

Pain Catastrophizing in Music Students: Examining its Relationship with Psychological Inflexibility and Perfectionism

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Abstract

Background: Music students face demands during training that can make them vulnerable to various issues, including pain that may limit their performance.

Objective: To examine the relationships between psychological inflexibility, perfectionism, and pain catastrophizing in music students.

Methods: A non-probabilistic sample of 145 classical music students (42.4% male) participated, with a mean age of 27.77 years. Of these, 89.66% studied in public conservatories. Pain catastrophizing was assessed using the Pain Catastrophizing Scale, psychological inflexibility with the Acceptance and Action Questionnaire-II, and perfectionism with the Multidimensional Inventory of Perfectionism in Sport.

Results: Participants had an average of 11.63 years of musical training, with 91% reporting pain associated with practice and 42.1% indicating they had temporarily stopped playing due to pain. Higher psychological inflexibility was significantly correlated with increased pain catastrophizing, particularly in the dimensions of rumination, magnification, and helplessness. Pain catastrophizing also correlated positively with both adaptive and maladaptive perfectionism; however, magnification and helplessness were not significantly associated with adaptive perfectionism. Students who linked pain to instrument use, as well as those who had temporarily stopped playing due to pain, exhibited greater pain catastrophizing, as reflected in higher rumination, magnification, and helplessness scores. However, these groups did not differ significantly in psychological inflexibility or perfectionism scores.

Conclusions: Pain catastrophizing is essential in assessing pain among music students. Acceptance and Commitment Therapy may help address behaviors related to psychological inflexibility and perfectionism, potentially impacting students' pain perception.

Keywords: Pain, Music, Inflexibility, Student, Conservatory, Perfectionism.

Introduction: Music students must manage both the academic demands of their discipline and long hours of training. Such training routines frequently entail repetitive movements in the pursuit of perfection. Consequently, this regimen is physically stressful and cognitively taxing for students, heightening their susceptibility to physical fatigue, pain, psychological distress, and injury (van Winden et al., 2019). Pain can reduce movement precision and negatively impact musical expression, potentially hindering professional growth (Engquist et al., 2004). It is also linked to increased absenteeism from conservatory classes (Korte et al., 2023; Zão et al., 2024) and, in some cases, premature dropout from musical training (Jääskeläinen et al., 2023).

In this context, pain is a significant concern due to its high prevalence among music students (Cruder et al., 2018; Cruder et al., 2020; Kok et al., 2013; Korte et al., 2023). Studies report that 63% (Kok et al., 2013), 77% (Korte et al., 2023), and 79.7% (Cruder et al., 2018) of music students have experienced pain while playing their instruments. Over the past year, 39% (Korte et al., 2023), 65% (Cruder et al., 2020), and 89% (Kok et al., 2013) reported pain. Identified risk factors include instrument type, level of experience, gender, physical factors (such as extended practice hours), psychological stressors (such as academic pressure or self-imposed expectations), limited adoption of wellness practices (e.g., adequate rest), and past injuries (Wu, 2007).

The International Association for the Study of Pain (IASP) defines pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" (IASP, 1979). This definition has enabled clinical researchers and practitioners to consider the subjective experience of pain when trying to understand its clinical progression and develop effective intervention strategies (Cohen et al., 2018; Raja et al., 2020). Consequently, pain is recognized as a personal experience influenced

by biological, psychological, and social factors, with individuals developing their understanding of pain through life experiences (Raja et al., 2020). Viewing pain as a process entails recognizing it as a complex series of psychological and biological factors that produce a sensory and emotional experience for the individual. This experience may not always directly correlate with the extent or severity of the injury but can be influenced by various characteristics, including educational level, race, age, depression, resilience, socioeconomic status, catastrophizing tendencies, and attitudes toward treatment (Harrison & Ruddock-Hudson, 2017).

The IASP definition of pain highlights the importance of constructs such as pain catastrophizing. Pain catastrophizing represents a psychological phenomenon characterized by a set of excessively negative emotional and cognitive processes triggered by pain, whether real or anticipated. These processes include an inordinate focus on the painful sensation, known as rumination, exaggeration of the perceived damage, termed magnification, and a perceived inability to control the pain, known as helplessness (Quartana et al., 2009; Ruscheweyh et al., 2011). Consequently, understanding pain catastrophizing becomes crucial for comprehensively assessing the individual experience of pain and the context in which it occurs.

The response to pain can be influenced by catastrophizing (Edwards et al., 2012), and research suggests that pain catastrophizing may vary depending on the type of pain experienced (Ruscheweyh et al., 2011). Pain catastrophizing is associated with several adverse outcomes, including increased pain intensity (Landmark et al., 2024; Martínez-Calderón et al., 2019), greater engagement in pain-avoidance behaviors (Keefe et al., 2000; Picavet et al., 2002; Sullivan et al., 2000), increased use of analgesics (Altan et al., 2019; Elphinston et al., 2022), reduced participation in daily activities (Zhaoyang et al., 2020), and greater susceptibility to injury and low resilience (Arbinaga & Bernal-López, 2023), among other issues.

Pain often triggers behaviors to alleviate discomfort, including avoidance strategies (Vlaeyen & Linton, 2000). However, in many cases, these strategies maintain and accentuate the perception of the painful experience and are ineffective in providing relief. From a contextual functional approach (Acceptance and Commitment Therapy, ACT), the

psychological flexibility/inflexibility model has been proposed to understand patterns of behavioral avoidance and persistence (McCracken, 2013). Psychological flexibility/inflexibility refers to the possibility of fully embracing the present moment as conscious human beings and accepting and acknowledging our inner experiences without unnecessary resistance or defense mechanisms. It involves choosing whether to persist with or let go of actions, even when they cause discomfort, to serve an individual's identified values (Hayes et al., 2006; Hayes et al., 2014). The psychological flexibility model promotes adaptive coping through various processes or skills (Cassar et al., 2018; Ferreira et al., 2013; Hayes et al., 2006; McCracken & Morley, 2014). Conversely, psychological inflexibility represents the rigid dominance of unwanted internal events at the expense of effective actions, the pursuit of long-term goals, and useful thoughts and emotions (Bond et al., 2011). It has been suggested that psychological flexibility and inflexibility are separate but related multidimensional constructs (Cherry et al., 2021; Tyndall et al., 2020).

Pain acceptance is considered a central facet of psychological flexibility (Arbinaga, 2023a; Deval et al., 2017), which can help reduce pain catastrophizing (Vowles et al., 2008). In contrast, psychological inflexibility correlates negatively with quality of life, perceived health, and positive emotional experiences (Hayes et al., 2014), a pattern observed across various performance domains (Chen et al., 2017; Zhang et al., 2014). Moreover, psychological inflexibility and experiential avoidance (the tendency to avoid or suppress internal states such as distressing thoughts, feelings, and sensations) play a key role in the relationship between negative emotional states and the emergence of a range of problems (Cobos-Sanchez et al., 2022; Levin et al., 2014; Peltz et al., 2020; Ugur et al., 2021).

In recent years, researchers have examined the role of perfectionism in high-performance contexts, including musical performance. Perfectionism is conceptualized from a multidimensional standpoint (Frost et al., 1990; Hewitt & Flett, 1991), with its defining features centered around high personal standards and negative self-evaluation (Flett & Hewitt, 2002; Frost et al., 1990; Hewitt & Flett, 1991; Khawaja & Armstrong, 2005). The first component, adaptive perfectionism (Khawaja & Armstrong, 2005), is associated with positive traits,

processes, and outcomes in subjective well-being, psychological adjustment, perceptions of challenges, and active coping strategies (Stoeber & Rennert, 2008). In contrast, the negative self-evaluation aspect is viewed as inherently dysfunctional or maladaptive. In this regard, Khawaja and Armstrong (2005) link maladaptive perfectionism to a preoccupation with errors, uncertainties about actions, and parental criticism and expectations.

Perfectionism is characterized by cognitive rigidity and behavioral inflexibility (Crosby et al., 2011; Delor et al., 2019), where the individual exhibits a lack of adaptive strategies, persisting with the same approaches regardless of the situation and despite unfavorable outcomes (Crosby et al., 2011). Experiential avoidance emerges as one of the underlying mechanisms of perfectionism, impacting overall health outcomes (Bisgaier, 2018). Consequently, acceptance and commitment therapy has been employed to mitigate perfectionism and its associated symptoms. Previous research has indicated a correlation between perfectionism, diminished functioning, and the frequency/intensity of pain (Gonzalez et al., 2019; Kemple et al., 2016).

The music education setting offers unique insights into the study of perfectionism, particularly because perfectionism often revolves around the performer's perception of perfection rather than achieving a truly flawless performance (O'Riordan & Griffith, 2014). Students' interpretations of success are often shaped by the preferences of their audience, including teachers, peers, family members, and others (Aydın-Almac, 2022). In students, this inclination towards perfectionism can also arise from "socially-prescribed perfectionism," driven by external expectations and demands — such as those from teachers or family members — who expect the individual to achieve perfection (Flett & Hewitt, 2015).

Research on pain-associated perfectionism in music performance by students is limited (Araujo et al., 2017; Cruder et al., 2023; Hill et al., 2020; Stoeber & Eismann, 2007). Studies have found that in music students, the onset of performance-related musculoskeletal disorders is significantly associated with an increase in socially prescribed perfectionism (Cruder et al., 2023). Cruder et al. (2023) note that the nature of musical activity in students, which often centers on meeting audience or school expectations, suggests that perfectionism may play a role

in the onset of physical symptoms. Thus, music students must develop effective strategies to manage high external expectations that could result in some form of maladaptive perfectionism (Araujo et al., 2017), contributing to disruptive physical symptoms and heightened levels of psychological distress (Stoeber & Eismann, 2007).

It can be argued that perfectionism has been analyzed as a vulnerability factor (Blanco et al., 2020). While a growing body of research has linked perfectionism to pain, investigations into the relationship between perfectionism and pain catastrophizing remain limited. The few published studies suggest that individuals scoring high on socially prescribed perfectionism and self-oriented perfectionism are more prone to pain catastrophizing (Rudolph et al., 2007) and exhibit dependency behaviors such as avoidance (Sherry et al., 2003).

Psychological flexibility and inflexibility appear to be related to perfectionism (Nguyen & Morris, 2024). Some perfectionists exhibit greater flexibility in adapting their behavioral and emotional responses to different situations (Clark, 2019, as cited in Nguyen & Morris, 2024). However, other forms of perfectionism seem to align with psychological inflexibility. In these cases, individuals respond to effort with high self-criticism, control, and experiential avoidance, leading to rigidity in their emotional and behavioral responses to various situations (Dunkley et al., 2000; Moroz & Dunkley, 2015; Nazarzadeh et al., 2015).

In this context, characteristics of perfectionism — such as the rigid pursuit of achievement to avoid unwanted emotions, even at the cost of engaging in personally meaningful activities — are similar to processes of psychological inflexibility (Clark, 2019, as cited in Nguyen & Morris, 2024; Moroz & Dunkley, 2015). These patterns reinforce the link between perfectionism and psychological inflexibility, limiting the individual's ability to connect with other influences on their behavior and perpetuating their perfectionistic tendencies (Clark, 2019, as cited in Nguyen & Morris, 2024; Gilman et al., 2014).

Given that pain catastrophizing is one of the most significant treatable psychological factors contributing to pain perception (Morey et al., 2024; Shen et al., 2024), this study aims to enhance our understanding of how psychological inflexibility and perfectionism are related to pain catastrophizing in a sample of music students. The first hypothesis posits that

psychological flexibility will be negatively correlated with pain catastrophizing scores. Similarly, the second hypothesis suggests that scores in perfectionism and maladaptive perfectionism will show positive and significant correlations with catastrophizing. Finally, the third hypothesis anticipates negative and significant relationships between adaptive perfectionism and pain catastrophizing.

Method

Participants

This was a cross-sectional study. The sample consisted of 145 music students (57.9% female) with a mean age of 27.77 years ($SD = 14.95$). The inclusion criteria were as follows: (1) to be a music student under the guidance of a teacher and not self-taught, (2) to have undergone training in a music academy with officially recognized professionals or at a conservatory, (3) to have been in training for a minimum of three years and always under the guidance of a teacher, (4) to be over 18 years of age, and (5) to give informed consent. The exclusion criterion was that the participant could not be currently experiencing pain due to trauma or illnesses unrelated to musical practice (e.g., trauma from accidents or illnesses with associated pain) and could not be taking medication for such conditions.

Instruments

Participants took part in an *ad hoc* interview to gather information on various demographic variables, including birth year and gender. Additionally, data related to their musical activity were collected, such as the number of years spent practicing music under the guidance of a teacher, the frequency of rehearsals per week, the number of hours of practice per week with a teacher (either in private, academy, or conservatory settings), the number of hours of solo practice per week, and the primary type of instrument played (e.g., wind, string, percussion, electric instruments). To exclude any potential references to painful experiences unrelated to musical practice (such as those resulting from illnesses, trauma, accidents, surgeries, etc.), participants were asked only about pain related to their musical activity. The information was requested as follows: “Considering that pain is a sensation, an unpleasant

emotional experience, which is usually associated with damage —either real or perceived — such as an injury or maintaining improper body postures for extended periods, *Have you ever felt pain that can be attributed to playing the instrument? In what areas of the body have you felt pain? And Have you ever had to stop playing the instrument for a period of time due to pain?*”

Pain catastrophizing was assessed using the Pain Catastrophizing Scale (PCS, Edwards et al., 2006; Sullivan et al., 1995) in its Spanish version validated in athletes by Olmedilla-Zafra et al. (2013). The PCS is a 13-item scale (e.g., When I feel pain..... “I worry about whether the pain will end”) in which participants take their past painful experiences as a reference and indicate the degree to which they experienced each of the 13 thoughts or feelings on a Likert scale ranging from 0 (never) to 4 (always). The total possible score is between 0 and 52 points, with low scores indicating low catastrophizing and high scores indicating high catastrophizing. The scale comprises three dimensions: a) rumination, the constant worry and inability to inhibit pain-related thoughts; b) helplessness, the perceived inability to cope with painful situations; and c) magnification, exaggeration of the unpleasantness of pain situations and expectations of negative consequences. In this study, the internal consistency, assessed by Cronbach’s alpha, was good for the total score ($\alpha = 0.929$) and for the dimensions of rumination ($\alpha = 0.855$), helplessness ($\alpha = 0.870$), and magnification ($\alpha = 0.804$).

The Acceptance and Action Questionnaire (AAQ-II, Bond, et al., 2011, in its adaptation to Spanish by Ruiz, et al., 2013) was used to assess psychological inflexibility. This instrument provides a general measure of psychological flexibility-inflexibility consisting of a 7-item questionnaire concerned with how the individual relates to their private events (e.g., thoughts, feelings, emotions, and memories) and to what extent they perceive these events as an obstacle to leading the life they wish (e.g., My memories of pain prevent me from leading a full life). Participants respond on a Likert-type scale (1: never to 7: always) to indicate the extent they believe the statements to be true. Low scores on the questionnaire indicate greater psychological flexibility, while high scores indicate greater inflexibility. The test used in this study has shown high internal consistency (Cronbach's $\alpha = 0.941$). To determine the relationship between the

level of flexibility and the rest of the variables, the participants were categorized according to tercile distributions of the total AAQ-II score (Gil-Roales-Nieto et al., 2016). Thus, three levels were established: High Inflexibility (≥ 34 points), Medium Inflexibility (21-33 points), and Low Inflexibility (≤ 20 points).

To measure perfectionism, we used the short version of the Multidimensional Inventory of Perfectionism in Sport (MIPS, Stoeber et al., 2006) in its Spanish version, adapted by Pineda-Espejel et al. (2017). This instrument is a general measure of perfectionism, with the presented items specifically contextualized for the target population. It is important to note that while the MIPS has not been adapted for use with music students, it has been employed in previous studies involving this population (Stoeber & Eismann, 2007; Stoeber & Rambow, 2007).

This instrument comprises ten items that begin with the following phrase, which is adapted to the musical context: “During rehearsal or performance in a show. . .” Five items assess Factor 1 (F1), “striving for perfection” (e.g., “I have the desire to do everything perfectly”), and the remaining five items assess Factor 2 (F2) “negative reactions to imperfection” (e.g., “I feel completely furious if I make mistakes”). The Likert-type response scale ranges from never (1) to always (6). The measure of total perfectionism was calculated by combining the scores of the striving for perfection and negative reactions to imperfection items. The scale has shown good internal consistency in the present study, assessed using Cronbach’s alpha, both for the total score ($\alpha = 0.897$) and the dimensions of perfectionism: striving for perfection ($\alpha = 0.896$) and negative reactions ($\alpha = 0.890$).

Procedure

The data collection process involved visiting various public music conservatories and private/public academies across four cities. Permission was sought from the management of these institutions to present the study in different classrooms and request volunteers. Upon receiving approval, researchers visited specific classrooms where participants completed the questionnaires. Additionally, an online survey was distributed through social networks and sent to conservatories nationwide for dissemination among students, producing a "snowball" effect. The online survey began by describing the research objectives, legal terms, and informed

consent for participation, which participants were required to accept before proceeding. This ensured that participants were fully informed and provided voluntary consent to participate in the study.

Data Analysis

An *a priori* power analysis was conducted using G*Power-3 (Faul et al., 2007) to determine the minimum sample size required to test the study hypothesis. The results indicated that $n = 147$ was the sample size required to achieve 95% power to detect a mean effect, with a significance criterion of $\alpha = 0.05$, for the Student's *t*-test for independent groups.

Descriptive analyses (frequencies, percentages, means, and standard deviation) were conducted to characterize the main research variables. The normality of the variables was confirmed using the Kolmogorov-Smirnov test. The reliability of the tests was calculated using Cronbach's alpha (α). The comparison of quantitative variables was carried out using the Student's *t*-test for independent groups. Effect size was estimated using Cohen's *d* ($d < 0.2$ - small effect size; $d = 0.2$ to 0.8 - medium effect size and $d > 0.8$ - large effect size). An ANOVA test was conducted for quantitative variables with more than two categories, with Snedecor's *F* statistic and Bonferroni's post hoc tests. Additionally, a univariate analysis of variance was performed. The effect size was calculated using Eta Squared η^2 , where the η^2 effect size coefficients were evaluated as follows: $0.01 \leq \eta^2 < 0.06$ = a small effect size, $0.06 \leq \eta^2 < 0.14$ = a medium effect size, and $\eta^2 \geq 0.14$ = a large effect size. For categorical variables, the Chi-Square test (χ^2) was used. To estimate the effect size for categorical variables, Cramer's *V* was applied (< 0.2 – small effect size; 0.2 to 0.6 – moderate effect size; > 0.6 – large effect size). Associations between variables were examined using Pearson correlations, and stepwise linear regression analysis was conducted to identify predictors of pain catastrophizing. All analyses were performed using the SPSS statistical package (IBM version 25.0, SPSS Inc., Armonk, NY, USA).

Results

Although the initial estimated sample size was 147 students, the final sample consisted of 145 participants. Using G*Power software to calculate statistical power, the sample size was

adjusted for ANOVA analysis with three comparison groups, a significance level (α) of .05, and a medium effect size ($f = .30$). This resulted in statistical power ($1 - \beta$) of .90, indicating a 90% probability of detecting an effect if one truly exists, given the final sample size. The achieved power is considered adequate for this type of analysis, ensuring a low probability of committing a Type II error.

As shown in Table 1, no gender differences were observed in these variables. The participants ($n=145$) indicated that they have been practicing with their musical instrument for more than 11 years, with no gender differences. Of the sample, 89.66% ($n=130$) of participants study at conservatories, accounting for 81.97% ($n=50$) of the men and 95.24% ($n=80$) of the women. In contrast, 10.34% ($n=15$) of the participants study at private academies, accounting for 18.03% ($n=11$) of the men and 4.76% ($n=4$) of the women. Additionally, participants reported practicing an average of two days per week, spending approximately three and a half hours per week playing their instrument with a teacher and nine hours independently. No gender differences were observed in these practice variables. Regarding specialization, 57.9% of the students focused on string instruments, 33.8% on wind instruments, and 8.3% on percussion instruments. However, a marginal gender difference emerged regarding the type of instrument specialization. Specifically, more women chose stringed instruments, whereas men favored percussion (Cramer's $V = 0.202$).

Table 1.- Social and music-related characteristics of the participants according to gender.

	Total 145	Men 61 (42.4)	Women 84 (57.9)	$t_{(df=143)}$	p
Age	27.77 (14.95)	28.34 (15.69)	27.36 (14.47)	0.391	.696
Practical time with teacher (months)	139.60 (70.45)	149.82 (84.79)	132.18 (57.27)	1.495	.137
Days/week rehearses with teacher	2.26 (1.47)	2.21 (1.49)	2.29 (1.46)	0.293	.770
Rehearsal time/week (min)					
With teacher	228.10 (245.19)	190.08 (170.74)	255.71 (285.31)	1.725	.087
Without teacher	540.6 (465.17)	541.48 (458.40)	540.00 (472.76)	0.019	.985
Specialty instrument				$\chi^2_{(2,145)} = 5.902.052$	
Wind	49 (33.8)	24 (39.4)	25 (29.8)		
String	84 (57.9)	29 (47.5)	55 (65.5)		
Percussion	12 (8.3)	8 (13.1)	4 (4.8)		

Note: For quantitative variables, $M (SD)$; for categorical variables, $n (%)$.

The data presented in Table 2 regarding pain and its association with musical activity reveal that 91.0% of music students reported experiencing pain attributed to playing their instrument. However, no significant differences emerged between men and women ($\chi^2_{(1,145)} = 0.098, p = .755$). Additionally, 42.1% of participants reported instances where they have had to cease playing their instrument due to pain, with no differences according to gender ($\chi^2_{(1,145)} = 1.557, p = .212$).

Table 2.- Pain, consequences, and body area affected by pain in the sample of music students.

	Total 145		Men 61 (42.4)		Women 84 (57.9)		$\chi^2_{(df=1, 145)}$	<i>p</i>
	Yes	No	Yes	No	Yes	No		
Pain related to playing an instrument	132 (91.0)	13 (9.0)	55 (90.2)	6 (9.8)	77 (91.7)	7 (8.3)	0.098	.755
Stop playing instrument because of pain	61 (42.1)	84 (57.9)	22 (36.1)	39 (63.9)	39 (46.4)	45 (53.6)	1.557	.212
Body area felt pain								
Head/mouth/jaw	64 (44.1)	81 (55.9)	24 (39.3)	37 (60.7)	40 (47.6)	44 (52.4)	0.981	.322
Neck	60 (41.4)	85 (58.6)	16 (26.2)	45 (73.8)	44 (52.4)	40 (47.6)	9.963	.001
Right shoulder	31 (21.4)	114 (78.6)	9 (14.8)	52 (85.2)	22 (26.2)	62 (73.8)	2.750	.097
Left shoulder	38 (26.2)	107 (73.8)	9 (14.8)	52 (85.2)	29 (34.5)	55 (65.5)	7.142	.008
Right elbow	7 (4.8)	138 (95.2)	2 (3.3)	59 (96.7)	5 (6.0)	79 (94.0)	0.550	.458
Left elbow	9 (6.2)	136 (93.8)	4 (6.6)	57 (93.4)	5 (6.0)	79 (94.0)	0.022	.882
Right arm	35 (24.1)	110 (75.9)	12 (19.7)	49 (80.3)	23 (27.4)	61 (72.6)	1.147	.284
Left arm	31 (21.4)	114 (78.6)	10 (16.4)	51 (83.6)	21 (25.0)	63 (75.0)	1.557	.212
Wrist/right hand	54 (37.2)	91 (62.8)	15 (24.6)	46 (75.4)	39 (46.4)	45 (53.6)	7.211	.007
Wrist/left hand	38 (26.2)	107 (73.8)	11 (18.0)	50 (82.0)	27 (32.1)	57 (67.9)	3.638	.056
Fingers right hand	30 (20.7)	115 (79.3)	11 (18.0)	50 (82.0)	19 (22.6)	65 (73.4)	0.453	.501
Fingers left hand	37 (25.5)	108 (74.5)	14 (23.0)	47 (77.0)	23 (27.4)	61 (72.6)	0.365	.546
Upper back	59 (40.7)	86 (59.3)	16 (26.2)	45 (73.8)	43 (51.2)	41 (48.8)	9.123	.003
Lower back	44 (30.3)	101 (69.7)	17 (27.9)	44 (72.1)	27 (32.1)	57 (67.9)	0.305	.581
Waist/hips	8 (5.5)	137 (94.5)	4 (6.6)	57 (93.4)	4 (4.8)	80 (95.2)	0.219	.640
Feet/knee/legs	11 (7.6)	134 (92.4)	6 (9.8)	55 (90.2)	5 (6.0)	79 (94.0)	0.760	.383

Note: For categorical variables, *n* (%)

Inspection of the specific areas of the body experiencing pain revealed that women showed a significantly greater tendency to identify the neck, left shoulder, right wrist/hand, and upper back as the affected areas. Conversely, marginal differences were observed when indicating the left wrist/hand as the affected area.

The Kolmogorov-Smirnov test was conducted to assess the normality of the variables. The results confirmed normal distributions for psychological inflexibility ($Z = 1.291, p = .071$),

pain catastrophizing ($Z = 0.746, p = .634$), rumination ($Z = 1.169, p = .130$), magnification ($Z = 1.120, p = .135$), helplessness ($Z = 1.143, p = .147$), perfectionism ($Z = 0.794, p = .554$), striving for perfection ($Z = 1.219, p = .103$) and negative reactions ($Z = 0.986, p = .286$).

No significant gender differences were observed for total pain catastrophizing scores ($t = 1.711, p = .089$), rumination ($t = 1.287, p = .200$), or magnification ($t = 0.674, p = .501$). However, such differences were found for helplessness ($t = 2.340, p = .021$), with women scoring higher ($M = 9.79, SD = 5.38$) than men ($M = 7.77, SD = 4.74$). Moreover, women obtained higher scores in psychological inflexibility ($t = 2.140, p = .034$) compared to men ($M = 23.30, SD = 11.20$ for women; $M = 19.75, SD = 8.73$ for men). Regarding perfectionism, significant differences were found in the total perfectionism score ($t = 3.892, p < .001$), with women scoring higher ($M = 42.80, SD = 10.68$) than men ($M = 36.16, SD = 9.33$). Adaptive perfectionism scores also differed between genders ($t = 2.440, p = .016$), with women ($M = 23.07, SD = 5.79$) scoring higher than men ($M = 20.77, SD = 5.34$). Similar differences were observed for maladaptive perfectionism ($t = 4.121, p < .001$), with women ($M = 19.73, SD = 6.69$) also obtaining higher scores than men ($M = 15.39, SD = 5.59$).

To control for the potential mediation effect of gender, a univariate analysis of variance (ANOVA) was conducted. When pain catastrophizing was used as the dependent variable, gender had no significant influence ($F(1,144) = 2.177, p = .143$). However, psychological inflexibility was significant ($F(38,144) = 1.951, p = .004$). Perfectionism was significant when taken as a fixed factor in the analysis ($F(36,144) = 1.5959, p = .035$), but gender was not ($F(1,144) = 0.260, p = .611$).

Table 3.- Total scores and scores on the catastrophizing and perfectionism tests according to the categories of psychological inflexibility in music students.

	Total 145	Low inflexibility (a) 78 (53.8)	Medium inflexibility (b) 43 (29.7)	High inflexibility (c) 24 (16.6)	$F_{(2, 144)}$	p
AAQ-II-	21.81 (10.35)					
PCS	21.90 (11.55)	17.86 (10.29)	24.00 (8.22)	31.25 (14.23)	16.151	< .001
PCS-Rumination	7.92 (4.19)	6.54 (3.79)	9.05 (3.46)	10.38 (4.93)	11.363	< .001

	Total 145	Low inflexibility (a) 78 (53.8)	Medium inflexibility (b) 43 (29.7)	High inflexibility (c) 24 (16.6)	$F_{(2, 144)}$	p
PCS Helplessness	8.94 (5.19)	7.22 (4.66)	9.58 (3.60)	13.38 (6.44)	16.153	< .001
PCS Magnification	5.04 (3.38)	4.10 (3.103)	5.37 (2.94)	7.50 (3.68)	10.963	< .001
MIPS	40.01 (10.62)	36.13 (9.80)	42.07 (9.59)	48.92 (8.63)	17.853	< .001
MIPS—striving for perfection	22.103 (5.70)	20.94 (5.53)	21.98 (5.60)	26.13 (4.73)	8.402	< .001
MIPS—negative reactions	17.903 (6.59)	15.19 (6.09)	20.09 (5.72)	22.79 (5.38)	19.621	< .001

Note: For quantitative variables, $M (SD)$; for categorical variables, $n (%)$. PCS, Pain Catastrophizing Scale; AAQ-II, Acceptance and Action Questionnaire-II; MIPS, Multidimensional Inventory of Perfectionism in Sport.

Table 3 presents the scores obtained in pain catastrophizing and perfectionism, categorized based on levels of psychological inflexibility: a) low inflexibility ($n=78$, 53.8%), b) medium inflexibility ($n=43$, 29.7%), and c) high inflexibility ($n=24$, 16.6%). An ANOVA revealed significant differences in the total pain catastrophizing score between the three groups, with a large effect size ($\eta^2 = 0.180$). Post hoc comparisons indicated that group $a < b$ ($p = .007$), $b < c$ ($p = .023$), and $a < c$ ($p < .001$). Similar significant differences, with a large effect size ($\eta^2 = 0.185$), were also observed in the helplessness dimension: group $a < b$ ($p = .028$), $b < c$ ($p = .006$) and $a < c$ ($p < .001$). Regarding the rumination dimension, significant differences, with a large effect size ($\eta^2 = 0.140$), were found primarily in the low inflexibility group (group $a < b$, $p = .003$; $a < c$, $p < .001$), with no differences observed between group $b = c$ ($p = .555$). For the magnification dimension, significant differences were also observed, with a medium effect size ($\eta^2 = 0.135$), primarily driven by the high inflexibility group, where group $a = b$ ($p = .108$), $b < c$ ($p = .027$) and $a < c$ ($p < .001$).

Furthermore, significant differences were also observed in the total perfectionism score among the three groups, with a large effect size ($\eta^2 = 0.201$). Post hoc comparisons revealed that group $a < b$ ($p = .004$), $a < c$ ($p < .001$), and $b < c$ ($p = .017$). Regarding adaptive perfectionism (striving for perfection), the group differences show a medium effect size ($\eta^2 = 0.106$), with post-hoc comparisons revealing that the main source of these differences was the high psychological inflexibility group, with group $a = b$ ($p = .943$), $a < c$ ($p < .001$) and $b < c$ ($p = .010$). Concerning differences in maladaptive perfectionism (negative reactions), the effect size

was large ($\eta^2 = 0.216$), with significant differences found in the low inflexibility group.

Specifically, group $a < b$ ($p < .001$), $a < c$ ($p < .001$) and $b = c$ ($p = .220$).

When students were asked, “Have you ever noticed pain that you can attribute to playing your instrument?” there was an absence of differences between those who responded ‘yes’ and those who did not. In particular, no differences were observed for psychological inflexibility ($t = 0.799, p = .426$), total perfectionism ($t = 1.154, p = .251$), the striving for perfection subscale ($t = 0.884, p = .378$), and negative reactions subscale ($t = 1.093, p = .276$).

However, differences were observed in pain catastrophizing ($t = 2.934, p = .004$), with students who responded ‘yes’ ($M = 22.76, SD = 11.16$) scoring higher than those who did not ($M = 13.15, SD = 12.28$). These differences were also evident across all subscales. Thus, for the rumination subscale ($t = 2.321, p = .022$), those who responded ‘yes’ ($M = 8.17, SD = 4.05$) scored higher than those who did not ($M = 5.38, SD = 4.82$); for the magnification subscale ($t = 3.066, p = .003$), students who responded ‘yes’ ($M = 5.30, SD = 3.30$) scored higher compared to those who did not ($M = 2.38, SD = 2.96$). Finally, for the helplessness subscale ($t = 2.636, p = .009$), those who responded ‘yes’ ($M = 9.29, SD = 5.09$) again scored higher than those who did not ($M = 5.38, SD = 5.17$).

Moreover, when asked, “Have you ever had to stop playing the instrument for a period of time because of pain?” we also found no differences in psychological inflexibility ($t = 0.580, p = .563$), total perfectionism score ($t = 1.797, p = .074$), the striving for perfection subscale ($t = 1.744, p = .083$), and negative reactions ($t = 1.380, p = .170$).

However, similar to the previous question, differences were observed in pain catastrophizing ($t = 4.273, p < .001$), where those students who responded ‘yes’ ($M = 26.44, SD = 11.81$) scored higher than those who did not ($M = 18.60, SD = 10.22$). These differences were observed across all subscales. Specifically, for the rumination subscale ($t = 3.553, p = .001$), ‘Yes’ respondents obtained a mean score of 9.31 ($SD = 3.88$) compared to a mean score of 6.90 ($SD = 4.13$) for ‘No’ respondents; for the magnification subscale ($t = 3.612, p < .001$) ‘Yes’ respondents obtained a mean score of 6.18 ($SD = 3.37$) compared to 4.21 ($SD = 3.13$) for ‘No’ respondents and, finally, for the helplessness subscale ($t = 4.021, p < .001$) ‘yes’ respondents

obtained a mean score of 10.95 ($SD = 5.66$) and those who report that they not have stopped playing their instrument obtained a mean score of 7.48 ($SD = 4.31$).

Correlation analysis of the study variables revealed significant correlations among them (Table 4). Specifically, pain catastrophizing scores show significant correlations with psychological inflexibility and perfectionism, both in their total scores and in the adaptive (striving for perfection) and maladaptive (negative reactions) subscales.

Table 4.- Pearson correlations between catastrophism, psychological inflexibility, and perfectionism (adaptive–disadaptive).

<i>r/p</i>	1	2	3	4	5	6	7	8
1Pain catastrophizing	1							
2Rumination	.901/<.001	1						
3Magnification	.893/<.001	.756/<.001	1					
4Helplessness	.918/<.001	.707/<.001	.728/<.001	1				
5Psychological inflexibility	.398/<.001	.323/<.001	.357/<.001	.394/<.001	1			
6Perfectionism	.328/<.001	.293/<.001	.290/<.001	.306/<.001	.477/<.001	1		
7Striving for perfection	.168/.044	.164/.049	.158/.057	.138/.097	.296/<.001	.841/<.001	1	
8Negative reactions	.384/<.001	.330/<.001	.331/<.001	.373/<.001	.513/<.001	.884/<.001	.491/<.001	1

Note: Pearson's *r*/significance.

Scores on the rumination subscale showed significant correlations with psychological inflexibility and perfectionism for both the total score and the two subscales. However, both the magnification and helplessness subscales show significant correlations with all test scores except for adaptive perfectionism (striving for perfection).

Table 5.- Lineal regression analysis, taking pain catastrophizing as the predicted variable and perfectionism and psychological inflexibility as predictor variables, in music students.

	β	<i>t</i>	<i>p</i>	R^2	ΔR^2	<i>p</i>	<i>F</i>	<i>p</i>
Model 1				.159	.159	<.001	$F_{(1,144)} = 26.969$	<.001
Psychological inflexibility	.398	5.193	<.001					
Model 2				.161	.003	.500	$F_{(2,144)} = 13.662$	<.001
Psychological inflexibility	.382	4.750	<.001					
Striving for perfection	.054	0.676	.500					
Model 3				.204	.043	.007	$F_{(3,144)} = 12.049$	<.001
Psychological inflexibility	.276	3.147	.002					
Striving for perfection	-.044	0.506	.614					
Negative reactions	.264	2.749	.007					

When generating regression models (Table 5), with pain catastrophizing as the predicted variable, it is observed that psychological inflexibility accounts for 15.9% of the variance, with a predictive power of $\beta = .398$ and a semi-partial correlation of .398. While the contribution made by adaptive perfectionism (striving for perfection) is not significant, it marginally increases the model's explanatory power to 16.1%. Finally, maladaptive perfectionism (negative reactions) makes a significant contribution, with the model explaining 20.4% of the variance in pain catastrophizing. However, psychological inflexibility lowers its predictive power to $\beta = .276$, with a semi-partial correlation of .236, while the negative reactions subscale has a predictive power of $\beta = .264$ and a semi-partial correlation of .207.

Discussion

Pain catastrophizing is considered a treatable psychological factor contributing to pain perception. Thus, our study aimed to provide insights into how psychological inflexibility and perfectionism are related to pain catastrophizing in a sample of music students.

Our first hypothesis predicted a negative relationship between psychological flexibility and pain catastrophizing scores. The results confirmed this hypothesis, revealing a statistically significant relationship between higher psychological flexibility and lower pain catastrophizing scores. These findings align with previous research indicating that pain acceptance is an important component of psychological flexibility (Arbinaga, 2023b; Deval et al., 2017) and that psychological inflexibility correlates positively with high catastrophizing scores. Thus, psychological inflexibility could facilitate the use of pain avoidance strategies (such as temporarily discontinuing instrumental practice) by exacerbating behavioral traits associated with catastrophizing.

The findings are also consistent with existing literature suggesting that psychological inflexibility plays a mediating role in the development and manifestation of pain catastrophizing

(Vowles et al., 2008) in both clinical and non-clinical populations (Cobos-Sanchez et al., 2022; Ugur et al., 2021) across various performance domains (Chen et al., 2017; Zhang et al., 2014). It is worth noting that when music students were categorized into low, medium, and high psychological inflexibility, as proposed in prior research (Gil-Roales-Nieto et al., 2016), a positive relationship was found between the levels of this construct and pain catastrophizing scores. This indicates the negative correlation between psychological inflexibility and perceived health and emotional well-being, as previously documented (Hayes et al., 2014).

Furthermore, supporting the notion that psychological inflexibility plays a central role in the expression of pain catastrophizing (Arbinaga, 2023a; Vowles et al., 2008), our findings revealed that the dimensions of catastrophizing (rumination, helplessness, and magnification) showed distinct relationships with psychological inflexibility. Specifically, higher inflexibility scores were associated with increased feelings of helplessness in response to pain. Conversely, students in the low inflexibility group demonstrated lower tendencies toward rumination than those in the medium and high inflexibility groups. Similarly, it was observed that individuals in the higher inflexibility group displayed greater magnification of pain.

Taken together, the results confirm that psychological inflexibility is characterized by a dominance of rigid coping strategies, focusing on unhelpful internal events at the expense of effective actions, thoughts, and adaptive emotions (Bond et al., 2011; Cobos-Sanchez et al., 2022; Peltz et al., 2020; Ugur et al., 2021). Thus, music professionals and students engaged in high-performance activities may show less effective behaviors, consequently missing out on opportunities to achieve optimal performance (Moore, 2009).

The results supported the second hypothesis, which posited that high scores in perfectionism and maladaptive perfectionism would be positively and significantly related to greater pain catastrophizing. Our findings revealed that perfectionism was positively correlated with pain catastrophizing in its total score and the rumination, magnification, and helplessness subscales. Similar positive and significant relationships were also observed for negative reactions. These results align with previous research indicating that individuals with elevated scores in socially prescribed perfectionism and self-oriented perfectionism were more likely to

catastrophize pain (Rudolph et al., 2007) and show dependent behaviors such as avoidance (Sherry et al., 2003).

However, among professional musicians, the observed relationship between perfectionism and pain is less clear. For instance, musicians with acute pain linked to focal dystonia (involuntary muscle contractions) have shown higher levels of perfectionism than controls, whereas those with chronic pain did not differ in perfectionism scores compared to control participants (Jabusch et al., 2004). These findings contrast with studies in other contexts, where individuals with pain have consistently shown higher perfectionism scores than those without pain (Dubé et al., 2024; Xiong et al., 2023). These apparent discrepancies may arise from not distinguishing between different dimensions of perfectionism, as the construct is often measured as a single overall score.

Regarding the third hypothesis, the findings do not support the predicted negative relationships between adaptive perfectionism and pain catastrophizing. Instead, positive and significant associations were observed between adaptive perfectionism and pain catastrophizing, consistent with prior research (Dubé et al., 2024; Gonzalez et al., 2019; Kemple et al., 2016; Xiong et al., 2023). However, it is noteworthy that these significant relationships were weaker than those observed between maladaptive perfectionism and pain perception. Moreover, the magnification and helplessness scales demonstrated associations with maladaptive perfectionism but not with striving for perfection. Regression analyses further revealed that adaptive perfectionism did not significantly predict pain catastrophizing, whereas maladaptive perfectionism contributed to increased explanatory power in the models and showed a significant predictive capacity for pain perception (Dubé et al., 2024; Kemple et al., 2016; Xiong et al., 2023).

These findings align with an earlier interpretation. While the tendency to pursue perfection is widespread among musicians, differences will likely arise in how individuals respond to challenges and setbacks. It is here that the characteristics of adaptive perfectionism could emerge. Adaptive perfectionism entails striving for excellence without magnifying errors

or feeling helpless in the face of obstacles. Instead, it involves employing resilient strategies to address adversities more effectively (Arbinaga, 2023b).

Perfectionism is characterized not only by high personal demands but also by a tendency toward negative self-evaluation and criticism of mistakes (Flett & Hewitt, 2002; Frost et al., 1990; Hewitt & Flett, 1991; Khawaja & Armstrong, 2005). This critical self-evaluation has been linked to dysfunctional traits (Khawaja & Armstrong, 2005). In the present context, instrumental musicians experiencing pain may find it exceptionally difficult to achieve optimal performance (Hansen & Reed, 2006), leading to compromised movement execution and adverse effects on musical interpretation (Engquist et al., 2004).

In addition, perfectionism may often be associated with the performer's subjective perception of perfection rather than accomplishing an objectively flawless performance (O'Riordan & Griffith, 2014). Particularly for students, the measure of success in their performance is frequently determined by the preferences of their audience, comprising family members, teachers, and peers, among others (Aydın-Almac, 2022) or by the perfectionist standards set by their instructors, as exemplified in the concept of "other-oriented perfectionism" (Flett & Hewitt, 2002). Consequently, this dynamic can foster an over-preoccupation with errors, feelings of self-doubt, and high expectations of performance.

Perfectionism has long been characterized by cognitive rigidity and behavioral inflexibility (Crosby et al., 2011; Delor et al., 2019), which may lead individuals to persist with ineffective strategies despite situational demands, often resulting in suboptimal outcomes (Crosby et al., 2011). Such inflexibility has been associated with an exacerbation of pain frequency and intensity (Gonzalez et al., 2019; Kemple et al., 2016). It is worth noting that direct correlations between perfectionist tendencies and pain have yet to be consistently demonstrated, particularly among musicians experiencing chronic pain (Jabusch et al., 2004). However, research indicates that individuals with pain tend to exhibit higher levels of perfectionism than those without pain (Dubé et al., 2024; Xiong et al., 2023).

An aspect not examined in these investigations — which can significantly impact the outcomes of such studies — is the use of strategies for coping with adverse situations (Rosset et

al., 2022). For instance, it has been observed that music students with low resilience obtained high scores in the maladaptive factor of perfectionism, specifically negative reactions to imperfection (Arbinaga, 2023b), while no differences were found in the adaptive or functional factor of perfectionism (striving for perfection). This pattern of results might be taken to suggest that in high-performance contexts, there could be a generalized tendency to pursue optimal outcomes and to set goals for improvement; however, individuals are likely to differ in their reactions to the non-achievement of these goals.

As expected, students who have experienced pain related to playing an instrument or have had to temporarily cease playing due to pain tended to score higher on pain catastrophizing and its rumination, magnification, and helplessness subscales. However, there were no significant differences in perfectionism and psychological inflexibility among these groups. Furthermore, concerning the body areas affected by pain, women were more likely to report discomfort in the neck, left shoulder, right wrist/hand, and upper back. This observation is unsurprising, given the prevalence of female participants training in string instruments such as the violin and harp, which place significant demands on these particular body areas.

On the other hand, the data support previous findings indicating that female students report a greater presence of pain (Cruder et al., 2021) and face a higher risk of experiencing it [OR: 1.1-5.2] (Rodríguez-Romero et al., (2016), similar to trends observed among professional musicians (Baadjou et al., 2016). When considering specific body areas, differences between men and women were observed in the neck, left hand, right wrist and hand, and upper back. In this study, these areas of pain appear to relate to the instruments participants play, as women more frequently reported playing string instruments, which engage these body areas more intensively. It is worth noting that reports of affected body areas in this study are higher than those in previous studies, though the specific areas are consistent with prior findings (Cruder et al., 2018; Cruder et al., 2021; Rodríguez-Romero et al., 2016).

Finally, given the prevalence and impact of pain in the field of music, conservatories have the potential to become environments offering comprehensive support. Beyond providing musical and instrumental training, they could introduce programs focused on effective practice

techniques (Baadjou et al., 2014; Chełkowska-Zacharewicz & Baran, 2023). These initiatives would equip students—many of whom are future professionals—with the skills and resilience needed to meet the diverse challenges encountered in training and professional settings (Perkins et al., 2017; Rosset et al., 2022).

From this perspective, understanding behavior as context-dependent suggests that interventions should not only address pain perception—particularly through targeting pain catastrophizing—but also promote flexible coping strategies and adaptive perfectionism, which has shown beneficial effects in high-performance settings. Implementing such programs should be led by psychology professionals with expertise in managing the relevant variables analyzed here. Collaboration with the conservatory's management and teaching staff is essential to foster student well-being and development. By adopting this comprehensive approach, conservatories can more effectively mitigate the negative effects of maladaptive perfectionism among music students.

Limitations

The study has several limitations worth noting. Firstly, its cross-sectional design prevents establishing causal relationships among variables. Moreover, reliance on self-report measures may introduce response biases. Generalizing the results to professional musicians may also be challenging, given that the sample consists of students with different demands and experiences. Although prior studies have used the same instrument to assess perfectionism in musical contexts, it is important to recognize this as a limitation, as no studies have validated the test specifically for music students. Additionally, pain catastrophizing—as a measure of pain perception—has been assessed retrospectively, which imposes limitations on interpreting the results. This is particularly due to the potential for memory interference and the inherent limitations of self-reporting. It is also worth noting that no specific instrument was used to evaluate painful body areas; instead, students were presented with a list of areas and asked to indicate any affected by pain. Furthermore, as this study focused on pain perception, more detailed information on the presence of injuries, pain related to other conditions, its severity,

and its impact on the training process should have been provided. Another limitation in interpreting the results is the lack of control over the timing and academic period during data collection and the absence of an assessment of coping strategies that may influence and mediate pain perception.

Conclusion

Pain is highly prevalent among musicians, whether they are students or professionals. One psychological factor that has shown significant connections to pain experiences is pain catastrophizing, a way of perceiving pain through three dimensions: rumination, a sense of helplessness in controlling pain, and magnification of pain intensity. In the present study, psychological inflexibility was found to be closely related to pain catastrophizing. Specifically, greater inflexibility is associated with an increase in catastrophizing, which in turn promotes avoidance strategies that are often ineffective in reducing or resolving perceived pain. Moreover, perfectionism — whether adaptive or maladaptive — has a strong relationship with pain catastrophizing among music students. Both forms of perfectionism are linked to inflexible coping strategies, such as experiential avoidance, though the relationship is particularly pronounced with maladaptive perfectionism.

The evidence suggests that all three constructs—pain catastrophizing, psychological inflexibility, and perfectionism—are interrelated; however, further research is needed to clarify the nature and direction of these interactions. Current studies reveal gaps and inconsistencies that future work should address. Such insights will enable conservatories to implement comprehensive training strategies to more effectively address pain associated with music practice among students.

Funding: This work has been partially financed by the Scientific Policy Plan of the Center for Research in Contemporary Thought and Innovation for Social Development (COIDESO) and by the EPIT-UHU support to the Research Group CTS-980.

Institutional Review Board Statement: All procedures were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and

national) and the Declaration of Helsinki of 1975, revised in 2013. Approved by the Andalusian Ethics Committee of Biomedical Research (Evaluation Committee of Huelva. Internal Code: 2159-N-21. Date of approval:14 December 2021; Act: 11/21).

Informed Consent Statement: Informed consent was obtained from all individual participants included in the study.

Data Availability Statement: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest: The authors report no conflict of interest. The authors alone is responsible for the content and writing of the paper.

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