Helpless at the mercy of school noise? The role of self-efficacy in teachers' noise-related coping

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ABSTRACT

Emphasizing on noise-related self-efficacy, this study offers a novel, comprehensive examination of the complex interactions between noise sensitivity, annoyance, strain, and coping. Self-efficacy and coping as central psychological constructs have been understudied in this context. A quantitative online survey with 820 Germann school teachers, recruited through direct outreach and online advertising, was conducted and data was analysed using structural equation modelling (SEM). Results indicate that individual noise sensitivity has only a limited influence on annoyance and coping. In contrast, noise-related self-efficacy significantly reduces annoyance and strongly predicts behavioural coping, suggesting that self-effective teachers actively manage school noise. High noise sensitivity is associated with avoidance behaviour, while cognitive coping is used less frequently. None of the three identified coping styles significantly predicted noise-related strain, partly in line with previous findings. The study highlights the need for noise-focused interventions that strengthen cognitive coping strategies and enhance teachers' self-efficacy in managing school noise.

1. Introduction

Teachers make an unquestionable contribution to society as they play a crucial role in educating young people and forming the future generation of working professionals (Hargreaves, 2009). Capable and healthy teachers are therefore a key element for a functioning society. At the same time, there is a constantly growing shortage of teachers and high turnover rates, which can become a serious social concern (Skaalvik & Skaalvik, 2016; Toropova et al., 2020). Compared to other professions, teaching is associated with the highest levels of work-related stress (Iriarte Redín & Erro-Garcés, 2020), which can lead to more absenteeism, less professional commitment, and a higher probability of leaving the profession. This, in turn, entails significant economic costs (Iriarte Redín & Erro-Garcés, 2020; Junker et al., 2021; Kim et al., 2020). Teachers' work demands range from long working hours (Kim et al., 2020) and high emotional involvement (Iriarte Redín & Erro-Garcés, 2020) to interpersonal conflicts and classes with high student diversity (Junker et al., 2021; Skaalvik & Skaalvik, 2016).

Work-related stress can also be caused by school environment.

Noise is known to be the most significant environmental stress factor in the teaching profession (Rudow, 1999; Wischlitzki et al., 2020). School noises are primarily caused by teacher-student interactions and background noises coming from technical equipment or surroundings (Augustyńska et al., 2010; Tiesler & Oberdörster, 2008). Especially students' verbal and non-verbal behaviour – such as disruptions or lack of discipline, interest and motivation – are associated with noise levels and teachers' experienced stress (Iriarte Redín & Erro-Garcés, 2020; Junker et al., 2021; Kim et al., 2020; Kristiansen et al., 2014; Skaalvik & Skaalvik, 2016). These noise factors are intensified by poor room acoustics or insufficient structural conditions of the school building (Kristiansen, Persson, et al., 2011, 2014). Persistent work- and noise-related stress is associated with health problems, such as chronic fatigue, lack of energy, decreased cognitive and physical activity, cardiovascular diseases and burnout (Hagermoser Sanetti et al., 2020; Iriarte Redín & Erro-Garcés, 2020; Junker et al., 2021; Kristiansen, Persson, et al., 2011; Lin et al., 2020). These well-documented effects of

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work- and noise-related stress on teachers' health raise the question of how working conditions can be optimized to support teachers' well-being. The present study aims to examine the role of teachers' noise-related self-efficacy and coping within the complex interplay of noise-relevant constructs, including noise sensitivity and annoyance. Given this aim, the prevailing research question was whether and to what extent school noise influences teachers' perceptions and subsequent strain as a function of individual characteristics such as noise sensitivity, noise-related self-efficacy, and coping. The findings are intended to enhance occupational health and safety practices in schools. Therefore, we conducted an online survey among school teachers, employing both existing and adapted scales, and analysed the data using structural equation modelling.

1.1. Noise perceptions and teacher stress

Noise, or unwanted sound, poses significant risks to both physical and mental health (Kjellberg, 1990; Natarajan et al., 2023; Thompson et al., 2022). It can damage the sensitive structures of the inner ear through sudden intense sounds or prolonged exposure, resulting in temporary or permanent hearing impairment (Basner et al., 2014; Ising et al., 1996; Schneider et al., 2005). Noise-induced hearing loss is often associated with reduced speech comprehension, distorted sound perception, and symptoms such as tinnitus, elevated blood pressure, stress, and fatigue (Basner et al., 2014; Schneider et al., 2005). Beyond auditory effects, noise adversely affects sleep, mental well-being, cognitive performance, and learning, and can influence cognition and behaviour more broadly (Babisch, 2002; Basner et al., 2014; Berglund et al., 2000; Hygge et al., 2003; Lercher et al., 2003; Monteiro et al., 2018; Steinhardt et al., 2011; Tortorella et al., 2022). In addition, noise can impair speech communication and shape social behaviour, for example by promoting withdrawal or increased aggressiveness (Kjellberg, 1990; Schneider et al., 2005). Among psychological effects, noise annoyance is the most common reaction to noise (Jensen et al., 2018; Stansfeld & Matheson, 2003) and is linked to health problems and mental illness (Kjellberg, 1990). The main predictor for noise annoyance is volume (Kristiansen, Persson, et al., 2011), which can refer to the sound pressure level in dB(A) or perceived loudness (Hellbrück & Guski, 2018; Stansfeld & Matheson, 2003). Loudness perception is frequency-dependent, with a 10-dB increase at 1000 Hz roughly doubling loudness, whereas at 100 Hz it can increase perceived loudness by a factor of four to five (Hellbrück & Ellermeier, 2004; Hellbrück & Guski, 2018; Kjellberg, 1990). It can be stated, that the higher and longer the intensity and duration of noise, the more profound the effect (Ising et al., 1996; Natarajan et al., 2023).

Assessing noise annoyance requires considering attitudes toward the noise source, its predictability, controllability, as well as individual personality traits (Guski et al., 1999; Kristiansen, Lund, et al., 2011; Zimmer & Ellermeier, 1999), as noise is perceived as less disturbing when individuals hold a positive attitude toward the source (Kjellberg, 1990). Noise sensitivity as a stable personality trait increases individuals' response to noise in general (Job, 1999) and significantly affects noise annoyance (Shepherd et al., 2015; Zimmer & Ellermeier, 1999). Sensitive people are more likely to notice sounds, assess them more negatively and intrusive, have stronger emotional reactions and consequently find it more difficult to adapt to them (Shepherd et al., 2015). In terms of a moderator variable, noise sensitivity can explain individual differences in the annoyance perception of the same noise (Stansfeld & Shipley, 2015; Van Kamp et al., 2004; Zimmer & Ellermeier, 1997, 1998). Noise sensitivity also influences how people appraise stressful environmental factors (Zimmer & Ellermeier, 1998) and is positively associates with health symptoms such as fatigue, headache, or ear symptoms (Baliatsas et al., 2016) up to psychological stress and depressive symptoms (Stansfeld & Shipley, 2015). It is typically assessed using self-report questionnaires that capture attitudes toward noise sources and emotional responses to sounds across different

environmental contexts, including their effects on sleep, communication, and health (Zimmer & Ellermeier, 1998, 1999). Interindividual differences in perceived noise annoyance to identical sounds can be attributed to individual noise sensitivity and are particularly well documented in traffic noise research.(Zimmer & Ellermeier, 1998, 1999). However, research on the impact of teachers' noise sensitivity is scarce. Correlations were found between noise sensitivity, noise-related symptoms and teachers' experienced stress pointing out the need of interventions for noise-sensitive teachers (Tomek, 2022; Tomek & Urhahne, 2023). The evaluation of noise sensitivity as part of the complex interactions between noise-relevant constructs is a sub-goal of our study. Given the lack of research on the (moderating) effects of noise sensitivity in the teaching profession, it is one of the key factors in our study leading us to the following hypotheses:

H1. Teachers' perceived loudness explains more variance in noise annoyance than noise sensitivity.

H2. Teachers' noise sensitivity moderates the relationship between their perceived loudness and noise annoyance.

1.2. Model of teacher stress

One of the best-established concepts in psychological stress research is the transactional stress model by Lazarus and Folkman (1984). Basically, the model suggests that stress arises from two cognitive appraisal processes when a person is exposed to a stressor: 1. In the process of primary appraisal, they assess if the stressor is relevant and if so, they determine if it's threatening, harmful, or challenging. 2. During the process of secondary appraisal, they evaluate whether their own coping strategies are sufficient to successfully deal with the situation. Consequently, stress occurs when a situation is threatening and there are no sufficient or appropriate coping mechanisms (Tomek, 2022).

These core assumptions were often adapted to a model explaining teacher stress assuming that stressors can be a variety of job demands (physical, psychological, social) (Kyriacou & Sutcliffe, 1978; Rothland & Klusmann, 2012; Rudow, 1999; Tomek, 2022). Teachers' stress experience depends on their subjective assessment of job demands (e.g., noise), which also relates to their individual personality traits such as self-efficacy or noise sensitivity (equals primary appraisal) and their own coping strategies (equals secondary appraisal) (Alhija, 2015; Kyriacou & Sutcliffe, 1978; Tomek, 2022). Each stress experience can cause short-term strain reactions (e.g., physiological activation), while persistently high stress levels can lead to medium- and long-term strain such as exhaustion or physical and mental illnesses (Kyriacou & Sutcliffe, 1978; Van Dick & Wagner, 2001). Research on the model show that the actual ability to cope is less important than teachers' belief of their abilities (Kyriacou & Sutcliffe, 1978). Consequently, the mere expectation of noise-related self-efficacy and coping abilities can be helpful for dealing with school noise and buffering related strain.

According to the model of teacher stress, it can be assumed that self-efficacy as a personality trait has an impact on the assessment of a stressor. Self-efficacy refers to a person's belief in their ability to achieve a specific goal (Lyons & Bandura, 2019). To reach this goal, self-efficacy determines which actions are taken, how much effort is being made, and how long those efforts persist despite overcoming obstacles (Schwarzer & Hallum, 2008).

Self-efficacy is area-specific, as one can be more self-confident in certain areas than in others. However, there is also a general self-efficacy, i.e., the overarching belief in one's own abilities when tackling demanding or novel situations (Schwarzer & Hallum, 2008). Teachers may have varying beliefs about their confidence in handling different job demands (e.g., noise exposure, student behaviour, time pressure). Skaalvik and Skaalvik (2010, p. 1059) define teacher self-efficacy "as individual teachers' belief in their own ability to plan, organize, and carry out activities that are required to attain given educational goals.". There are positive correlations between teacher

self-efficacy, performance, motivation, and student self-efficacy (Verešová & Malá, 2012). High self-efficacy also contributes to job satisfaction (Skaalvik & Skaalvik, 2010), increasing work effort, planning, and engagement with new methods (Verešová & Malá, 2012). Studies have also examined the link between self-efficacy and burnout. Schwarzer and Hallum (2008) could show that self-efficacy is a resource in coping with work-related stress and therefore lowers the likelihood of burnout. Skaalvik and Skaalvik (2010) found weak correlations between teacher self-efficacy and the two central burnout elements emotional exhaustion and depersonalization. While self-efficacy has been studied in relation to teachers' health, most studies solely focus on general self-efficacy. The impact of self-efficacy in specific areas, such as dealing with noise, has been widely overlooked. Therefore, our study focuses on the effects of noise-related self-efficacy on teacher stress. As we developed and used a scale to measure noise-related self-efficacy for the first time, we posed the following research question:

RQ_1: What different types of noise-related self-efficacy can be identified among teachers?

Effective coping is a key requirement for successful stress management. Ineffective coping-styles, however, can increase the risk for burnout as teachers are then less tolerable against stress experiences (Herman et al., 2020; Rudow, 1999; Verešová & Malá, 2012). Coping is defined as a person's ability to deal with (job) demands that are perceived as threatening as they exceed their own personal resources (Pogere et al., 2019). There are different ways to classify coping strategies, among the most common are the following (Carver & Connor-Smith, 2010; Folkman, 1997; Lazarus & Folkman, 1987): 1) *problem-focused coping* vs. *emotion-focused coping*, 2) *engagement coping* vs. *disengagement coping,* 3) *accommodative coping* vs. *meaningful coping*, and 4) *proactive coping*. As the classification of different coping styles is not always distinct, it is often operationalized differently in scientific research.

Wang et al. (2022) identified three main coping profiles (adaptive, social-withdrawal, problem-avoidant) among nearly 950 Canadian teachers. Adaptive copers showing high problem-solving and social support coping had the best patterns in terms of well-being, emotional exhaustion and intentions to quit, while the results for the social-withdrawal copers were the least favourable. Aulén et al. (2021) analysed not only the type of coping strategy (problem-focused, emotion-focused) being used by teachers, but also the quantity of strategies being used (low-vs. high-coping users). They found that teachers who used fewer coping strategies overall (i.e., low-coping users) showed the best results in terms of their own well-being (e.g., stress, depressive symptoms, sleep problems), suggesting that the type of problem solving is more important than the number of strategies being used. In a study by Verešová and Malá (2012) problem-focused coping was also shown to be beneficial in terms of stress experience and indicated a strong positive correlation with teacher self-efficacy. In addition, the link between coping and self-efficacy was shown by Herman et al. (2020): Teachers, who were characterized by high stress levels and less coping, showed lower self-efficacy and higher burnout scores (Herman et al., 2020). This raises the question of whether the association between self-efficacy and coping is moderated by individual noise sensitivity. As noise-sensitive individuals tend to perceive sounds more negatively, show stronger emotional reactions, and exhibit reduced habituation, this circumstance might influence their perceived ability to manage noise (i.e., noise-related self-efficacy) and, in turn, their available coping strategies (Shepherd et al., 2015).

The relationship between noise perception and coping has mainly been analysed in traffic and aircraft noise research. In this context, short-term coping strategies focus on immediate actions to alleviate discomfort from noise, such as problem-solving, emotional regulation, or escaping the noise. Long-term coping strategies for noise issues include actions like changing regulations, relocating, or complaining to authorities, while some individuals may refrain from coping due to lack of perceived annoyance or learned helplessness, potentially leading to negative mental health outcomes and increased health risks (Bartels et al., 2022). However, the relationship between coping and noise among teachers has been studied very rarely. Tomek and Urhahne (2022) found that teachers with high levels of professional commitment and resilience (healthy coping type) are less likely to show noise-related stress and strain and suggested that teachers using this coping style are able to successfully deal with school noise. Both, this study and the studies mentioned before raise the question of the applicability of coping – either to school as a workplace or to noise as a stress factor. A scale that measures noise-related coping and relates to the teaching profession does not yet exist. We have addressed this issue by developing a scale, which leads to the following research question:

RQ_2: What different types of noise-related coping can be identified in teachers?

The previous findings on self-efficacy, coping and noise-related variables such as sensitivity and annoyance are the scientific basis for our study objective and lead us to the following assumptions:

H3. There is a correlation between perceived noise annoyance and noise-related coping among teachers.

H4. There is a correlation between noise-related self-efficacy and noise-related coping.

H5. The relationship between noise-related self-efficacy and noise-related coping is moderated by noise sensitivity.

H6. Dispositional factors such as noise sensitivity and noise-related self-efficacy can predict noise-related coping.

Regardless of the type of operationalization and the field of investigation, all above mentioned results show that coping, especially the problem-focused approach, has a positive effect on work-related stress and strain, leading us to our hypothesis:

H7. There is a correlation between noise-related coping and perceived strain.

2. Method

2.1. Research procedure and sample

All underlying data were obtained from an online questionnaire conducted between March and November 2022 using the survey software LamaPoll (Lamano GmbH & Co. KG, Berlin, Germany). The questionnaire was disseminated via the website of the Occupational Health Institute for Schools and through representatives of staff councils and professional associations. The target population comprised teachers and teaching staff across all school types in Germany, to whom the questionnaire instructions were explicitly addressed; no further differentiation was applied, and a simple random sampling approach was used.

The sample included 820 participants in total. According to the power analysis, achieving a medium effect size of $R^2 = .13$ with a power of 90 % and an alpha level of $\alpha = .001$ in a regression analysis with seven predictors requires a sample size of 226. Therefore, the present sample size can be considered sufficient for the analysis (Cohen, 1977).

To address any potential concerns about data privacy and encourage participation, participants were given the option to complete the questionnaire without providing socio-demographic details. A total of 164 participants chose this option. As a result, the sample size for socio-demographic characteristics in Appendix A differs from the overall sample. Teachers represented the majority of participants ($n = 515$; 79 %), followed by headmasters/headmistresses ($n = 75$; 12 %) and other school staff with teaching responsibilities ($n = 64$; 10 %). The sample included 448 women (69 %), 199 men (31 %) and one non-binary

person (0,2 %). By the time the survey was conducted about 65 % of respondents were between the ages of 35 and 54. The gender and age distribution of the sample closely reflects the demographics of German—and particularly Bavarian—school teachers (Bayerisches Staatsministerium für Unterricht und Kultus, 2024; Statistisches Bundesamt, 2025a). School staff from all types of schools were represented, with primary schools ($n = 126$; 18 %), grammar schools ($n = 353$; 51 %), and vocational schools ($n = 105$; 15 %) being the most prevalent. Primary and grammar schools constitute the largest share of school types in Germany (Statistisches Bundesamt, 2025b).

2.2. Research instruments

In addition to sociodemographic items, the online questionnaire assessed the key variables relevant to the study's central research question, as outlined below.

2.2.1. Loudness and noise annoyance

Loudness and annoyance were each assessed with a single item. Participants responded to the question, "Thinking back to the last four weeks of classroom teaching, how loud was the noise at school?" on a 6-point scale (1 = very soft to 6 = painfully loud). This scale for measuring loudness follows the category partitioning (CP) method outlined by Heller (1985, p. 479; 1991). Participants were then asked to rate the perceived noise annoyance based on the following question: "Thinking back to the last four weeks of classroom teaching, how annoyed or disturbed did you feel by the noise at school?". This scale ranged from 1 (*not at all*) to 6 (*more than extremely*) and was adapted from the categories for assessing noise annoyance proposed by the International Commission on the Biological Effects of Noise (ICBEN; Fields et al., 2001). To maintain a consistent response format, we followed an approach used in previous experimental studies (e.g., Keilhacker, 2013) and added an additional category to the original 5-point scale (i.e., 6 = more than extremely). Both single-item scales are well-established methods of categorization in psychoacoustic research (Fields et al., 2001; Hellbrück & Ellermeier, 2004).

2.2.2. Noise sensitivity

Noise sensitivity was measured with the short form of the Noise Sensitivity Questionnaire of Zimmer and Ellermeier (1998). The questionnaire consists of nine items, which assess perceptual, affective, cognitive and behavioural noise sensitivity, which allows an extensive assessment. An exemplary question is "Even in a noisy environment I can work efficiently and focused.", which could be evaluated on a 6-point scale ranging from 1 (*does not apply at all*) to 6 (*fully applicable*). Item and scale indices of this questionnaire have been proven to be of satisfactory psychometric quality (Zimmer & Ellermeier, 1998).

2.2.3. Noise-related self-efficacy

Due to the domain-specific nature of self-efficacy (Schwarzer & Hallum, 2008), the use of a general self-efficacy scale did not seem to be sufficient to address our hypotheses. A noise-related self-efficacy scale was therefore needed to be able to make precise predictions for noise exposure in schools. As there is no established noise-related self-efficacy scale yet, we developed an 8-item scale based on the existing and well-validated 10-item General Self-Efficacy Scale (GSES) by (Schwarzer & Jerusalem, 1995a, 1995b). We chose this scale as a template because it has been used in different samples and contexts over the past decades and has shown good psychometric parameters. Furthermore, the GSE has often been used as template for developing self-efficacy scales for various occupations (e.g., general teacher self-efficacy) (Schwarzer & Schmitz, 1999). Our noise-related self-efficacy scale measures teachers' beliefs, that they are able to successfully master noise-related stress at work, whereby success is attributed to their own competence. All questions could be rated on a 6-point scale ranging from 1 (*does not apply at all*) to 6 (*fully applicable*). Table B.1 in Appendix B provides an

overview of the verbalized items as well as the factor loadings of the confirmatory factor analysis. Further test results and reliability indices are described in the results.

2.2.4. Noise-related coping

The items for noise-related coping were derived from Carver's Brief COPE (Carver, 1997), the short form of Carver's COPE Inventory (Carver et al., 1989). It measures 14 conceptually different coping styles, each with two items. The scale ought to determine someone's primary coping styles based on problem-focused coping, emotion-focused coping and avoidant coping. We decided to use this questionnaire as a baseline for developing our own scale, as the COPE Inventory has proven to be particularly useful in the health-related field and because of its satisfying psychometric structure. Although each subscale consists of only two items, their reliabilities are all between .5 and .9, which are considered acceptable to excellent values. In order to design a practical coping scale based on noise theory, we had to translate the items into German, adapt their content accordingly and omit the subscales that would have been inappropriate or not relevant in terms of noise exposure at school (e. g., *religion*). We included the subscales *active coping*, *planning*, *positive reframing*, *acceptance*, *using instrumental* support, *self-distraction*, *denial*, *behavioural disengagement*, and *self-blame*, and added two self-defined items that can be best described as *avoidance*. In total the scale consisted of 20 items to measure noise-related coping. Table B.2 in Appendix B shows the results of the factor analysis for the remaining items. Further results, including the explanation for the exclusion of certain items, are presented and described in the results.

2.2.5. Perceived strain

Since there is no dedicated noise-related strain questionnaire, we created items based on theory-driven assumptions and established instruments. To capture all aspects of medium-term strain reactions, we followed the framework for categorizing empirical studies on workload and strain in the teaching profession (Rothland & Klusmann, 2012), which includes psychophysiological, affective, cognitive, and behavioural strain. Items assessing psycho-physiological symptoms were based on the 25 most common somatic complaints from SOMS-2 questionnaire (Herr et al., 2009), with irrelevant or inappropriate items excluded. Psycho-physiological strain was measured using two items each for *headaches, muscle tension, digestion, heart and circulation, sleep,* and *voice and hearing*. Cognitive and affective strain items were based on known noise reactions (e.g., fatigue, irritability) (Kjellberg et al., 1996), and one item on behavioural strain ("I often reach for stimulants (nicotine, alcohol)") was added. Some items were adapted from the Stress and Coping Inventory (SCI) (Satow, 2024). We added the term "often" to each question to capture symptoms that occur beyond normal or random instances. Confirmatory factor analysis revealed one factor (excluding the question on behavioural strain), with factor loadings above .40 for the remaining 19 items. The scale showed high internal consistency with a Cronbach's alpha of .91.

3. Results

Data were analysed with IBM SPSS Statistics 28 and IBM SPPS AMOS 29.

Firstly, we were interested in the research question, what different types of noise-related coping can be identified among teachers. To address this question, we conducted a confirmatory factor analysis. The principal axis factoring with varimax rotation for all twenty items resulted in a five-factor solution. The results suggested the exclusion of five items, as they did not load sufficiently high on any of the five factors. A repeated factor analysis confirmed three factors on which all remaining items scored sufficiently high (see also Table B.2 in Appendix B). The three factors could be assigned to theoretical considerations. The first factor, consisting of seven items, can be understood as *cognitive coping* ($N = 804$, $M = 2.71$, $SD = .76$, Cronbach's $\alpha = .78$). The second

factor relates to *behavioural coping* (N = 804, M = 4.21, SD = .85, α = .74) and consists of a total of 5 items. The third scale can be described as *avoidance coping* (N = 805, M = 3.77, SD = 1.17, α = .75).

Secondly, another research question focused on the different types of noise-related self-efficacy that can be identified among teachers. The confirmatory factor analysis using principal axis factoring initially identified two factors. Two of the eight items loaded higher on the second factor. Due to theoretical considerations and the visualization of the graphical distribution of the factors in the scatterplot, we conducted a second analysis and forced one factor. As a result, all items loaded on this factor with adequate values between .44 and .78 (see also Table B.1 in Appendix B). Reliability analyses indicated a highly satisfactory Cronbach's alpha of .86 (N = 813, M = 3.39, SD = .79). Noise-related self-efficacy can therefore be understood as a one-dimensional scale.

Results of moderator analysis do not support Hypothesis 2 postulating that noise-sensitivity serves as moderator between loudness and noise annoyance (Fig. 1, Table 1).

To address Hypothesis 5 another moderator analyses was conducted. The moderator variable has no significant influence on the different coping styles implying that the relationship between noise-related self-efficacy and noise-related coping is not moderated by the individual noise sensitivity of a teacher (Fig. 2, Table 2).

In order to test all other hypothesis, we used structural equation modelling (SEM) with maximum likelihood estimation (Fig. 3, Table 3). Missing data were replaced using Bayesian Imputation. Multiple fit indices were employed to evaluate model fit, including the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Following the conventions of Hu and Bentler (1999) strict criteria were used to indicate good model fit (CFI ≥.95; SRMR ≤.08; RMSEA ≤.06).

With a standardized regression coefficient of .57, the results of the SEM support Hypothesis 1 that loudness can predict noise annoyance. Furthermore, the squared multiple correlation shows that 54.7 % of the variance in noise annoyance can be explained by loudness, noise sensitivity and noise-related self-efficacy. Consequently, loudness itself has the greatest predictive value.

The signs of the model estimates as well as the highly significant effects of noise annoyance on all three coping styles confirm Hypothesis 3 assuming that there is a correlation between perceived noise annoyance and noise-related coping among teachers. The regression coefficient of .31 shows that annoyance plays a significant role in predicting behavioural coping especially.

Hypothesis 4, assuming there is a correlation between noise-related self-efficacy and noise-related coping, can be partially confirmed. There are highly significant correlations between noise-related self-efficacy and behavioural coping (β = .55***) as well as with avoidance coping (β = −.13***). The higher the self-efficacy of teachers, the more behavioural coping and the less avoidance behaviour is shown. Meanwhile, this correlation could not be found for self-efficacy and cognitive

Table 1

Regression results of the moderating effects of noise sensitivity on loudness and noise annoyance.

Paths			Estimate	S.E.
Sensitivity	→	Annoyance	.18[a]	.04
Loudness	→	Annoyance	.67[a]	.03
Moderator	→	Annoyance	−.04	.04

Note. Standardised estimates are reported. S.E. = standard error.
[a] p < .001.

coping.

Looking at noise sensitivity as second dispositional factor, the predictive power for avoidance coping is particularly relevant (β = .35***), while it has a negligible impact on the other two coping styles. These results are partly coherent with Hypothesis 6, assuming that dispositional factors such as noise sensitivity and noise-related self-efficacy can predict noise-related coping.

Finally, there are highly significant correlations between cognitive coping as well as avoidance coping and perceived strain, whereas their predictive character is limited. Significant correlation could not be found for behavioural coping and perceived strain. Hypothesis 7 assuming a correlation between noise-related coping and strain can therefore partly be confirmed.

4. Discussion

4.1. Theoretical implications

Our study aims to analyse the role of teachers' noise-related self-efficacy and coping mechanisms to enhance occupational health and safety practices in schools. To measure noise-related self-efficacy we adapted the GSES by Schwarzer and Jerusalem (1995a) in terms of noise. Since all eight items had sufficient factor loadings, we assumed a one-dimensional scale, identical to the original. This suggests that our scale reliably measures noise-related self-efficacy, though further validation in larger, diverse samples is needed. In addition, we aimed to identify types of noise-related coping among teachers. Our results revealed three types: behavioural (actively addressing noise), cognitive (distraction or acceptance), and avoidance (avoiding or withdrawing from noisy situations). The scales thus align with the short-term coping strategies known from noise research (problem-solving, emotional regulation, escaping) (Bartels et al., 2022). Comparable results were also found by Foley and Murphy (2015), who used the original version of Carver's Brief COPE in their study with Irish school teachers. Consistent with other studies where proactive coping was used most frequently among teachers (Tomek & Urhahne, 2022; Verešová & Malá, 2012; Wang et al., 2022), behavioural coping was the most common in our sample as well. These results show that our scales are a promising method for assessing noise-related coping and deserve to be studied
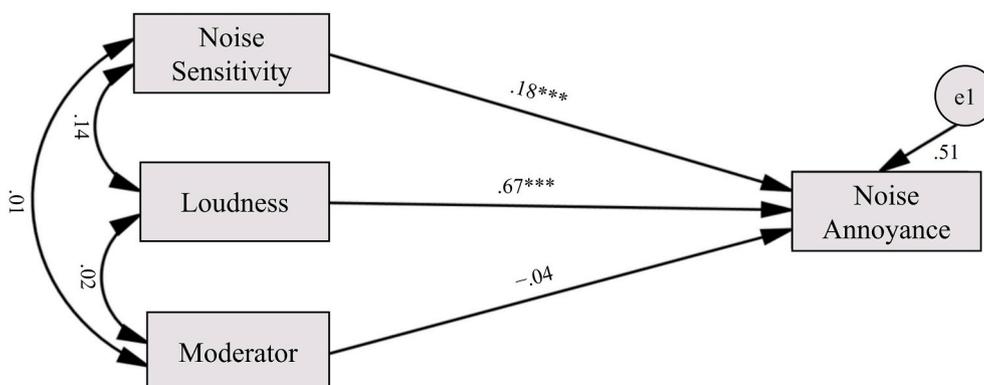

Fig. 1. Conceptual model of the moderating effects of noise sensitivity on loudness and noise annoyance.
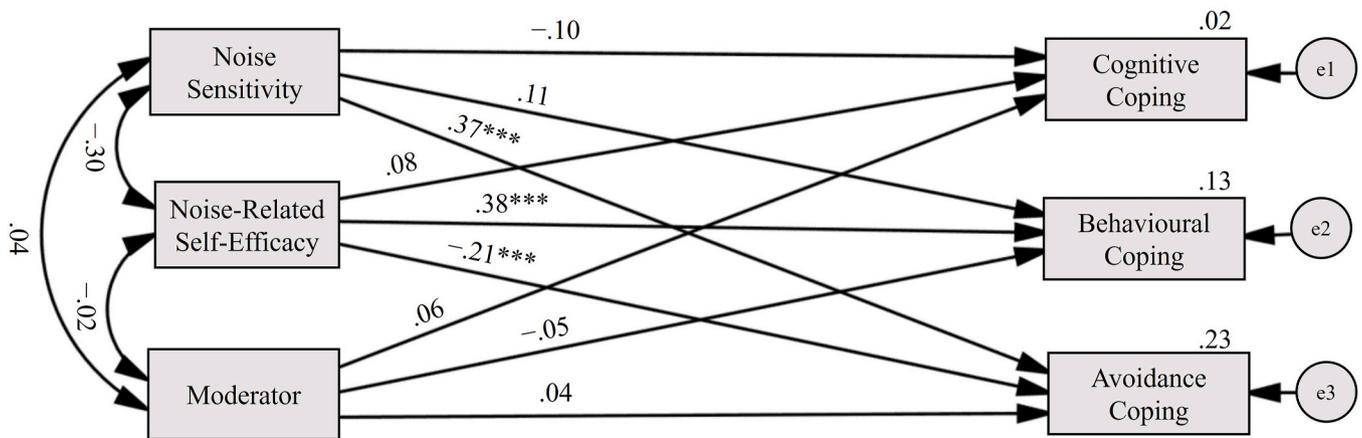
Fig. 2. Conceptual model of the moderating effects of noise sensitivity on noise-related self-efficacy and coping.

Table 2
Regression results of the moderating effects of noise sensitivity on noise-related self-efficacy and coping.

Paths			Estimate	S.E.
Sensitivity	→	CogCo	−.10	.04
Self-efficacy	→	CogCo	.08	.04
Moderator	→	CogCo	.06	.04
Sensitivity	→	BehCo	.11	.04
Self-efficacy	→	BehCo	.38[a]	.04
Moderator	→	BehCo	−.05	.04
Sensitivity	→	AvoCo	.37[a]	.05
Self-efficacy	→	AvoCo	−.21[a]	.05
Moderator	→	AvoCo	.04	.05

Note. Standardised estimates are reported. S.E. = standard error, CogCo = Cognitive Coping, BehCo = Behavioural Coping, AvoCo = Avoidance Coping.
[a] *p* < .001.

more thoroughly.

Part of our research focused on the predictive power of loudness, noise sensitivity, and self-efficacy on annoyance. We found loudness to be the strongest predictor for annoyance, supporting prior studies (Guski et al., 1999; Job, 1999; Van Kamp et al., 2004; Zimmer & Ellermeier, 1998). Interestingly, noise-related self-efficacy predicted annoyance more strongly than noise sensitivity. As teachers' self-efficacy increases, their annoyance with school noise decreases. Studies on road traffic and aircraft noise show that, aside from actual loudness, annoyance can be primarily explained by noise sensitivity (Stansfeld & Shipley, 2015; Van Kamp et al., 2004; Zimmer & Ellermeier, 1998). Apparently, these results cannot be directly applied to school noise. However, self-efficacy as an additional personality trait has not been considered in previous research. These findings suggest a new research direction focusing on self-efficacy as a protective factor for noise perception in schools and as variable, that should be considered in psychoacoustic research.

Noise sensitivity can be seen as a moderator explaining why annoyance judgments vary even at the same sounds (Stansfeld & Shipley, 2015; Van Kamp et al., 2004; Zimmer & Ellermeier, 1998). However, we were not able to replicate this effect in our study. This could be due to the fact that participants did not rate actual sound levels but were asked to evaluate the loudness of the recalled noise levels over the last four weeks of classroom teaching. Memory effects may have had an impact on participants' judgement (Hellbrück, 2000; Jacoby et al., 1988; Ward, 1987). Also, noise judgments could be biased by individual traits like self-efficacy and noise sensitivity. Contrary to our hypothesis, noise sensitivity did not moderate the relationship between self-efficacy and coping either. Both constructs seem to be equally important personality traits in noise-related behaviour. Self-efficacy is an important predictor of behavioural coping suggesting that self-effective teachers are confident that they are able to influence school-related noises

(Verešová & Malá, 2012). Therefore, they might be more likely to engage in problem-solving behaviours. At the same time high noise sensitivity can predict the avoidance behaviour of teachers. The negative correlation between self-efficacy and sensitivity suggests that more sensitive teachers are less confident in dealing with noise and more likely to avoid noisy situations. No correlation was found between self-efficacy and cognitive coping, suggesting self-efficacy is more linked to active, external behaviours (reducing or avoiding noise).

The hypothesis that noise-related self-efficacy predicts coping was confirmed for behavioural and avoidance coping, but not for cognitive coping. These results are partly consistent with previous studies that found correlations between self-efficacy and various coping style (Herman et al., 2020; Verešová & Malá, 2012). The not found effect of self-efficacy on cognitive coping may be due its emotion-focused, internal nature. Problem-focused coping could be more apparent to teachers with higher self-efficacy, while they are less aware of mental strategies. If there is a limited understanding of cognitive strategies among teachers in general, variance cannot be sufficiently explained.

As assumed, annoyance is linked to all three coping styles, with the strongest effect for behavioural coping. The negative correlation found between annoyance and cognitive coping aligns with previous findings showing that noise is particularly annoying during cognitively demanding tasks (Kjellberg et al., 1996). This suggests that high annoyance reduces cognitive capacity, making it harder to apply mental strategies.

The expected relationship between coping and strain was not found for any coping style. Previous studies have shown mixed results, with problem-focused or adaptive coping often linked to well-being (Foley & Murphy, 2015; Verešová & Malá, 2012; Wang et al., 2022). A reason why we couldn't replicate this effect may be that the operationalization of strain as we used a self-developed and noise-related scale. Compared to other studies that often apply burnout scales to measure health outcomes (Herman et al., 2020; Wang et al., 2022), the level of perceived strain in our sample was moderate (*M* = 3.14, *N* = 807). That may have been due to the strong focus on noise. Teachers' stressors are diverse, and strain could possibly not solely be attributed to school noise.

4.2. Practical implications

Our findings are of great practical relevance as they allow to derive specific measures for schools and teachers in particular. Firstly, noise-related self-efficacy has shown to be an influencing factor for annoyance and behavioural coping. Annoyance, on the other hand, seems to be important for behavioural coping as well. Even if our results did not show a significant effect of coping on strain, there is evidence for its positive influence (Aulén et al., 2021; Herman et al., 2020; Wang et al., 2022). Self-efficacy is a personality trait whose underlying beliefs are
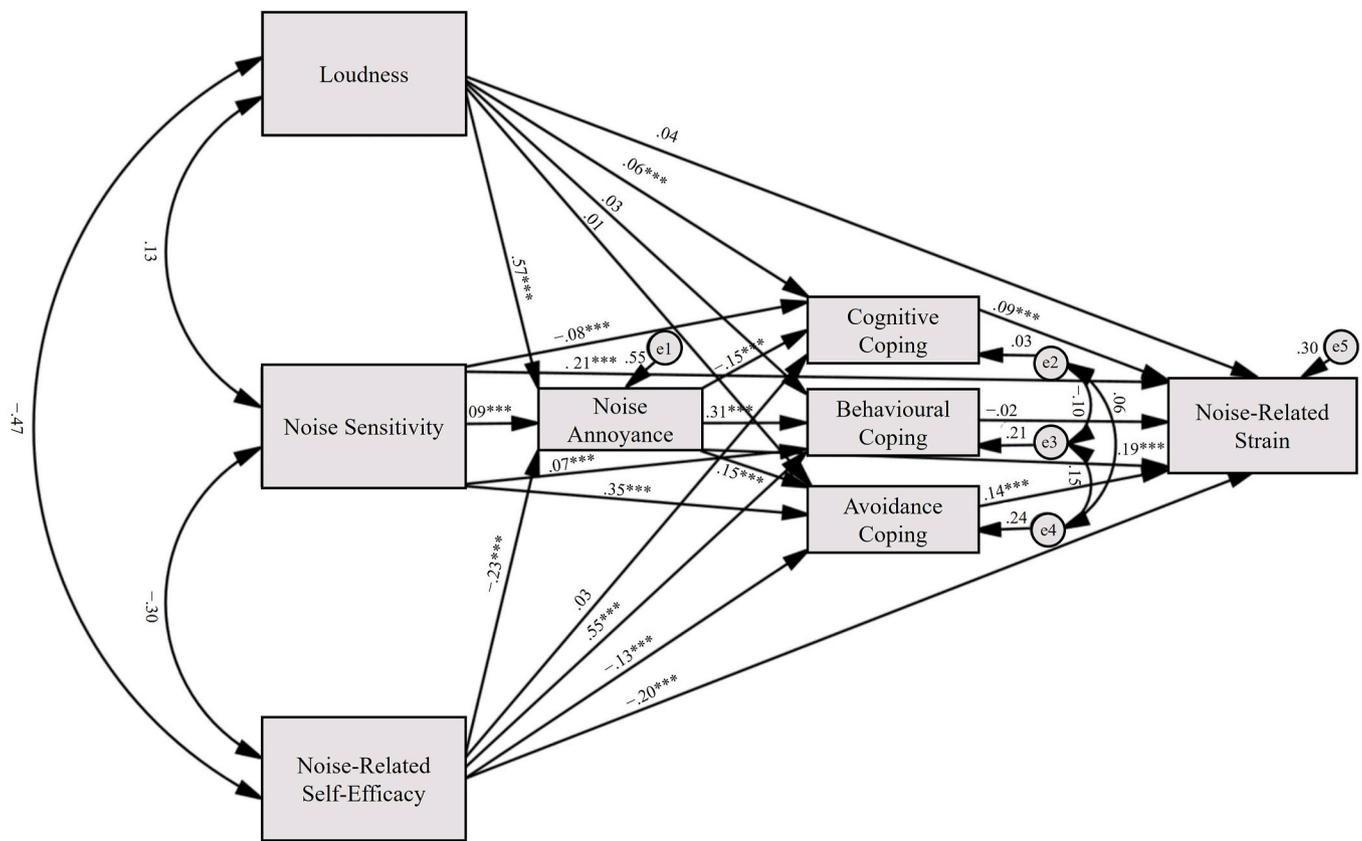
Fig. 3. Conceptual model.

Table 3
Regression results exploring the relationship between loudness, noise sensitivity, noise-related self-efficacy, annoyance, noise-related coping, and strain.

Paths			Estimate	S.E.	95 % CI
Annoyance	→	AvoCo	.15[a]	.02	[.12, .17]
Annoyance	→	BehCo	.31[a]	.01	[.28, .33]
Annoyance	→	CogCo	−.15[a]	.01	[-.18, −.12]
Annoyance	→	Strain	.19[a]	.01	[.17, .22]
AvoCo	→	Strain	.14[a]	.01	[.12, .16]
BehCo	→	Strain	−.02	.01	[-.04, .00]
CogCo	→	Strain	.09[a]	.01	[.07, .11]
Loudness	→	Annoyance	.57[a]	.01	[.56, .59]
Loudness	→	AvoCo	.01	.02	[-.01, .03]
Loudness	→	BehCo	.03	.01	[.00, .05]
Loudness	→	CogCo	.06[a]	.01	[.03, .09]
Loudness	→	Strain	.04	.01	[.01, .06]
Self-efficacy	→	Annoyance	−.23[a]	.01	[-.25, −.22]
Self-efficacy	→	AvoCo	−.13[a]	.02	[-.15, −.11]
Self-efficacy	→	BehCo	.55[a]	.01	[.53, .57]
Self-efficacy	→	CogCo	.03	.01	[.01, .06]
Self-efficacy	→	Strain	−.20[a]	.02	[-.22, −.18]
Sensitivity	→	Annoyance	.09[a]	.01	[.08, .11]
Sensitivity	→	AvoCo	.35[a]	.02	[.34, .37]
Sensitivity	→	BehCo	.07[a]	.01	[.05, .09]
Sensitivity	→	CogCo	−.08[a]	.01	[-.1, −.06]
Sensitivity	→	Strain	.21[a]	.01	[.19, .23]

Note. Standardised estimates are reported. S.E. = standard error, CI = confidence interval, CogCo = Cognitive Coping, BehCo = Behavioural Coping, AvoCo = Avoidance Coping.

[a] $p < .001$.

changeable. Therefore, it seems to be crucial to increase teachers' self-efficacy expectations. This can be accomplished, for instance, through behavioural-based trainings in which teachers are taught to deal more effectively with school noises (e.g., effective classroom-management). The demonstrated impact of noise-related self-efficacy on both annoyance and coping, enhancing teachers' self-efficacy beliefs should be a priority. One of the questions assessing cognitive coping "I try to distract myself from the noise of my work at school by concentrating on other things." was rejected by nearly 71 % of the participant. Given, that proportionally few participants already use cognitive coping ($M = 2.71$) could be an indication for not knowing about these strategies or not being able to apply them effectively to everyday work. Trainings to promote mindfulness, acceptance-based approaches, and other cognition-related techniques could therefore be an opportunity. Although these strategies may not reduce noise itself, they can help to deal with it more effectively in the moment of occurrence and provide faster relief and recovery from noise-induced stress (Charness et al., 2024; Lindsay et al., 2018).

While environmental improvements such as acoustic refurbishment are necessary to lower background noise and create a calmer teaching atmosphere (Kristiansen et al., 2016), they are not sufficient on their own. Teachers also need to be equipped with psychological tools that allow them to manage noise-related stress internally.

4.3. Strengths, limitations, and future directions

A strength of our study is the large sample size ($N = 820$), which allows in-depth statistical analyses and conclusions to be drawn. The results can therefore be considered representative and relevant for the target group. Furthermore, this is the first study to examine the complex interactions between perceptual, behavioural and coping effects of school noise and tries to explain these correlations using SEM. By developing a new scale, we also examined the context-specific character of self-efficacy in terms of noise for the first time. This scale can be used in future research and validated in larger samples. Due to the protective qualities of self-efficacy on noise annoyance and coping, it offers a valuable opportunity for the further noise prevention research. As, according to the results, self-efficacy has a decisive influence on noise

perception, this study is of great importance for working practice. Measures can be derived helping teachers to deal more effectively with the stress factor of school noise.

It needs to be acknowledged, that the study is based on subjective data and no actual sound levels measured in schools were included in the analyses. Subjective data are always susceptible to bias due to memory effects or other influencing factors. Moreover, environmental factors of the schools where participants worked has not been assessed.

Furthermore, this is a cross-sectional study. Longitudinal data could explain even more variance in the field of strain reactions and long-term effects. This could be a starting point for future research. Many of the applied scales were developed specifically for our research purpose. Even if they are based on already existing, valid scales and have shown good psychometric values, a comparison with results from similar studies and other countries is limited. Furthermore, the wording of the questions assessing strain may have been associated with illness too strongly, which is influenced by many factors beyond school noise. If a school already has poor room acoustics and students are particularly loud and noisy, it can be assumed that there are other adverse working conditions, that influence teachers coping behaviour and perceived strain but were not assessed in this study.

5. Conclusion

Our results show that noise-related self-efficacy is of great relevance in noise research. It can not only predict noise annoyance but is an indicator for noise-related coping as well. Occupational health and safety prioritize measures to improve the working environment. However, these measures are often long-term processes beyond the control of teachers. Interventions aimed at strengthening teachers' self-efficacy (e.g., through targeted training programs) offer a feasible and impactful pathway to mitigate especially the non-auditory effects of noise exposure. Measures focused on enhancing teachers' beliefs in their self-efficacy and coping abilities provide practical short-term solutions with the prospect to reduce noise-related strain. Ultimately, environmental modifications must be complemented by psychological interventions aimed at strengthening teachers' noise-related self-efficacy and coping. This holistic approach would not only reduce annoyance and strain but also contribute to improved occupational health and safety. Accordingly, the integration of noise-related psychological

constructs into health and safety frameworks is essential for the sustainable development of teaching environments.

CRediT authorship contribution statement

Victoria Heumann: Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Manuela Sirrenberg:** Writing – review & editing, Validation, Supervision, Methodology, Formal analysis, Conceptualization. **Stefanie Heinze:** Writing – review & editing, Supervision. **Caroline Herr:** Supervision. **Tina Tischer:** Writing – review & editing. **Marco Steinhauser:** Writing – review & editing, Validation, Supervision.

Ethics Committee approval

Prior to data collection, ethical approval was obtained from the Ethics Committee of the Medical Faculty at LMU Munich, ensuring compliance with ethical guidelines (project number: 21–0706; date of approval: September 08, 2021).

Data availability statement

The data that support the findings of this study are available from the corresponding author, [VH], upon reasonable request.

Generative artificial intelligence (AI) statement

For reasons of language improvement (i.e., optimising the translation of particular sentences and phrases from German into English), the authors used the AI tools ChatGPT (OpenAI, United States, version October 23, 2024 and April 10, 2025) and DeepL (DeepL GmbH, Germany, version 24.11.4) in the preparation of the manuscript.

Declaration of interest statement

We declare that the manuscript is original, not previously published, and not under concurrent consideration elsewhere. We declare no conflict of interests. The requirements for authorship have been met.

Appendices.

Appendix A: Demographic Characteristics

Table A.1
Sociodemographic Characteristics of Sample

Characteristic	*n*	*%*
Gender (*n* = 648)		
Male	199	30.7
Female	448	69.1
Nonbinary	1	.2
Age in years (*n* = 654)		
≤24	2	.3
25-34	84	12.8
35-44	171	26.1
45-54	255	39.0
55-60	102	15.6
≥61	40	6.1
Work experience in years (*n* = 651)		
0-5	57	8.8
6-10	77	11.8
11-15	106	16.3
16-20	138	21.2

(continued on next page)

Table A.1 (*continued*)

Characteristic	n	%
21-25	128	19.7
≥26	145	22.3
School type (*n* = 687) [a]		
Primary school	126	18.3
Middle school	74	10.8
Secondary school	11	1.6
Grammar school	353	51.4
Comprehensive high school	2	.3
School for children with special needs	13	1.9
Business school	3	.4
Vocational school	105	15.3
Occupation (*n* = 654)		
Headmaster/headmistress	75	11.5
Teacher	515	78.8
Other (e.g., school counsellor)	64	9.8

[a] Multiple answers possible.

Appendix B: Results of Factor Analysis

Table B.1

Results from a factor analysis of the noise-related self-efficacy items (N = 780)

Noise-related self-efficacy item	Factor loading
	1
I am helpless when it comes to dealing with the many sources of noise at my work at school.	.78
No matter how hard I try, I can't do much about the noise at my work at school.	.78
I usually find a way to positively influence the noise at my work at school. (R)	−.72
No matter what I do, I have no control over the noise at my work at school.	.71
I can easily protect myself from the noise at work at school. (R)	−.71
No matter what noise-reducing measures I use at my work at school, it won't make any difference.	.68
Even when I'm not feeling well, I can still manage the noise at my work at school. (R)	−.49
No matter how loud it is at my work at school, I can deal with it. (R)	−.44

Note: The extraction method was principal axis factoring with the rotation method varimax with Kaiser normalization. One factor was forced. Reversed-scored items are denoted with (R). Original scale in German, all items were translated accordingly.

Table B.2

Results from a factor analysis of the noise-related coping items (N = 738)

Noise-related coping item	Factor loading		
	1	2	3
To stop noise interfering with my work at school, I focus my attention on other things.	.71		
I try to focus on the positive aspects of noise during my work at school (e.g., it helps me to draw my attention to a particular situation).	.68		
If I can accept that it's loud at work, it no longer bothers me.	.62		
I tell myself that the noise at my work at school is not disturbing.	.58		
I try to distract myself from the noise at my work at school by concentrating on other things.	.54		.31
I pretend that there is actually no noise at my work at school.	.54		
I tell myself that noise can also be useful for my work at school (e.g., as an alert that students are not paying attention).	.47		
I don't even try to control the noise at my work at school anymore. (R)		−.71	
I think carefully about how I can reduce the noise at my work at school.		.67	
I have stopped looking for solutions to get the noise under control at my work at school. (R)		−.64	
I use specific measures to reduce noise in my work at school (e.g., silence signals).		.53	
I actively look for measures to positively influence the noise in my work at school (e.g., speaking louder or quieter to gain the students' attention)		.51	
I try to avoid situations at my work at school where it is particularly loud (e.g., auditorium during recess, crowded teachers' lounge).			.76
I try to plan my workday at school in a way that I am exposed to noise as little as possible.			.63
Whenever possible, I withdraw to a quiet place during work at school.			.62

Note: The extraction method was principal axis factoring with the rotation method varimax with Kaiser normalization. Reversed-scored items are denoted with (R). Original scale in German, all items were translated accordingly.

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