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Psychobiological Mechanisms of the Effectiveness of Music Interventions



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**PSYCHOBIOLOGICAL MECHANISMS OF
THE EFFECTIVENESS OF
MUSIC INTERVENTIONS**

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ABSTRACT

The present thesis aimed to determine the psychobiological mechanisms of the purported beneficial effectiveness of music interventions. For this purpose, two studies were conducted. In a first study, the associations between music listening and health were investigated under consideration of predicted mediating mechanisms. In a second study, we set out to examine the assumed stress-reducing effect of listening to relaxing music in a rigorously controlled experiment in a laboratory setting across neuroendocrine, autonomic, cognitive, and emotional domains of the acute stress experience in healthy participants.

EMPIRICAL STUDY I

BACKGROUND & AIMS: Music listening has been suggested to have short-term beneficial effects upon the listener. Everyday music listening may lead to a habituation to these beneficial effects and may consequently be positively associated with health. However, no data exist on whether music listening is associated with health and what factors may mediate this association. The aim of the current study was therefore to address this gap in the literature by investigating the association and potential mediating variables between various aspects of habitual music-listening behavior and health indicators. **METHODS:** An internet-based survey was conducted in university students. A total of 1,230 individuals (mean = 24.89 ± 5.34 years), 55.3 % women, provided complete data sets. Habitual music-listening behavior, emotion regulation, stress and health variables were measured. **RESULTS:** Quantitative aspects of the habitual music-listening behavior, i.e. average duration of music listening and subjective relevance of music were not associated with health. In contrast, qualitative aspects, i.e. reasons for listening (especially ‘reducing loneliness and aggression’, and ‘arousing or intensifying specific emotions’) were significantly related to health (all $p = 0.001$). These direct effects were mediated by distress-augmenting emotion regulation and

individual stress reactivity. **CONCLUSION:** Our findings indicate that music listening is an essential ingredient of the everyday lives of individuals. The habitual music-listening behavior appears to be a multifaceted behavior that is further influenced by dispositions that are not usually related to music listening. Consequently, associations between habitual music-listening behavior and health do not seem to be obviously linked to health. Possible additional mediating factors of this association are discussed.

EMPIRICAL STUDY II

BACKGROUND & AIMS: Music listening has been suggested to beneficially impact health via stress-reducing effects. However, the exact mechanisms through which music exerts its positive consequences on the body are poorly understood. The aim of the current study was to address this gap in knowledge and to examine the underlying mechanisms of music effects across acute neuroendocrine, autonomic, cognitive, and emotional domains of the human stress response. **METHODS:** Sixty healthy female volunteers (mean = 25.27 years) were exposed to a standardized psychosocial stress test after being randomly assigned to one of three different conditions prior to the stress test: 1) relaxing music ('Miserere', Allegri) (RM), 2) sound of rippling water (SW) and 3) rest without acoustic stimulation (R). Salivary cortisol and alpha-amylase (sAA), anticipatory cognitive appraisal, subjective stress perception and anxiety were repeatedly assessed in all subjects. We hypothesized that listening to music prior to the stress test, compared to SW or R, would result in an attenuated stress reaction. **RESULTS:** The stress test caused significant changes in all measurements in all three groups over time. The three conditions differed significantly regarding cortisol responses ($p = 0.014$), with highest values in the RM and lowest values in SW. sAA recovery delta showed a statistical trend ($p = 0.060$) in favor of the RM. Psychological measures did not significantly differ between groups during the experiment. **CONCLUSION:** Our findings indicate that music listening differentially impacts the psychobiological stress system.

Listening to music prior to a psychological stress test increases rather than attenuates subsequent psychological and endocrine stress responses. In contrast, listening to the sound of water seems to result in an attenuated endocrine response to stress compared to no auditory stimulation. Listening to music seems to increase autonomic recovery more efficiently than listening to the sound of water or resting in silence. These findings bear potential to explain the effects of music on the human body.

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ABBREVIATIONS

ACTH	=	Adrenocorticotropin hormone
ANOVA	=	Analysis of variance
ANS	=	Autonomic nervous system
AUC_G	=	Area under the curve with respect to the ground
AUC_I	=	Area under the curve with respect to increase
BDI	=	Beck Depression Inventory
BMI	=	Body mass index
CNS	=	Central nervous system
CRH	=	Corticotropin-releasing hormone
DAR	=	Distress augmenting emotion regulation
EP	=	Epinephrine
ERI	=	Inventory for regulation of emotion
ERQ	=	Emotion Regulation Questionnaire
FBL	=	Freiburger Beschwerdeliste
FIML	=	Full information maximum likelihood
fMRI	=	Functional magnetic resonance imaging
GAS	=	General adaptation syndrome
HED	=	Hedonistic emotion regulation
HG	=	Heschl's gyrus
HPA axis	=	Hypothalamus-pituitary-adrenal axis
HR	=	Heart rate
IgA	=	Immunoglobulin A
LC	=	Locus ceruleus
MOD	=	Emotional moderation emotion regulation
NAc	=	Nucleus accumbens
NE	=	Norepinephrine