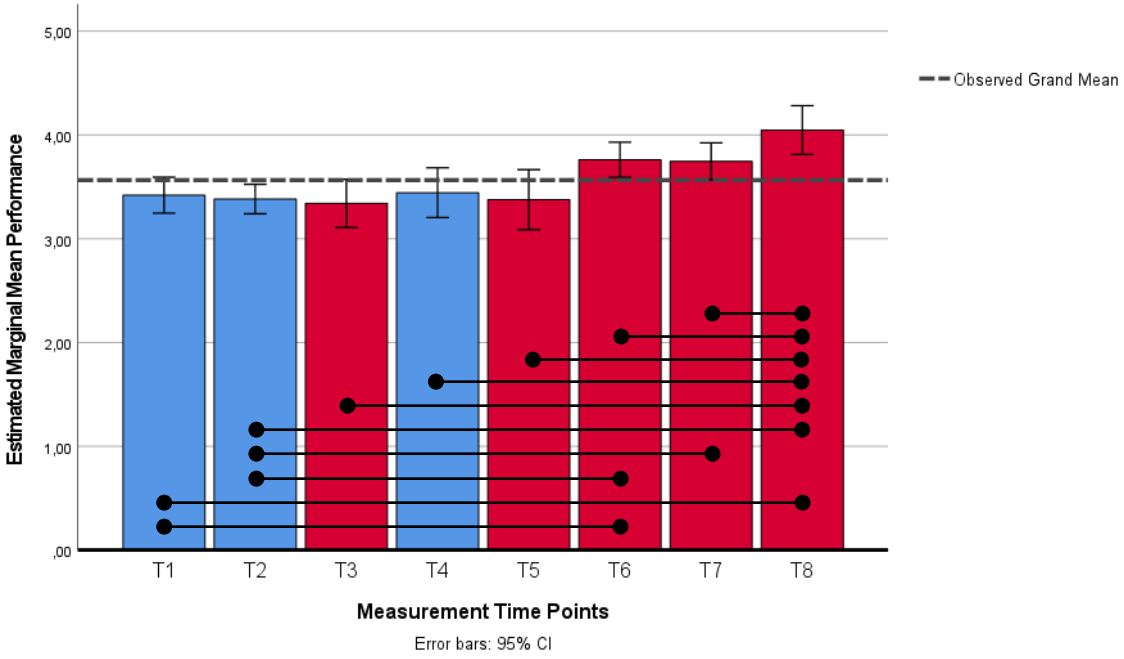
Participating Dancers' Average Amount of Cognitive Distraction Across Conditions and Time



Note. Blue bars refer to non-pressure contexts. Red bars refer to pressure contexts. Horizontal lines ending with a dot indicate significant differences at $p < .05$ concerning perceived pressure levels across measurement points.

Figure 4

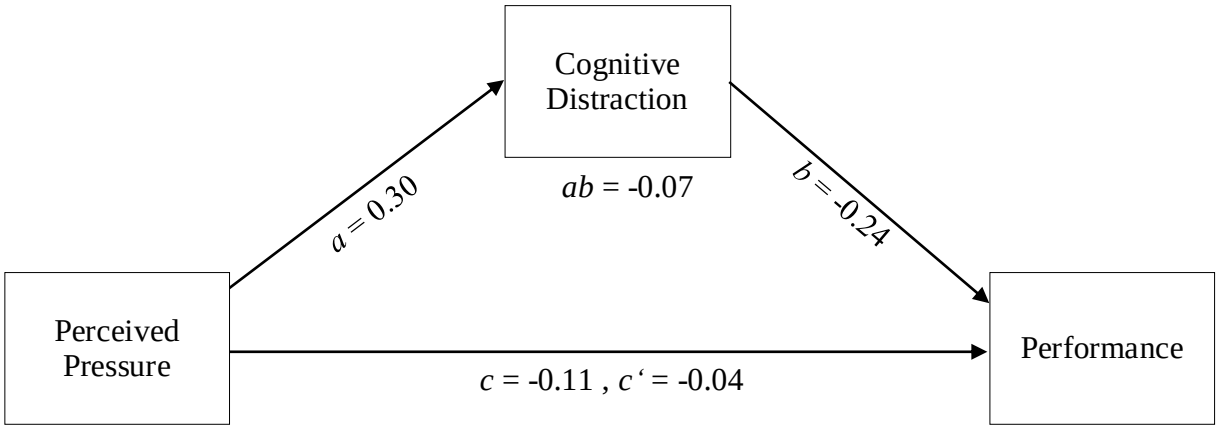
Participating Dancers' Average Amount of Self-Rated Performance Across Conditions and Time



Note. Blue bars refer to non-pressure contexts. Red bars refer to pressure contexts. Horizontal lines ending with a dot indicate significant differences at $p < .05$ concerning performance levels across measurement points.

Figure 5

Statistical Model with Covariates Predicting Performance with Perceived Pressure via Cognitive Distraction as a Mediator

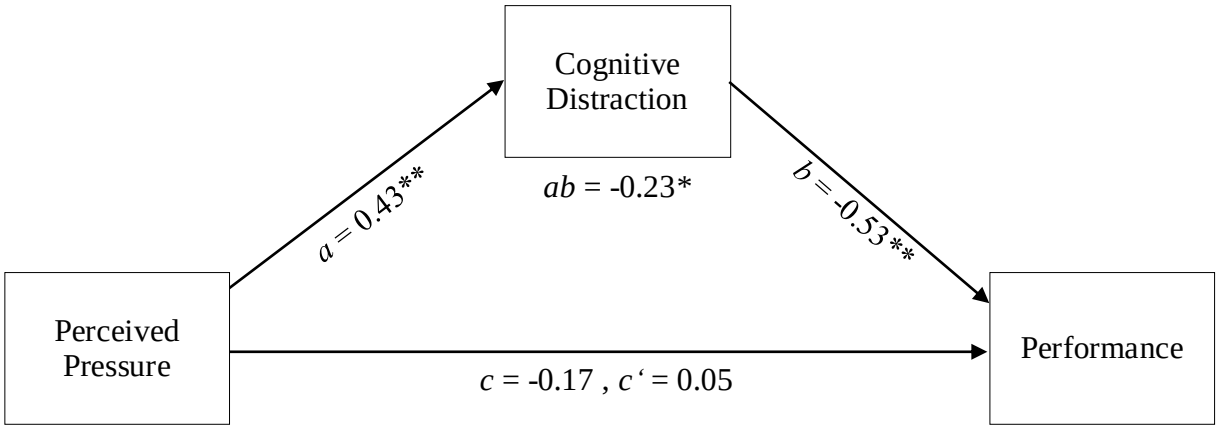


Note. The model controls for age and the tendency of participants to visualize ballet exercises independently of the study (i.e., visualization home, visualization during training, visualization after training, and visualization public performance). *a*, thereby, represents the effect of perceived pressure on cognitive distraction. *b* indicates the effect of cognitive distraction on performance. *ab* indicates the indirect effect of perceived pressure on performance via cognitive distraction. *c* represents the total effect of perceived pressure on performance and *c'* the direct effect of perceived pressure on performance controlling for cognitive distraction.

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

Figure 6

Statistical Model Without Covariates Predicting Performance with Perceived Pressure via Cognitive Distraction as a Mediator



Note. *a* represents the effect of perceived pressure on cognitive distraction. *b* indicates the effect of cognitive distraction on performance. *ab* indicates the indirect effect of perceived pressure on performance via cognitive distraction. *c* represents the total effect of perceived pressure on performance and *c'* the direct effect of perceived pressure on performance controlling for cognitive distraction.

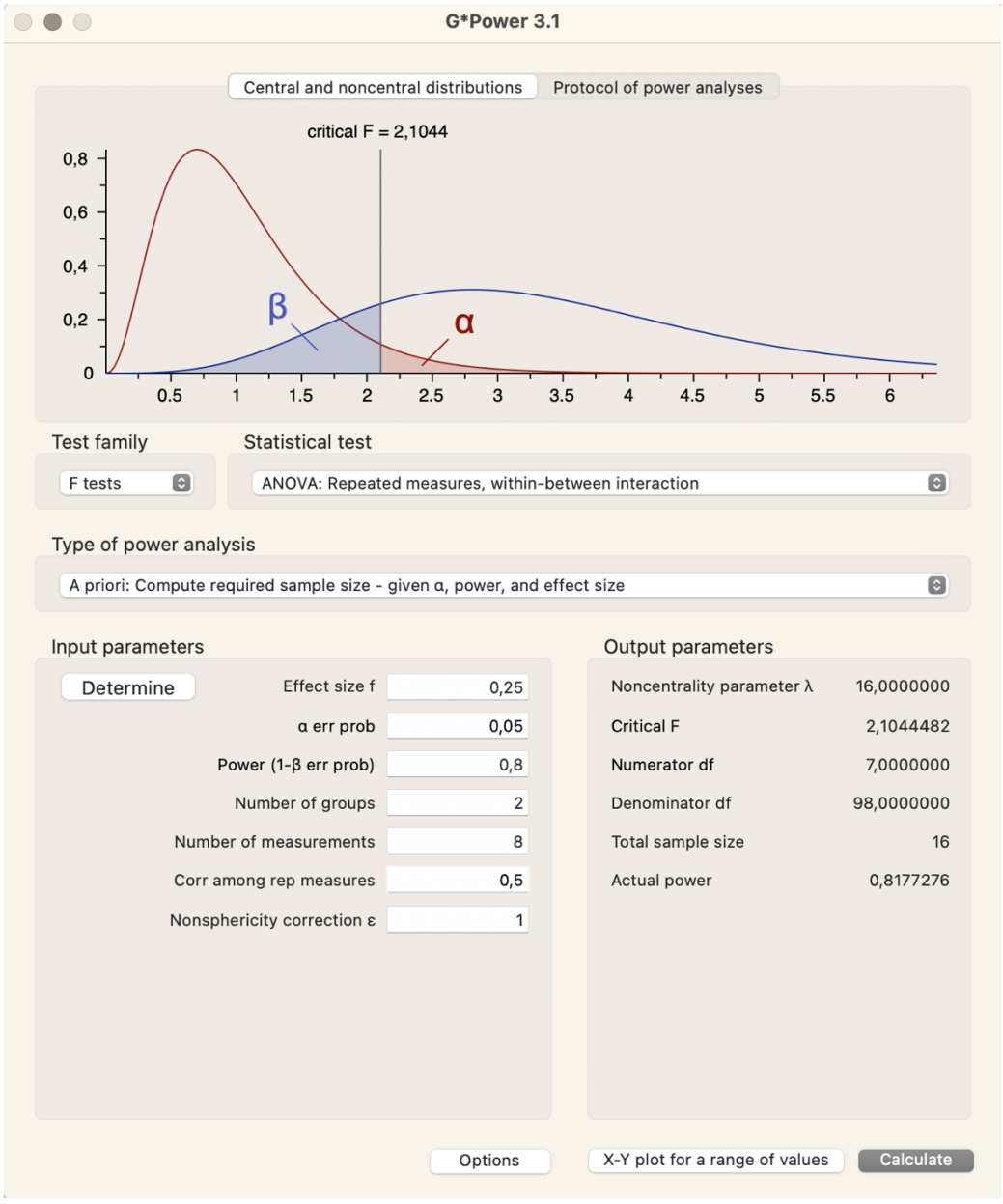
* $p < .05$. ** $p < .01$.

Appendix A

G*Power Analyses

Screenshot A

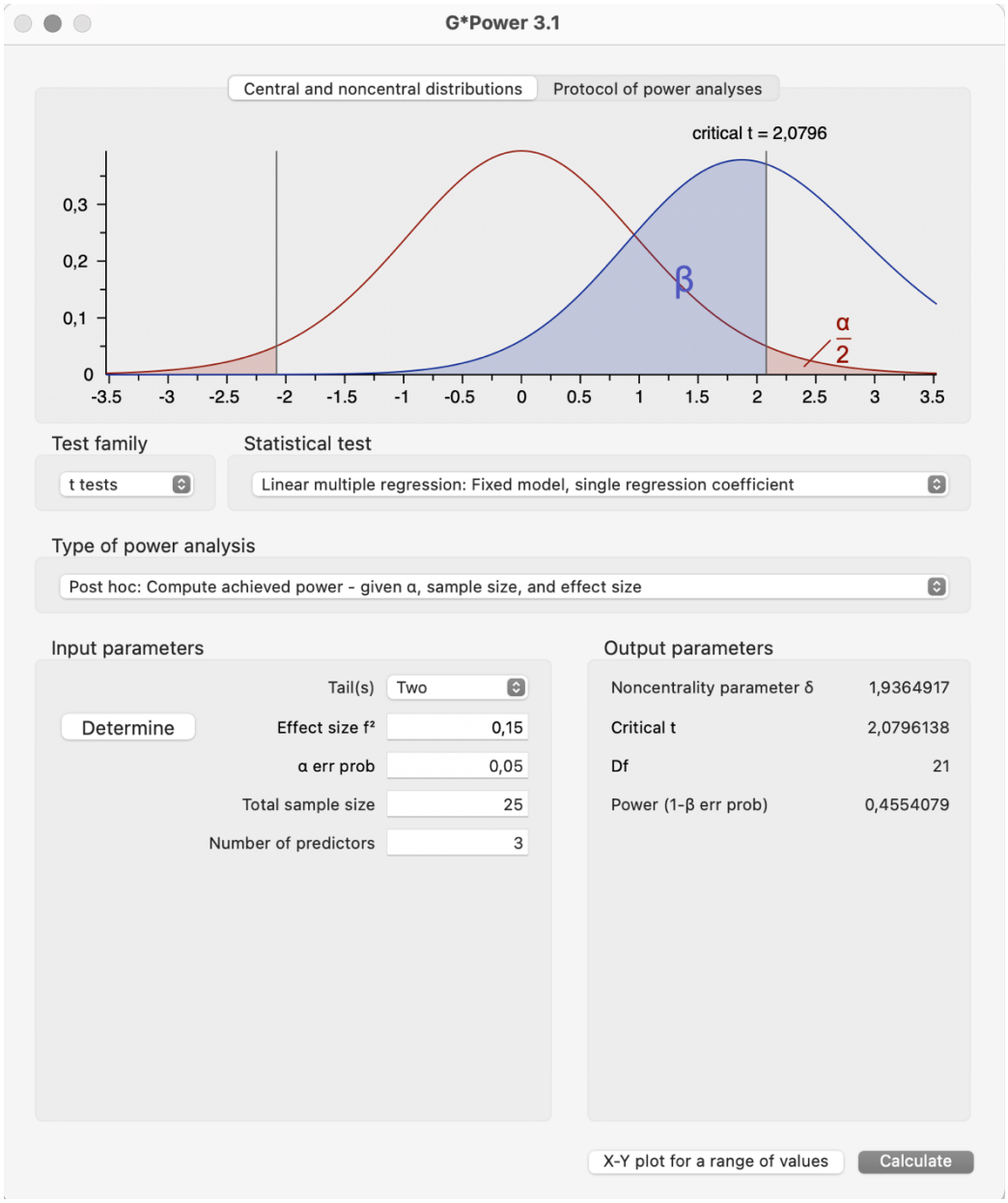
*A Priori G*Power Analysis*



Note. Screenshot of the study's a priori G*Power analysis determining the research project's appropriate sample size given the intended analysis approach.

Screenshot B

*Post Hoc G*Power Analysis*



Note. Screenshot of the study's post hoc G*Power analysis determining the research project power given the actual sample size and analysis approach.

Appendix B

Recruitment Flyer

university of groningen

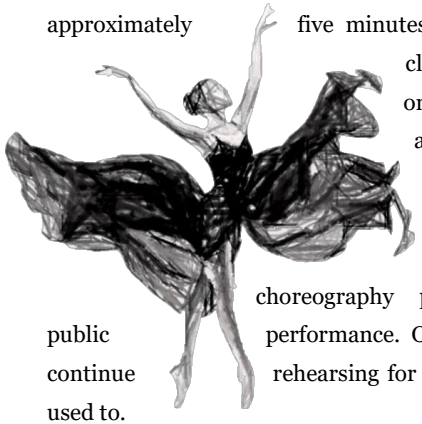
DANCE PERFORMANCE MASTER THESIS RESEARCH

Why this flyer?

We are very interested in cognitions during performance of amateur ballet dancers and are looking for dancers who are interested to participate in this study.

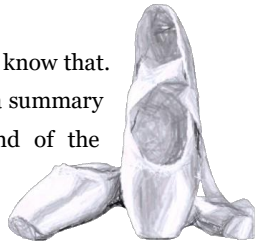
What would I need to do?

If you decide to take part in our research, starting in calendar week 19 and ending after your public dance performance in calendar week 23, we would ask you to fill out weekly questionnaires of approximately five minutes after each of your dance classes. From a certain point onwards we would additionally ask you to undergo a short imagery task after your warm up-phase but prior to your choreography practice and, eventually, public performance. Other than that, you would continue rehearsing for your dance performance as used to.



Do I get something in return?

Your time and effort is precious and we know that. Therefore, we would provide you with a summary of our research findings after the end of the research.



I'm in: How can I participate?

Good to hear! Are you 16 years or older, and are you an *amateur* ballet dancer at Wanda's for one year or longer? Then you can participate simply by filling out the questionnaire we will provide at the end of your dance class from calendar week 19 onwards. And do not forget to wear your favorite dance clothes

I'm still insecure: Can I get more information?

Do you have further questions before deciding to participate or not? Then feel free to contact us via email (v.m.kirklies@student.rug.nl).

We would love to welcome you as part of this research.
Viviane Kirklies and Amira Knief

Appendix C

Mental Practice Tasks

Intervention Task[16]

You are about to perform your dance choreography. Beforehand, please envision your performance as vividly as possible. Consider the following aspects thereby. Imagine the room where you will perform, how the dance floor might feel under your feet and the dance clothes on your body. Envision your fellow dancers standing in the room next to you. Picture the onset of the music and how you start with your dance movements in harmony. Feel free to use your body to mark the envisioned motions thereby. Imagine your stable core; the turnout of your legs; the development and easing of tension in your muscles. Sense the fluent movement of your arms and fingers, the stretching of your foot, and the position of your head. What will be your physical and emotional reaction to your performance? Does your heart rate increase? How is your breathing rhythm? You might feel excited, nervous, or stressed. Please envision these aspects as well. Do not rush through the imagination, but rather remember the dance choreography's real-time speed. Moreover, perceive how you perform each successive movement through your own eyes. Now, take a deep breath in and with your exhale start with the imagination.

Filler Task[17]

Part I

You are about to perform your dance choreography. Beforehand, please read this first part of a short story about a public dance performance.

"It's mid-afternoon on a burning hot summer's day when I arrive at the gates of the Hong Kong Coliseum. There is a long queue, snaking around the stadium. After a few hours

[16] The script builds upon the ones used by Smith and Holmes (2004) respectively Smith and colleagues (2020).
[17] The short story was written by Chan (2018) with the cognitive assignment at the end of each part being inserted by the researchers of the present study.

of sweltering in the heat, I finally find myself in front of a table. Behind it sits a man, holding a clipboard with the words 'Hong Kong's Got Talent' printed in a large, bold font.

"Name?" He asks monotonously. He doesn't look up from his sheet. He must've seen so many other contestants, all with hopeful looks in their eyes. He must've seen it all: so many dreams, crushed. Will I be one of those people? I've competed before; I should be fine, right? The problem is, I'm not the same me I was before.

I take a deep breath. "Eva. Eva Poon." My voice shakes.

He shifts his glasses. "And what will you be doing today, Miss Poon –" He pauses, staring up at me in shock.

I know what he sees. From a distance, the girl in the leotard looks ordinary. One of her arms is behind her back, trembling fingers crossed. Where her other arm is supposed to be, is nothing but a stump. "Car accident." I mutter, head down.

"Oh." He collects himself, wipes his face clear of any previous emotion. "What did you say you were doing again?" He asks suspiciously.

I hear the girls behind me giggling. The man taps his pen impatiently. "I- I'll be doing con-con-contemporary dance." I stutter.

One of the girls bursts out laughing. "Contemporary dance? With one hand? How does she expect to compete against us?"

They cackle like hyenas. I've danced before – they should know that. I recognize them from my old days of competing. I've beaten them before, and I should be able to do it again. The man clears his throat. "Ahem. You can go backstage now, and wait until you hear your name called." I nod, making my way out.

"See you later, Con-Con-Contemporary Dancer." One of the girls jeers, and her friends snigger."

After having read this first part of the story, please take two minutes to think about potential reasons for Eva to participate in the competition.

Part II

You are about to perform your dance choreography. Beforehand, please read this second part of the short story about a public dance performance.

"Backstage is a cluster of people. One is a comedian, telling jokes and hoping that someone will listen and laugh. Another is a singer. I've seen her on the streets, playing her guitar and singing her heart out. I see a child, probably less than half my age, playing a classical song on the piano, her chubby fingers flying over the keys. They're all immensely talented.

I see the girls from earlier a few feet away from where I sit. Their ballet choreographer shouts at them.

"*Plié! Arrière! Balancé!* Left leg, Daisy, not your right!" The girl at the back instantly switches feet, trying to regain her balance. The rest of the girls don't even try to hide their laughter.

"Sorry, Miss." The girl ducks her head, ashamed. "It won't happen again."

The choreographer glares at her. "It better not! Your performance is in half an hour! It must be perfect! No flaws!" The girls sneer at Daisy.

The speaker buzzes. "Eva Poon, please make your way to the performance hall. I repeat, Eva Poon, please go to the performance hall."

After having read this second part of the story, please take two minutes to consider the pros and cons of a performance preparation like Daisly and the other girls faces.

Part III

You are about to perform your dance choreography. Beforehand, please read this third part of the short story about a public dance performance.

"I wait by the curtain, anxiously hopping from one foot to the other. The crowd howls in their seats, eager for entertainment. I hear the harsh BUZZ of the buzzer as the judges send away an act that wasn't good enough. She runs offstage and I see her wiping her tears away. Another dream crushed. Will that be me? The host of the show pats me on the shoulder. "You got this, girl. Just pretend this is a dance test. No matter what happens, take a deep breath, and just carry on." She ignores my protests and pushes me towards the stage.

I am blinded temporarily by the bright lights shining onto the stage. I gasp as my vision clears. The audience is huge and looms behind the three judges at the very front. They stare expectantly. I recognize them. Ethan Chung; he's a singer and radio host. On the other side of the panel is Wang Chi-lin, comedian and TV personality. Sandwiched in the middle of the two men is a young woman. Her long, black hair cascades down her back. Her hands lie on the table and she sits ramrod straight. Her fingers are long and slim, and she moves with the elegance and fluid grace which only professional ballerinas can achieve. She has been my idol since childhood. Lily Tam. She is the prima ballerina at San Francisco Ballet, which produced stars of the dance world like Misty Copeland. I struggle to close my gaping mouth. Judged by Lily Tam? It's a daunting thought.

I gulp. "Hi…?" Just pretend this is another dance test, I tell myself, it's just another test. But with higher stakes.

Lily smiles, not unkindly. She doesn't seem to care about my stump. "Hello, there. What's your name?"

"E-E-Eva. Eva Poon." Ba-BOOM. Ba-BOOM. Ba-BOOM. I can hear my heart pounding like thunder in my ears.

"How old are you?"

"Fourteen." Just breathe. Pretend it's just a test.

She hums. "What will you be doing for us today?"

I take a deep breath. “I’m a dancer. I’ll be doing contemporary dance.”

She looks impressed. “You have ninety seconds. Show us what you’ve got, Eva.”

It’s just another dance test, I think to myself. I nod at the judges, and the lights fade to black.”

After having read this third part of the story, please take two minutes to think about the aspects that might lead Eva to fail her performance.

Part IV

You are about to perform your dance choreography. Beforehand, please read this fourth part of the short story about a public dance performance.

“There is silence. Standing in the middle of the stage is a girl. She lies in a fetal position on the floor, curled up in a ball. Andra Day’s *Rise U*p begins playing in the background. It’s the perfect song for me.

“You’re broken down, and tired.” Immediately, I push myself up, black tendrils of hair curling around my face.

“Of living life on the merry-go-round.” I lean back and stretch my leg upwards, toes pointed. “And you can’t find the fighter.” My cape slips off my body. One leg is firmly attached to the ground, and the other is facing skyward.

“But I can see it in you, so we gonna walk it out.” Wang looks gobsmacked. Breathe, I remind myself. It’s just like another dance test.

“And move mountains.” I twist and turn, rise and fall, spin and leap. My body sways from side to side, and I slide to the other side of the stage.

“And I’ll rise up, I’ll rise like the day.” I leap to the rhythm, momentarily airborne. “I’ll rise up, I’ll rise unafraid.” I land as lightly as a cat. “I’ll rise up, and I’ll do it a thousand times again.” I spin like a ballerina, the world whizzing around me.

"I'll rise up, high like the waves, I'll rise up, in spite of the ache, I'll rise up, and I'll do it a thousand times again." I do an aerial cartwheel, legs slicing through the air while my hands never touch the floor. Yes! I haven't lost my touch.

"For you, for you, for you, for you," the singer's voice croons. Lily is perched on the edge of her seat, head propped up on her hands. Her eyes are wide open, staring at me. I take a deep breath. I can do this. The next chorus plays as my feet fly over the floor as I prance around the stage, my body flying like my heart.

The chorus repeats, playing the last few lines of the song. "I'll rise up." I reach towards the audience, pulling them in. "I'll rise like the day." I twirl gracefully, like a figurine in a music box. "I'll rise up, rise unafraid." I balance on my good hand, legs kicking in the air. "I'll rise up, and I'll do it a thousand times again." I slide to the floor, kneeling as my arm punches up to the sky. The music stops."

After having read this fourth part of the story, please take two minutes to take on the perspective of the public, including the judges, and consider what they might have thought of the performance.

Part V

You are about to perform your dance choreography. Beforehand, please read this fifth part of the short story about a public dance performance.

"My breath catches in my throat as I take in the scene in front of me. The crowd is cheering wildly. The judges are all on their feet, massive smiles on their faces. Ethan claps loudly, shooting me a thumbs up. Grinning, I give him one back. Wang still looks astounded, clapping slowly. My eyes focus on Lily. She's the only dancer on the panel, the only one fit to judge another dancer.

The clapping and cheering fades to silence as Wang clears his throat. "What you did just now was amazing!" He gushes excitedly, a childlike tone in his voice. "I can't even do a

split on the ground and I can't even think of doing a cartwheel, and you just did both in mid-air, and the worst thing? You made it look so easy!" The audience laughs at his infectious happiness, and even I can't help but giggle. Ethan nods in agreement. "What you did was phenomenal for a fourteen year old girl. Your strength and agility astounded me, and your movements and expressions matched every single one of the lyrics. You looked fierce. Lily, what did you think of Eva?" I cross my fingers behind my back. What does she think? Will she be impressed? Will she be harsh? Or will she accept me for who I am? I wait for her judgment.

Lily smiles. "I agree with Ethan." I breathe a sigh of relief. "Each and every one of your moves was so precise, and so clean. You're probably one of the best dancers we've seen. You definitely belong here, and we're glad to have you." Ethan and Wang nod in agreement. "You've certainly raised the bar, and I pity the person who comes after you."

"Thank you," I mumble shyly. "That means a lot to me. You're my idol." I whisper this in a small voice, but the microphone amplifies it through the entire hall. Lily smiles. "I'm glad to hear that I inspire people, especially someone like you. When I dance, I treat it like a test of my own abilities, and if that was a test for you, you killed it. Your talent shone through your entire performance, and you didn't let your hand hinder you. It takes immense courage to do that." She pauses for a moment, letting her words sink in. "Most people come on stage and let their nerves overcome them, but you didn't. I was stunned by your performance, and I think I speak for everyone here." She stands up once more, clapping for me. "Well done, Eva. I have high hopes for you. Don't let me down." I blush, thanking her profusely for her praise. She waves it away like it's nothing. "Thank you, Miss Tam; I won't let you down," I promise her."

After having read this fifth part of the story, please take two minutes to envision Eva's reaction if the judgement did not turn out as favorably as it did.

Appendix D

Measurement Scales Assessing the Study's Main Variables of Interest

Manipulation Checks

When I received the imagination instructions…

…I envisioned my physical reaction to the dance performance situation (e.g., increasing heart rate, breathing rhythm, etc.).

- o Strongly disagree
- o Somewhat disagree
- o Neither agree nor disagree
- o Somewhat agree
- o Strongly agree

…I imagined the room where I would perform my dance choreography, including the feeling of the dance floor under my feet and my dance clothes on my body.

- o Strongly disagree
- o Somewhat disagree
- o Neither agree nor disagree
- o Somewhat agree
- o Strongly agree

…I envisioned myself performing the dance choreography, including sensations like my stable core, the turnout of my legs, and the fluent movement and stretching of my arm, fingers, and foot.

- o Strongly disagree
- o Somewhat disagree
- o Neither agree nor disagree
- o Somewhat agree

- Strongly agree

…I imagined my dance performance not rushing but rather remembering the choreography's real-time speed.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

…I envisioned my emotional reaction to dancing the choreography (e.g., excitement, nervousness, stress, etc.).

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

…I envisioned each successive movement of my dance performance through my own eyes.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

Perceived Pressure[18]

While performing the ballet choreography…

[18] The measurement scale focusing on perceived pressure consist of selected and adapted items of the Cognitive-Somatic Anxiety Questionnaire (DeGood & Tait, 1987).

… I worried about not performing well.

- Not at all
- A little
- A moderate amount
- A lot
- A great deal

… I felt under pressure.

- Not at all
- A little
- A moderate amount
- A lot
- A great deal

… I felt anxious.

- Not at all
- A little
- A moderate amount
- A lot
- A great deal

Cognitive Distraction[19]

While performing the ballet choreography…

…I found it difficult to concentrate.

- Not at all
- A little

[19] The measurement scale focusing on cognitive distraction consist of selected and adapted items of the Cognitive-Somatic Anxiety Questionnaire (DeGood & Tait, 1987).

- A moderate amount
- A lot
- A great deal

… I had distracting thoughts.

- Not at all
- A little
- A moderate amount
- A lot
- A great deal

… I lacked focus on the task.

- Not at all
- A little
- A moderate amount
- A lot
- A great deal

Performance[20]

Physical Instrument: How was my alignment/posture, turn out, feet, and port de bras?

- Terrible
- Poor
- Average
- Good
- Excellent

Musicality: How was my phrasing, rhythm, and dynamics created in response to music?

[20] The measurement scale focusing on performance is based on various public criteria used for the assessment of dance performances in competitions or auditions (Cab Calloway School of the Arts, 2021; Royal Academy of Dance, 2020; Scottish Qualification Authority, 2017; Victorian Curriculum and Assessment Authority, 2012).

- Terrible
- Poor
- Average
- Good
- Excellent

Technique: How was my technical accuracy?

- Terrible
- Poor
- Average
- Good
- Excellent

Kinesthetic Skills: How was my awareness of the body in space and in relationship to the surrounding?

- Terrible
- Poor
- Average
- Good
- Excellent

Expression Elements: How was my self-expression, sense of performance, concentration, and focus?

- Terrible
- Poor
- Average
- Good
- Excellent

Movement Quality: How was my overall manner with which individual movements were executed (e.g., use of sustained, staccato, swing, and stillness)?

- Terrible
- Poor
- Average
- Good
- Excellent

Appendix E

Assumption Checks

Assumption Checks: Intervention Testing

The data's adequacy for mixed ANOVAs was verified by checking its congruence with the statistical assumptions of independent random samples, an approximately normally distributed dependent variable gauged at interval or ratio level, sphericity, and homogeneity of (co)variance. Independency and interval measurement were given due to the experiment's design as well as sampling and measurement processes. Normality was checked by means of descriptive statistics concerning each variable's skewness and kurtosis, the Shapiro-Wilk test of normality, as well as Q-Q plots. Based on these indicators of normality, the data was considered acceptable for further analysis. Moreover, boxplots functioned as visual means to detect potential outliers. Although this visual inspection method suggested two possible outliers, their respective z-score did not exceed a value of 3.29 so that these apparently extreme scores were not modified further. Mauchly's test of sphericity, Box's test of equality of covariance matrices, and Levene's test of equality of error variances were used to scrutinize sphericity as well as homogeneity of (co)variance. These tests revealed that the data predominantly coincided with the analytic procedure's assumptions so that its conduction was assumed to be appropriate[21].

Assumption Checks: Model Testing

The data's adequacy for the model testing approach was verified by checking its congruence with the statistical assumptions of linearity, homoscedasticity, normality, and multicollinearity. Whereas a residual plot was utilized to inspect the first two assumptions, a

[21] The only exceptions were apparent sphericity in the case of cognitive distraction as well as performance plus seeming heterogeneity of variance on cognitive distraction on T2 and on performance on T4. However, taking into account the opportunity to rely on methods correcting for sphericity (e.g., Greenhouse-Geisser, Huynh-Feldt) as well as the comparatively higher number of remaining measurement time points, these exceptions were considered no major violation of the data's adequacy.

normal probability plot (P-P plot) was created to check for normality. Both assumptions were met according to these visual inspection methods. Multicollinearity did not arise as no variance inflation factor exceeded a value of five. Furthermore, with no cook's distance score above 1 no major outlier was found.