

Developing an explicit error management in instrumental music education

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Abstract

Dealing with errors is a key aspect of teaching, practice and performance. Musicians tend to strive for flawless performance and perfection, avoiding errors at all costs. And yet, to be innovative, or to make their performance extraordinary, musicians need to risk making errors. Research in instrumental pedagogy is still neglecting error issues. In this contribution we discuss structured approaches to error management from different domains regarding different mindsets of training and performing, to provide orientation for further music education and musicians at all levels. The benefits of risk management (before the error) and error management (during and after the error) are still underestimated. Specifically error management training (EMT) encourages emotional control and metacognition, because it helps students to think about their own knowledge and learning process, including the causes of the errors and the possible solutions. Currently, most music students only acquire the ability to manage errors implicitly - or not at all. A more explicit, , creative and differentiated culture of errors would balance error tolerance and risk-taking against error prevention in ways that enhance music practice and music performance. The teaching environment should lay the foundation for the development of such a constructive approach.

Introduction

An error can be defined as the unintended result of an action (Maidhof, 2013). Musicians at all levels of proficiency and across the lifespan must deal with errors and develop strategies that balance the vitality of risk-taking against error prevention in both practice and performance (Westney, 2003). Given the scarcity of previous research about musicians' error management, in this paper we refer to studies from different domains, such as education, psychology, economics, cybernetic as well as

high-risk disciplines such as aviation and medicine (concepts of error management in other domains are described in more detail in Kruse-Weber & Parncutt, 2014).

The role of errors in music performance is comparable with the role of errors in high-risk disciplines such as aviation and medicine. Both cases refer to dynamic complex systems in which large amounts of data are quickly processed. Both involve psychological distress in response to errors or the threat of errors. Like errors in aviation or medicine, errors in musical performances (e.g. competitions) can have specific, irreversible consequences. Musicians have to deal with expected and unexpected incidents, external and internal threats. Errors can have specific, severe and irreversible consequences. Although errors in music performance cannot be compared with the fatal errors that sometimes occur in hospitals and or airline flights, they may nevertheless give a musician the feeling that their career is over and dead, and in extreme cases errors and fear of negative evaluation may indeed mean the end of a musical career (Kenny & Osborne, 2006). In this regard, even music performance may be seen as a high-risk discipline.

In almost every learning process, errors occur because of insufficient knowledge and skills, or as a consequence of inappropriate goals and or inadequate planning (Zapf, Frese, & Brodbeck, 1999). If errors are approached in a negative or destructive way, the fear of errors can induce state anxiety and stage fright, which in turn affects performance quality (Möller, 2004). Taking risks is an essential part of learning processes and music performances. When risks are taken in a deliberate, appropriate, and systematic manner, the result is a dynamic mixture of failure and innovation that increases the chances of (artistic) success (Maher, 2012).

Several researchers from different perspectives have outlined the advantages of taking risks and making errors during learning processes, assuming that errors are the motor of effective learning and subsequent successful performance. Atkinson (1957) argued that performances can be “greatest when there is greatest uncertainty about outcome”: people with a strong motivation to achieve prefer immediate risk, whereas those with strong motivation to avoid failure, prefer easy tasks or extremely difficult and risky tasks.

Dweck explains the potential of errors in relation to two kinds of mindsets: fixed-mindset and growth-mindset (Dweck, 2006, 2007). Individuals with a fixed-mindset believe their abilities are set and unchangeable. In learning contexts, they focus on how they can be judged, as being either smart or not smart. Students of this kind tend to seek learning activities in which their success is almost guaranteed, and reject tasks which involve taking more challenges, since they could lead to failure. By contrast, individuals with a growth-mindset believe that abilities are malleable and can be

developed through learning and effort. They tend to take on challenging tasks because they perceive errors as opportunities to learn. They know that becoming aware of errors and correcting them helps them develop their abilities.

Nielsen (2012) analysed the relationship between the epistemic beliefs of music students (the beliefs that every individual hold about the nature of knowledge and learning) and their self-reported learning strategies when practicing their instrument. Students who believed their musical abilities were fixed were less likely to use metacognitive and effort regulation strategies than those who believed their ability to learn was malleable and based on hard work.

Similar conclusions have recently been drawn in the field of neuroscience. Moser and colleagues (2011) identified an on-line neural mechanism that underlies the association between growth mindsets and adaptive responses to mistakes.

Traditional approaches to learning and instructional processes involve a kind of direct thinking, based on a linear stimulus-response understanding of causality (Bautista, Pérez-Echeverría, & Pozo, 2010; Marín, Scheuer, & Pérez-Echeverría, 2013). Assuming that the same cause generally leads to the same effect, the teacher focuses entirely on the result of the performance - the outcome behaviour – rather than considering what might be happening inside the “black box” of the student’s psychology and physiology (in psychology this is called a cognitive approach rather than a behavioural or stimulus-response approach). Learners are guided by a step-by-step series of strategies that go “from easy to hard” or “from simple to complex”. Teachers may expect a single correct answer to a question; Teachers often wait for one correct answer to a question; they fail to realize that there may be many possible solutions, and that errors have productive potential. From a cybernetic approach, Foerster and Pörksen (2008) commented that linear systems of teaching “dumb children down” to “trivial machines” (Foerster & Pörksen, 2008; pp. 54-55).

From a constructivist perspective, errors are considered useful and positive sources of information for further learning (Spychiger, Kuster, & Oser, 2006). They are a necessary step in learning to apply new knowledge and developing expert levels of skill (Chi, DeLeeuw, Chiu, & LaVancher, 1994; Feltovich, Prietula, & Ericsson, 2006). Learners are constantly constructing new ideas or concepts based upon interactions between their experience and their existing knowledge (Bruner, 1960, 1961). The learning process involves metacognitive skills of selection and transformation of information, decision making, hypothesis generation and testing, and meaning generation based on available information and experiences. An active process of discovery allows the student to uncover the interrelationships between concepts and ideas, which in turn allow them to

gain new knowledge. Making errors is necessary; it gives the learner a better comprehension of the information being learned. It seems that we learn more rapidly about cues for which we initially make incorrect predictions than cues for which our initial predictions are correct (Wills, 2007).

Empirical research in general pedagogy has demonstrated that the productive and creative potential of errors is often not used to full capacity (Oser & Spychiger, 2005). In educational contexts, errors may be accepted as unavoidable incidents, but generally they are not considered to be helpful, so they are no discussions of errors in educational discourse (Weingardt, 2004).

The processes of learning (errors are informative) and performing (errors will be judged) are not distinguished sufficiently during lessons. Support and evaluation procedures in pedagogical contexts are not transparent enough (Spychiger, 2012). In learning situations, where errors could be informative and provide positive learning opportunities, students may merely avoid them, for fear of being judged.

In the field of instrumental pedagogy, little is known about systematic strategies for managing errors. There is a tendency to focus on unilateral error prevention rather than using errors to learn (Bautista et al., 2010; Bautista, Pérez-Echeverría, Pozo, & Brizuela, 2012). Musicians have a generally negative attitude towards errors, equating them with fear and doubts about the quality of their performance; in short, their performance goal is too perfectionist (Kenny & Osborne, 2006).

This paper aims to provide a conceptual framework for error management in the learning, teaching, and performing of music. We review research on error management in different disciplines and apply the concepts to instrumental music pedagogy.

Concepts of Error Management in Learning, Teaching and Performing Music

Practice Versus Performance Mindset

Practicing and performing music require different skills, all of which should be trained in instrumental music pedagogy. If students stay in the practice mindset while performing, it can sabotage their ability to perform and interpret freely and creatively. Instead of communicating musically with their audience, they tend to evaluate themselves. To avoid this, they need to practice getting into a performance mindset as performance approaches (Cohn & Allan, 2012).

Practice and performance mindsets differ in their approach to errors. The practice mindset includes the usual methods for dealing with errors during practice. Different skills are necessary for

performance situations, for which the term “error management” (used in non-musical disciplines) may be more appropriate.

Theories of risk and error management play an important role in industrial and organizational psychology. Risk management occurs prior to a potential error; it refers to the process of understanding and estimating errors and their potential consequences. Error management occurs during and after an error, and it is devoted to the development of a flexible and emotionally relaxed attitude toward errors. The main aim of these techniques is not to avoid the error, but to minimize its negative consequences, and to resolve errors easily, quickly, and without stress (Zapf et al., 1999). To achieve this goal, it helps to develop a flexible and emotionally relaxed attitude toward errors. Error management involves understanding the nature and extent of the error and identifying behavioral responses that can prevent errors or mitigate their effects (Helmreich, 2000).

Non-musical research and applications suggest that these techniques have positive effects. Risk and threat management generally improves performance. Error management training promotes skill transfer from one task to another, because errors during training stimulate attention, which in turn facilitate later retrieval of similar problems and their solutions.

Table 1 illustrates three approaches to error management, and summarizes the most important objectives, issues, methods, and motives. All three approaches can be seen as error-friendly: errors are looked at and analyzed as positive sources of information rather than ignored.

	Risk and Threat Management	Error Management Training (EMT)	Error Management
Where	Practice and instruction	Practice and Instruction	Performance
When	Before the error	After the error	During and after the error
Why	An “early warning System” Threat recognition and the implementation of error avoidance behavior	Understanding, managing and preventing errors by generating emotionally stress-free attitude towards errors	Minimizing negative consequences of errors through constructive cognitive appraisal or fast error corrections
How	Asking <i>What could go wrong?</i> Anticipating risks, threats and disturbances through simulation during practice. Having realistic expectations	Developing metacognitive and task- orientated strategies	Using the creative potential of errors managing them constructively and fast

Table 1. Approaches to error management strategies (Kruse-Weber & Parncutt, 2014)

In the following, we will consider different approaches to dealing with errors during music practice, music instruction, and music performance in more detail.

Practice and Instruction

Risk management

Errors can be avoided if the potential risk factors are anticipated and appropriate response strategies developed, and if the corresponding skills are practiced in advance. Such skills can positively impact performance quality while at the same time reducing the associated psychophysiological costs. Proactive techniques, like those to be explained here, are needed to detect, evaluate and mitigate risk factors, and facilitate the avoidance of incidents (Kallus, 2012).

Balancing technical versus expression-related risks may be one of the core competences of musicians. The latent underlying risks of performance situations are often ignored and underestimated, leading to stress. Musicians need training to achieve situational awareness and skills for coping with threatening situations.

Risk management focuses on anticipating and detecting potential errors, and managing associated disruptions. It is frequently used in aviation, where it is known as “threat and error management” (Helmreich, Merritt, & Wilhelm, 1999) and is used to evaluate both the performance of individual pilots and the environment in which they work (Koglbauer, 2009). This proactive approach is an attempt to detect and evaluate errors, and to mitigate risk factors and facilitate the avoidance of incidents and accidents (Langeroodi, Ehsani, & Hamidi, 2011).

ISO 31000 is a family of standards relating to risk management, codified by the International Organization for Standardization (International Organization for Standardization, ISO 31000:2009. Risk management – Principles and guidelines 2.25). The purpose of ISO 31000:2009 is to formulate principles, generic guidelines, assessment techniques, and definitions in the area of risk management. ISO 31000 seeks to establish a universally recognized paradigm for practitioners and companies interested in risk management. It lists the following responses to risk:

1. Avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk
2. Accepting or increasing the risk in order to pursue an opportunity
3. Removing the risk source
4. Changing the likelihood
5. Changing the consequences
6. Sharing the risk with another party or parties
7. Retaining the risk by informed decision

These guidelines present risk taking as a deliberate strategy. With this checklist, one is able to analyse, evaluate, balance, and decide which approach is the best. The process involves risk identification, which involves “finding, recognizing, and describing the risks” that could affect the achievement of an organization’s objectives.

Having identified potential risks or vulnerabilities, the next step is to analyse them. Analysis includes the evaluation of scenarios according to the criteria of probability and consequence potential. It also includes the analysis of causes or failures. The next step is to plan possible responses to the risk and to identify ways to reduce negative outcomes. Through simulation and anticipation of risk situations in practice, one can monitor whether new skills are implemented correctly.

These ideas can be applied in instrumental learning contexts. For example, students could generate a list of possible individual risks and crosscheck it while rehearsing appropriate responses to the anticipated incidents. Systematic risk management training can improve awareness for

performance traps and knowledge of risks that apply to specific kinds of music or performance, or even to an individual performer. Realistic expectations about errors can prevent errors from occurring, and awareness for anticipatory processes can reduce emotional stress. Following this kind of preparation, musicians are more able to take risks during performance, respond spontaneously to the situation in which they find themselves while performing. That can help them improve their technique, expression and interpretation.

Error Management training (EMT)

Error management training (EMT) encourages emotional control and metacognition, because it helps students to think about their own knowledge and learning process, including the causes of the errors and the possible solutions. Through this training, musicians can learn to better manage the negative consequences of their errors. The benefits include more security and more effective decision-making.

An exaggerated focus on avoiding errors may lead to the “true-false syndrome” e.g. a correct vs. incorrect’ dichotomy (Hallam, 1995; Mantel, 2003; Bautista et al., 2012). If an error occurs that lies beyond the performer’s experience and expectations, the musician does not know how to react (Figure 1, left). Systematic error management training can help (Figure 1, right). In this case, the error lies within the anticipated range of possibilities. An extended number of solutions allow musicians to manage and fix errors faster and more easily. Practising them can help students to manage errors more easily to achieve good error management. By promoting an anxiety-free approach to error analysis, a positive error climate is created. (Kruse-Weber, 2012a). An optimistic mindset of error friendliness can help students to look at their errors directly rather than to look away (Oser, & Spychiger, 2005; Spychiger, 2012; Von Weizsäcker, & Von Weizsäcker, C., 1984; Wehner, 1992).

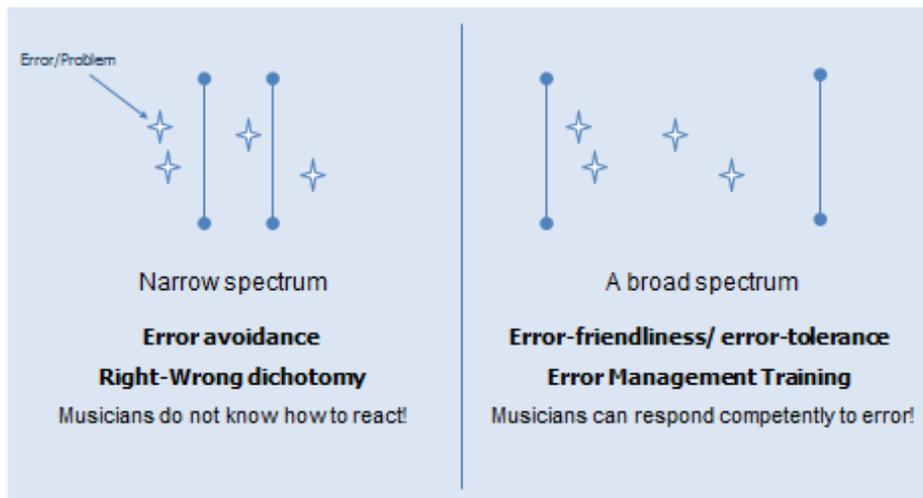


Figure 1. Different approaches to errors in learning situations (adapted from Kruse-Weber, 2012a)

Error management training assumes that errors provide valuable feedback for learning (Heimbeck, Frese, Sonnentag, & Keith, 2003). The basic principle of error management training is to give participants opportunities to make errors during training. It is similar to exploratory learning (Bruner, 1966) because it also emphasizes the importance of allowing the learner to explore and test ideas and solutions.

Error management training differs from exploratory learning in two ways. First, tasks in error management training are provided to the participants, but they are difficult from the beginning, which leads to a higher exposure to errors. Second, participants are explicitly informed about the advantages of making errors during learning. They receive brief statements such as: “The more errors you make, the more you learn!” “You have made an error? Great! Because now you can learn something new!” “Errors are a natural part of the learning process!” “There is always a way out of an error situation!” (Keith & Frese, 2008). It has been demonstrated that error management training leads to a better performance than an approach based on avoiding errors, called “error avoidant training” (Keith & Frese, 2005), in which participants are provided with step-by-step instructions and not informed about the positive function of errors in learning activities.

Keith and Frese (2008) showed that error management training is more effective in well-structured tasks with clear feedback opportunities. This suggests that the discussion and analysis of errors should play an important role in instrumental teaching. The learner should be encouraged to think independently about dealing with errors. Guidelines and questions should be brief to give the

learner space to develop individual metacognitive skills. Music teachers should encourage students to adopt a self-reliant attitude to a reflective practice and metacognition skills (Barry & Hallam, 2002; Kruse-Weber, 2012b). Thus, error management training can also help musicians practicing at home without an instructor. They learn to reflect on their errors and monitor their skill development on their own. Instead of merely avoiding errors, they can regularly evaluate the strengths and weaknesses of their performance and plan strategies for the next session. In this sense, error management training is a kind of self-regulated learning. The development of appropriate strategies to solve a task depends on how the learners self-regulate their learning process (Zimmerman, 1990). Self-regulated learning helps students to achieve academic success, and increases their intrinsically motivation (Zimmerman, 1990). Recent research in music education and music psychology has suggested that self-regulation should be taught from beginning of learning a musical instrument by teachers and parents, since it is a key for musical success (McPherson, 2012).

The learning and teaching approach of error management training are relevant for both novices and experts in music performance. With the support of researchers and teachers, instrumental students would creatively and collectively generate lists of difficult situations that lead to errors in their performance. They would consider the skills that they need to respond creatively to such situations as they occur, and how these skills could be acquired by practice.

Performance

Error Management

As already said, error management refers to the process of dealing with errors when and after they take place. It involves understanding the nature and extent of the error and identifying responses that can prevent errors or mitigate their effects (Helmreich, 2000). Disturbances are dealt with in a differentiated manner that does not significantly compromise the initial goals of the performer (Weingardt, 2004).

The most important strategy for performance is to “practice performing!” (Norris, 2009; p. 24). Practicing performing and developing a good error management needs extension of the usual range of solutions and creative or challenging physical or mental coordination exercises (Westney, 2003). A list of examples include playing with closed eyes, mental training, performing music after sport (with high blood pressure), performing in the middle of the night, performing with errors and blackouts, performing while standing on one leg (see e.g., Norris, 2009). The most advanced stages

of practice leading to performance should take challenging tasks in an error positive climate. Different approaches can be combined: improvisation, invention, exploration and risk taking.

Zapf et al. (1999), Flossmann, Goebel and Widmer (2011), and Maidhof (2013) found that expertise does not generally lead to a reduction of performance errors. Instead, highly trained musicians manage and correct errors faster and more easily: one learns to create an impression of accuracy in a performance that is actually far from faithful to the score (Sloboda, 1985, cited in Repp, 1996). In other words, experts manage errors better, but it is unclear whether this process is conscious or implicit. One might expect the best performer-teachers to teach skills of error management to their students, and a corresponding body of literature in instrumental music pedagogy. We are instead confronted with a striking lack of explicit or theoretical knowledge about error management and learning from errors in music performance.

Conclusions

In this paper we have analysed error management concepts from different disciplines as well as connected them to the musical field. By doing so we have added a new dimension to existing approaches to error in music performance and music education, opening up and rethinking unilateral negative attitudes towards errors in teaching and traditional learning theories. Taking the perspectives presented in this work as a whole, we assume that metacognition and cognitive monitoring are very important key aspects of managing errors.

As seen in this paper, research in other disciplines confirms that exploration in combination with metacognitive and task-orientated strategies, positive experiences of failure and error-friendly working conditions can promote successful learning and performing. Encouraging error instructions and an atmosphere of trust and mutual estimation in the classroom are fundamental, further low blame and no punishment combined with a relatively high degree of empathy when confronting errors to develop these abilities.

Further research is needed to describe and explain developmental acquisitions from learners and find more effective ways of teaching metacognitive knowledge and cognitive monitoring skills in instrumental music pedagogy. Finally the competency specifications that we have described need to be empirically validated and then again could be compared with the investigations in other trainings in e.g. aviation to verify the benefits and clarify also the differences in these concepts before we can develop the best strategies to improve the current instrumental pedagogy.

In instrumental music instruction, we should promote analysis and discussion of errors during teaching, so as to utilize them strategically as potential learning opportunities. Adopting a

constructivist attitude that acknowledges the active role of the student in generating her or his own knowledge in interaction with the teacher, as well as promoting metacognitive abilities in students can lead them to learn more independently and to ensure their long-term success. It would be desirable that instrumental teachers can receive specific training in order to learn how to deal with errors in the lessons, as well as how to help students to develop their personal metacognitive abilities, so that the ideas expressed in this paper can be incorporated more into instrumental teaching and learning contexts. The development of metacognitive skills including error management can feasibly be listed among the main goals of music academies.

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