



# Music listening as a means of stress reduction in daily life



Alexandra Linnemann<sup>a</sup>, Beate Ditzen<sup>b</sup>, Jana Strahler<sup>a</sup>,  
Johanna M. Doerr<sup>a</sup>, Urs M. Nater<sup>a,\*</sup>

<sup>a</sup> University of Marburg, Department of Psychology, Marburg, Germany

<sup>b</sup> Heidelberg University Hospital, Department of Medical Psychology, Heidelberg, Germany

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**Summary** The relation between music listening and stress is inconsistently reported across studies, with the major part of studies being set in experimental settings. Furthermore, the psychobiological mechanisms for a potential stress-reducing effect remain unclear. We examined the potential stress-reducing effect of music listening in everyday life using both subjective and objective indicators of stress. Fifty-five healthy university students were examined in an ambulatory assessment study, both during a regular term week (five days) and during an examination week (five days). Participants rated their current music-listening behavior and perceived stress levels four times per day, and a sub-sample ( $n=25$ ) additionally provided saliva samples for the later analysis of cortisol and alpha-amylase on two consecutive days during both weeks. Results revealed that mere music listening was effective in reducing subjective stress levels ( $p=0.010$ ). The most profound effects were found when 'relaxation' was stated as the reason for music listening, with subsequent decreases in subjective stress levels ( $p \leq 0.001$ ) and lower cortisol concentrations ( $p \leq 0.001$ ). Alpha-amylase varied as a function of the arousal of the selected music, with energizing music increasing and relaxing music decreasing alpha-amylase activity ( $p=0.025$ ). These findings suggest that music listening can be considered a means of stress reduction in daily life, especially if it is listened to for the reason of relaxation. Furthermore, these results shed light on the physiological mechanisms underlying the stress-reducing effect of music, with music listening differentially affecting the physiological stress systems. © 2015 Elsevier Ltd. All rights reserved.

## 1. Introduction

Stress has the potential to be a major health threat facilitating the development of disease and illness (McEwen, 1998). As stress is a ubiquitous phenomenon in everyday life, it is necessary to develop interventions that can target stress in daily life and thus prevent its detrimental effects

\* Corresponding author. Tel.: +49 6421 28 23943.  
E-mail address: [nater@uni-marburg.de](mailto:nater@uni-marburg.de) (U.M. Nater).

on health. It is assumed that music listening has health-beneficial effects, which might be mediated by its potential stress-reducing effect (Thoma and Nater, 2011). However, the empirical evidence on the stress-reducing effect of listening to music is far from being consistent, and the underlying psychobiological mechanisms of this potential stress-reducing effect – especially in daily life – remain unknown.

### 1.1. Music listening as a means of stress reduction in daily life

While the effects of music therapy (for an overview see Hanser, 2010) and music making (e.g., Bittman et al., 2013) on health-related outcomes have been studied in a plethora of (experimental) studies, the effects of mere music listening remain understudied. Particularly due to the fact that music is present in everyday life (Hargreaves and North, 1999; Juslin and Laukka, 2004; Krause et al., 2015), it is an important endeavor to study the effects of music listening in ecologically valid settings (Skanland, 2013). Results from research in experimental settings and in clinical contexts suggest that music listening has the potential to reduce stress, both subjectively and physiologically. For example, Sandstrom and Russo (2010) found that music high in valence and low in arousal positively affected recovery of heart rate and skin conductance levels after a stressor. Although most studies support the notion that music low in arousal is stress-reducing, Chanda and Levitin (2013) suggest that context factors, such as control over music selection (experimenter- vs. participant-selected), need to be considered as well. In contrast to experimental studies in which the context of listening to music is highly artificial, recent research efforts suggest that it might be more ecologically valid to study music in people's natural habitat (North et al., 2004; van Goethem and Sloboda, 2011).

Only a small number of studies have investigated music listening in daily life (Greasley and Lamont, 2011; Juslin et al., 2008; Krause et al., 2015; Randall et al., 2014; Skanland, 2013; van Goethem and Sloboda, 2011). These studies predominantly describe music-listening behavior, and to date, no study has directly investigated the effects of music listening on both subjective and physiological stress. Some studies do hint at the idea of a stress-reducing effect of music listening in daily life (Juslin et al., 2008; van Goethem and Sloboda, 2011). Juslin et al. (2008), for example showed that listening to music increased feelings of calmness. Still, research investigating this potential stress-reducing effect from a multi-dimensional perspective, exploring both subjective and physiological measures of stress, and considering both musical and nonmusical context factors in this relationship, is lacking.

### 1.2. Beyond self-reports: The effect of music listening on the physiological stress response

Music listening has been associated with a down-regulation of the hypothalamic–pituitary–adrenal (HPA) axis, as shown via reductions in the concentrations of cortisol in various experimental and clinical contexts (for an overview see: Kreutz et al., 2012), as well as with alterations of

autonomic nervous system activity, with decreases in heart rate and blood pressure (for an overview see: Hodges, 2011). However, the pattern of results concerning biological effects of music is not consistent. Some studies failed to find an effect of music on stress-related physiological changes. Chlan et al. (2013), for example, found no effect of music listening on cortisol levels in mechanically ventilated patients. However, another study found a beneficial effect of music listening on parameters of the autonomic nervous systems in mechanically ventilated patients (Han et al., 2010). A plethora of studies (either investigating patients or healthy participants) report discrepant findings when comparing self-reports of stress to physiological markers of stress (DeMarco et al., 2011; Gerra et al., 1998; Thoma et al., 2013): for example, Thoma et al. (2013) found relaxing music to be less effective in reducing cortisol concentrations than the sound of rippling water, whereas there was no difference with regard to subjective stress levels. The same pattern emerged in the study by DeMarco et al. (2011) in which music reduced subjective stress levels but not heart rate and blood pressure in patients undergoing surgery. This heterogeneity of findings is probably due to methodological issues, such as different music selection and/or varying intensity of stressors, thus emphasizing the need to further study the effect of context variables on the stress-reducing effect of music listening.

### 1.3. The need to consider context variables: Valence/arousal, reasons for music listening, and stress intensity

To date, there is no empirically sound knowledge on which music (in terms of valence and arousal) is particularly effective for stress reduction purposes (Sandstrom and Russo, 2010). To the best of our knowledge, only one experimental study has systematically investigated the effect of the valence and arousal of music in the context of stress. In this aforementioned study, Sandstrom and Russo (2010) were able to show that recovery from a stressor worked best if participants listened to music which was low in arousal and positive in valence. However, in daily life, no study so far has related valence and arousal ratings to the stress-reducing effect of music listening

Juslin et al. (2008) suggest that the emotional effect of music varies as a function of reasons for music listening. Since 'relaxation' is one of the main reasons why individuals listen to music (Greasley and Lamont, 2011; Juslin et al., 2008; van Goethem and Sloboda, 2011), it seems plausible to examine reasons for music listening in the context of the stress-reducing effect of music listening. To date, no study has empirically examined whether reasons for music listening may affect the stress-reducing effect of music listening in daily life.

In her review on the stress-reducing effect of music listening, Pelletier (2004) summarized that music may only be effective in reducing stress in the context of a mild stressor as opposed to a strong stressor. This finding was corroborated by a recent experimental study from our group (Thoma et al., 2013), which found that listening to music prior to a (strong) socio-evaluative stressor was not effective in reducing stress, thus emphasizing the idea that the

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