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„Music-induced Flow Alters the Emotional Response to Environmental Scenes“

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Simon Tobias Lüdtke, BSc.

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1. Introduction

Positive psychology emphasizes human strengths and virtues, that help preventing mental illness (Seligman & Csikszentmihalyi, 2000). Early works from the 1930s, focused on giftedness, martial happiness, effective parenting and a search for and discovery of meaning in life. However, after World War II, psychologists in research and profession were mainly occupied with repairing damage within a disease model of human functioning, while neglecting how people, in general, could more productive and fulfilling lives and make the most out of their talents. Analogously, psychologists applied a stimulus-response framework as was promoted by behaviorists and they came to view themselves as part of a mere subfield of the health professions (Seligman & Csikszentmihalyi, 2000).

The recognition of human needs beyond sole survival and endurance under adversity, is due to humanistic psychologists of the 1960s and has led to a more appropriate stimulus-organism-response framework. It was slowly established that human beings actively shape their environment and themselves, that they strive for subjective well-being, contentment, and life-satisfaction, and that they can thrive and flourish under certain circumstances (Seligman & Csikszentmihalyi, 2000).

However, while concepts of self-actualization, need satisfaction, and others did not attract much of a cumulative empirical base, self-help movements, flooding the psychology section in general book stores, encouraged self-centeredness and excluded concerns for collective well-being. To fill empirical gaps in psychological research following the humanistic tradition, Csikszentmihalyi, a Hungarian research, who was raised in Italy and later emigrated to the United States, interviewed people from different professions, usually high-achievers, in search for the factors that let them outdo others in terms of work productivity and satisfaction (Seligman & Csikszentmihalyi, 2000).

The present master's thesis tries to further strengthen the empirical base of what became known as *flow* states (Csikszentmihalyi, 1991) by investigating its antecedents, processes and consequences, namely personality and other trait characteristics linked to a proneness for flow, its psychophysiological underpinnings as well as affective modulation of subsequent environmental stimuli. Findings on the psychophysiological flow signature are still very rare and partly inconsistent and of now, there are no investigations of affective consequences of flow on the perception of neutral visual stimuli.

1.1 The Theory of Flow

Flow denotes an altered state of mind, which is characterized by a deep absorption into an activity – the merging of action and awareness (Csikszentmihalyi, 1991). In such a state, the perception of irrelevant information from the environment and of ourselves fade into the background, which the individual usually experiences as very positive and rewarding. The joy connected to this rewarding experience is referred to as *autotelic experience* – it is intrinsically motivating and lets us engage in the activity over and over again, even in the absence of objective benefits. From interviews conducted in the early seventies, Csikszentmihalyi condensed four broad characteristics that are typical to flow activities: they have (i) rules that recognize the learning of skills, (ii) clear goals, (iii) provide feedback and (iv) allow control. Seemingly effortless, one can concentrate on such an activity for long periods of time. Time itself seems to transform in that it subjectively runs faster or slower – perhaps most significant of the altered state of mind. In the literature, these nine flow dimension are usually referred to as *Challenge-skill Balance, Action-awareness Merging, Clear Goals, Unambiguous Feedback, Total Concentration, Sense of Control, Loss of Self-consciousness, Transformation of Time,* and the *Autotelic Experience* (Csikszentmihalyi, 1991; Jackson & Marsh, 1996; Jackson, Martin, & Eklund, 2008a; Jackson et al., 2008a). Consequences of flow states can be affective, cognitive, physiological and improved quality of task performance (Landhäußer & Keller, 2012).

According to the Csikszentmihalyi (1991), *optimal experience* – often used interchangeably with flow – is an experience, in which the consciousness is ordered, thus the opposite of psychic entropy, which would be connected to negative emotions such as fear, pain and anxiety. During optimal experience, our attention resources are working to capacity, resulting in high efficiency and productivity. Less capacity is left for maladaptive behaviors such as repetitive thinking or worrying, and feedback from somatic sensors involved in the perception of chronic pain. In extreme cases, flow can inhibit vital bodily functions like food intake and sleep. Accordingly, there have been numerous confirmed reports of deaths due to excessive video gaming and it is argued that virtual reality games may even increase this statistic, due their game immersion (Tisdale, 2016). Since flow and optimal experience are highly rewarding, we urge for continuation of the activity. Likewise, interruptions – irrelevant sensory information too salient to dismiss – can trigger negative emotions. Due to these side effects that parallel behaviors in dependence and addiction (e.g., compulsivity), there also has emerged a research field within the flow community focusing on “the dark side of the flow” (cf. e.g. Keller, Bless, Blomann, & Kleinböhl, 2011; Partington, Partington, & Olivier, 2009).

Concerning the operationalization of flow, Moneta (2012) appropriately wonders how there can be such high agreement on the concept of optimal experience, but such high disagreement on how to measure it. Over the years, researchers have proposed numerous operationalizations, including the Experience Sampling Method (ESM), a first questionnaire closely aligned to the subjective measure of flow in the ESM (FQ), a quadrant model, an experience fluctuations model, a regression modeling approach and finally, the componential approach, covering state and trait flow on several dimensions most appropriate for controlled experimental studies (Jackson & Marsh, 1996; Jackson et al., 2008a; Rheinberg, Vollmeyer, & Engeser, 2003).

1.2 Flow of Music

Studies of flow and music have mainly focused on three realms, namely, music performance, composition and listening (for a review see Chirico, Serino, Cipresso, Gaggioli, & Riva, 2015). In *Flow of Music* (Csikszentmihalyi, 1991, p. 108), music listening is ought to induce flow experiences when seriously attended to because "music helps organizing the mind due to quality of its sound", which most likely refers to its mere physical properties in form of oscillations or sound waves, believed to represent the constellations of planets in ancient times and utilized to synchronize moods of pupils attending the Platonic Academy. However, as has already correctly been pointed out by Chirico et al. (2015) and Engeser and Schiepe-Tiska (2012), analyzing flow in relation to music listening may appear odd at first glance because flow is connected to high achievement and peak performance, and to objectify when music listening was successful seems rather difficult.

1.2.1 Music Listening. Music listening can however improve performance in sports by increasing flow (Pates, Karageorghis, Fryer, & Maynard, 2003). In this study, music excerpts were self-chosen, which has a greater impact on emotional states than unfamiliar music (Mitchell, MacDonald, Knussen, & Serpell, 2007).

1.2.2 Music Composition. Concerning music composition and flow, Baker and MacDonald (2013) found that global trait flow positively influenced original song creation in a therapeutic context. No influence of age and/or gender was found on flow, which is one of the original premises, namely that flow is independent of socio-demographic variables such as sex, age, ethnicity, social class, etc. (Csikszentmihalyi, 1991). In another study on music composition and flow, participants engaged in a Music Paint machine conductive to flow, in that higher flow scores were associated to presence (i.e., being able to realize own intentions in a real or virtual world; Nijs, et al., 2012, as cited in Chirico et al., 2015). Further, it has been shown that higher levels of flow are connected to higher levels in creativity and quality of music compositions (MacDonald, Byrne, & Carlton, 2006).

1.2.3 Music Performance. Flow in music performance has received more attention from the research community than composition and listening, respectively. Sinnamon, Moran, and O'Connell (2012) first validated the revised dispositional flow scale for amateur as well as elite musicians and found that the Challenge-skill Balance as well as Clear Goals dimensions were less pronounced in trait flow of amateur musicians, while they scored higher on Loss of Self-consciousness (Jackson et al., 2008a; Jackson, Eklund, & Martin, 2004). As previous research on athletes concluded that the dimensions Time Transformation and Loss of Self-consciousness received lower endorsement in flow experiences, for musicians it was found that all scales seemed to be important, which manifested itself in positive intercorrelations. This finding might be due to the fact that sport activities differ from musical activities concerning time because almost all sports bear some kind of time restrictions and monitoring one's own performance might often be unavoidable in order for high achievement.

Wrigley and Emmerson (2013) first validated the revised flow state scale (Jackson et al., 2008a) for musicians and found time transformation to be a weak predictor for flow since it explained very little of the variance. No significant effect of gender was found and flow occurred regardless of what semester students were in. Given that flow was measured under examination conditions, and thus participants were pressured to perform especially well, it may come as no surprise that a majority of students experienced no or low flow, scoring very low on Action-awareness Merging and Loss of Self-consciousness and rather low on Autotelic Experience and Challenge-skill Balance.

Freer (2009) examined the experience of six young choir singers and found that lack of awareness concerning time constraints was among other things like deep personal involvement – something largely out of the scope in flow research except for in Keller et al. (2011) – responsible for higher levels of flow. Moreover, he concluded that the experience of the individual is inseparable from that of the ensemble, a proposal first studied in depth a decade later under the *Networked Flow model* (Gaggioli, Chirico, Mazzoni, Milani, & Riva, 2017). Here the authors video-taped 15 bands in their rehearsal room and found that music performance was positively associated with exchange of gazes and negatively associated with the exchange of orders. Hence, high-flow groups may tend to rely more on nonverbal communication through the visual channel. Networked Flow is based on principles of group flow, first assessed by Sawyer (2006) in studies of creativity, as well as Hart and Di Blasi (2015) in musical jam sessions.

1.3 The Autotelic Personality

One might wonder why some people voluntarily engage in music performance publicly, where they are exposed to hundreds, maybe thousands of critical spectators – at times a rather frightening idea. Who are those people and why are they doing it? Csikszentmihalyi himself already pointed out the close alliance between flow and coping with stress (1991): some people may have superior styles of coping with psychological strain by transforming adversity into enjoyable challenge. *Transformational coping* (Csikszentmihalyi, 1991) is believed to follow three steps, namely (i) unselfconscious self-assurance (being less self-centered; focusing on being in harmony with the environment), (ii) focusing attention to the world (looking for other possibilities for reaching certain goals) and (iii) the discovery of new solutions (adjusting one's goal). Thus, the so-called *autotelic personality* may be characterized by a certain set of personality factors, including a healthier style of dealing with potentially negative emotions. In fact, recent studies have shown that proneness to flow is positively related to trait emotional intelligence (Marin & Bhattacharya, 2013; Srinivasan & Gingras, 2014), conscientiousness and extraversion, as well as internal locus of control (Keller & Blomann, 2008), but negatively related to neuroticism (Heller, Bullerjahn, & Von Georgi, 2015; Ross & Keiser, 2014; Ullén et al., 2012). So far, no evidence has shown a relation between flow proneness and intelligence (Ullén et al., 2012), which also would not be expected from the theory of optimal experience directly. However, a link between flow proneness and intelligence could appear as a covariate to psychological resilience or cognitive capacities such as sustained attention or as a result of positive development due to frequent optimal experiences or autotelic personality.

From these considerations it follows that autotelic personalities might engage in flow activities such as music performance because they are stress-inducing, thrilling experiences, and coming out on top of the challenge potentially leaves them with a whole range of rewarding, positive emotions, including lifted self-confidence, pride and joy. Nonetheless, flow would still be a form of stress, however, most likely a form of *eustress*, of which Selye (1957) believed it would lead to personal growth, health and happiness. On the opposite, so-called nervous and psychic disorders – increased blood pressure, peptic ulcers, certain forms of rheumatism, allergies, kidney and circulatory diseases – essentially originate from maladaptation to *distress*. Lazarus (1993) argued that psychological stress (as opposed to physiological stress) should be considered a part of the emotions and that, though belonging together, the literature on psychological stress and the literature on emotions have generally been treated as separate.

Today it is believed that the active use of emotions is adaptive by (i) promoting habituation to stressors, (ii) serving as signaling function to the individual, (iii) engendering cognitive reappraisal, (iv) directing attention and (v) regulating the social environment (Snyder, Lopez, & Teramoto Pedrotti, 2011). However, although flow might subjectively feel different to stress due to the positive emotions involved, it should be quantifiable through physiological methods commonly employed when interested in stress reactivity.

The following section dips into psychophysiological markers investigated in relation to flow including electromyography (EMG) of facial muscles, galvanic skin response and skin conductance (SC), respectively, heart period and heart rate variability (HRV), and respiration.

1.4 The Psychophysiology of Flow

1.4.1 Early investigations. Psychophysiological investigations of flow had started in the early 2000s when Kivikangas (2006) found reduced contraction of the corrugator supercilii (CS), while no relationship was found for the zygomaticus major (ZM) and SC in ego shooter video gaming. A few years later, Nacke and Lindley (2010) could, however, confirm a contraction of the ZM accompanied by increased SC also in a shooter game. The co-occurrence of ZM and SC may most obviously reflect *elevated valence and arousal* signaling enjoyment as predicted by Lang (1995).

1.4.2 The HRV of flow. Based on similar predictions derived from Lang (1995), De Manzano, Theorell, Harmat, & Ullén (2010) investigated a wide range of physiological markers, including ZM, CS while newly introducing HRV measures as well as thoracic respiration during music performance, namely piano playing. They were the first to assess the psychophysiology of flow during music performance and as of now there are no replication studies in the music domain. Concerning the facial expressions associated to flow, they could replicate that activation of the ZM is linked to state flow, however, no association to CS was found. Regarding HRV and respiration, De Manzano et al. (2010) found flow to be linked to an increase of total power, decreased variability on the high frequency band (HF), a higher ratio between variability on the low frequency band and the high frequency band (LF/HF), reduced heart period (HP or RR) and increased respiratory depth (RD). No effect was found however for respiratory rate. The authors concluded that flow might be associated to parasympathetic modulation of sympathetic activity.

Based on the hypothesis that physiological markers of flow indicate a non-reciprocal increase of activity in both branches of the autonomous nervous system (ANS), Harmat et al., (2015) let participants play games of Tetris under Easy, Optimal and Difficult conditions, while measuring state flow, subjective concentration and affective state (valence-arousal), heart rate variability and oxygenation of the prefrontal cortex. They could replicate that flow is associated with increased respiratory depth. Further, a reduced statistical model revealed associations to lower LF. Contrary to the hypothesis, no relationship was found between flow and hypofrontality suggesting that flow might rather be associated with activity of deeper brain regions involved in emotional control and autonomous regulation (i.e., deactivation of left amygdala, Ulrich, Keller, Hoenig, Waller, & Grön, 2014; D2 receptor binding in the striatum, De Manzano et al., 2013). Tozman, Magdas, MacDougall, and Vollmeyer (2015) also found a decrease of LF being related to subjective ratings of flow during a challenge-skill balanced condition of a driving simulator task. In addition, authors revealed a moderate increase of HF in relation to flow. Note that they made use of a different flow state scale (i.e., FKS, Rheinberg et al., 2003) than the studies cited above and that the questionnaire disregards the rewarding nature of flow experiences, namely the autotelic experience.

1.4.3 Endocrine correlates of flow. According to the Tozman et al. (2015) they are contradicting Keller et al. (2011) who found decreased HRV (i.e., root means square of successive differences in RR intervals, RMSSD) in the fit condition (i.e., highest challenge-skill balance) of a board game task in contrast to the boredom condition, arguably reflecting stronger involvement in the fit condition or mental strain/workload leading to mental fatigue. The difference between the fit and overload condition only reached trend level, hence the results are inconclusive of whether decreased HRV is associated to flow or purely stress (i.e., eustress or distress) and even more so because valence/pleasantness or any of the other flow dimensions besides challenge-skill balance were not measured during the task. Correspondingly, in a second experiment, no difference was found in salivary (endogenous) cortisol levels between the fit and overload conditions, while there was a significant difference between the fit and boredom condition. In conclusion, Keller et al. (2011) were the first to demonstrate that flow and overload both share similar levels of cortisol and extent earlier findings concerning flow and HRV (i.e., De Manzano et al., 2010). However, in contrast to their claim, they did not show that “flow experiences represent a distinct state that can be identified not only with self-report data but also on physiological measures” (p. 852), since it was in fact indistinguishable from a state of stress. Moreover, they dismissed the interpretation that flow may be a form of eustress, since it was not accompanied by better mood and argue that elevated levels of cortisol may not be considered healthy. Nonetheless, there was an undeniable tendency in the data, suggesting that mood was in fact most positive in the fit condition ($M = 6.24$, $SD = 1.21$ vs. $M = 5.61$, $SD = 1.33$ in the overload condition, $F = 1.33$, $p = .28$), which may prove to be statistically relevant in a more hypothesis based approach, and secondly, it is worth considering that cortisol’s basic function is to release energy, which may be beneficial or even necessary in tasks that require high skills also at skill-demand-compatibility.

The latter argument is corroborated by Peifer, Schächinger, Engeser, and Antoni (2015), who emphasize that cortisol secretion enhanced blood-glucose levels can facilitate sustained attention and help tackle a challenging task. In a double-blind, randomized, placebo-controlled, cross-over design, participants were administered relatively high doses of oral (exogenous) cortisol. The experiment showed that high levels of cortisol are negatively linked to flow. By taking earlier findings of Keller et al. (2011) into account, who found moderate levels of endogenous cortisol were increasing the likelihood of reaching a state of flow, they suggest that the relationship between cortisol and flow is following a u-shaped function.

To summarize, findings on the psychophysiological signature of flow are somewhat paradox: Flow was found to be positively related to respiratory depth, deactivation of the left amygdala, activation of the reward system and smile muscle as well as to decreased LF, increased blood pressure and cardiac output, decreased heart period, RMSSD and parasympathetic activity (lower HF), an imbalance of the ANS (higher LF/HF ratio) and moderate levels of endogenous cortisol. The psychophysiology of flow is often hypothesized to share many characteristic effects found in research on mental effort, workload, stress and effortless attention. Regarding HRV measures, a meta-study conducted by Castaldo et al. (2015) showed that during mental stress heart period, RMSSD, pNN50 (percentage of successive RR interval pairs that differ more than 50ms), SDRR (standard deviation of RR intervals) and HF were decreased while LF and LF/HF were increased in most of the reviewed journal papers, pointing to a “shift of the ANS balance towards the sympathetic activation and the parasympathetic withdrawal” (p. 376), a phenomenon explained through the theory of the fight or flight response. According to Cacioppo, Tassinary, and Berntson (2007), LF is currently believed to index not only sympathetic activity but is also determined by parasympathetic activity. However, as an sympathovagal index, LF/HF assumes a reciprocally regulated autonomic continuum as evident in orthostatic stress, but very unlikely in psychological contexts. Therefore the authors caution against interpretation of the LF/HF ratio as a measure of ANS imbalance.

1.5 The Present Study

On grounds of the literature reviewed above, it is hypothesized that flow in music performance may resemble many of those effects on HRV found in case of stress and mental workload, namely decreased HF, as well as decreased heart period, RMSSD and NN50, reflecting an increase of sympathetic arousal and decrease of parasympathetic activity. However, contrary to what would be expected from findings on mental stress, LF was decreased in two flow studies (Harmat et al., 2015; Tozman et al., 2015) and one study (De Manzano et al., 2010) found a relative increase of LF over HF by means of LF/HF ratio, most likely due to decreased

HF, while LF remained constant, or even slightly increased. Therefore, no a priori assumptions were made concerning this particular HRV measure.

According to flow theory, these stress-like states are however experienced as very rewarding and contribute to mental health and subjective well-being. Therefore, it should be possible to measure positive affective consequences of the flow experience. Such consequences could include an altered perception of visual stimuli. The broaden-and-build theory of positive emotions (Fredrickson, 2001) proposes that one's thought-action repertoires are widened when experiencing joy, for example, letting the person engage with the environment more successfully and building personal psychological resources, which ultimately leads to subjective well-being and happiness, through an upward spiral. Within the affect-as-information framework (Storbeck & Clore, 2008), sympathetic arousal during music performance may enhance subjective urgency or importance of subsequent visual stimuli. In 2012, Marin, Gingras, and Bhattacharya revealed such a transfer of arousal from the musical to the visual domain. Felt arousal during music listening increased arousal felt in response to affective pictures (International Affective Picture Set, IAPS; Lang, Bradley, & Cuthbert, 2008). No such transfer effect was found for valence/pleasantness. However, the hypothesized transfer of music-induced arousal may be relatively brief and exhausted as soon as balance between sympathetic and parasympathetic systems is restored.

From the literature on the link between personality traits indicating healthier coping styles and flow (i.e., Heller et al., 2015; Huber, 2015; Marin & Bhattacharya, 2013; Ross & Keiser, 2014; Srinivasan & Gingras, 2014; Ullén et al., 2012), it is deducted that resilience, EI, internal locus of control, conscientiousness, extraversion and openness to experience should be positively related to flow, whereas neuroticism is expected to be negatively linked to trait flow.

Musical expertise is expected to enhance the likelihood of reaching a flow state, since the current quadrant model of flow proposes that flow activities are posing at least a moderate degree of personal challenge as evidenced by elevated endogenous cortisol levels in contrast to boredom (Keller et al., 2011), and thus require an adequately skilled individual to preserve it from becoming a threat. The greater the challenge, the larger is the reward in successfully mastering it.

Finally, given the rather difficult operationalization of flow (Moneta, 2012), it is suggested that studies may benefit from straightforwardly asking about the reward connected to the experience, when trying to obtain an undiluted indicator of flow. The main focus of studies on optimal experience has been their relation to personal fulfillment and happiness, thus, by temporarily disregarding the remaining eight flow dimensions, which may be more easily contaminated by confounders including state variables such as mood or trait variables such as styles of coping, researchers may gain a relatively unbiased indicator of the flow amplitude.

2. Methods

2.1 Design

The primary aims of this study were to investigate to what extent flow experiences influence the emotional appraisal of environmental scenes and to determine whether cardio-vascular measures may underlie these changes. Therefore, a subset of neutral pictures was created from the International Affective Picture Set (Lang, Bradley, & Cuthbert, 2008), namely low-arousing pictures that were neither high nor low on valence/pleasantness according to the IAPS manual. The study had two phases – the pretest and the main experiment. In the pretest, selected pictures were presented to musicians with at least three years of training in an attempt to validate emotional neutrality of the picture set. In the main experiment, flow was induced through a music/flow task (i.e., making music in a group) prior to the presentation of the picture set. In order to investigate between-subject differences in picture ratings depending on the degree of the induced flow state, participants' data was split along the median of global flow to constitute a *low-flow* and a *high-flow* group as well as the median of autotelic experience (AE) to constitute a *low-AE* and *high-AE* group. Differences in heart period and heart rate variability as well as mood states were also compared between these groups. Heart rate variability was investigated among participants of the main experiment only, because there was no music/flow task in the pretest and hence no heart rate monitoring was applied. Further, differences in picture ratings and mood states were also investigated as within-subject factors in each group.

Originally, it was planned to have a control condition in which music groups would have had to complete the picture task before the music/flow task, but since participant recruitment was more difficult than expected, only a pretest for picture ratings and the more vital condition of the main experiment (music/flow task first, then picture task) were compared with each other. The general design of the study is depicted in Figure 1.

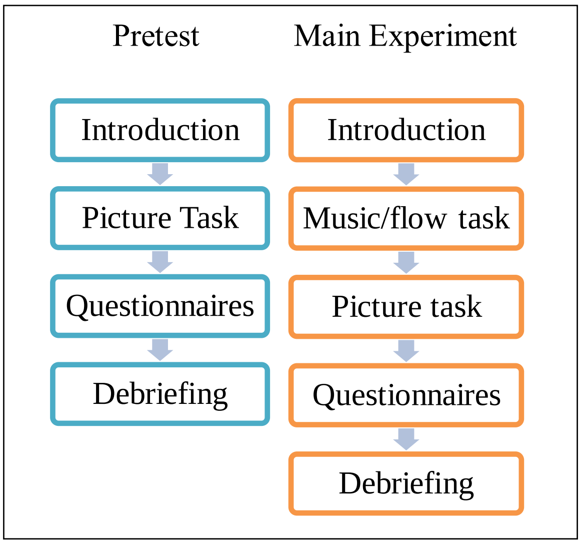

Figure 1. *Experimental design.*

2.2 Participants

Participants were recruited via the Faculty's database, poster advertisement at different university sites and nearby music stores as well as emails directed at local bands found on the internet. Advertisement wording and format were used consistently. Due to limited space and equipment in the laboratories of the department where the study was conducted, music groups were required to have no more than four members and due to the experimental design, at least being able to perform one well-practiced fast and one slow song, all of which was already pointed out in the advertisements. Moreover, the poster said that the music would be audio-recorded, and that these recordings would be made accessible to the respective group, which on the one hand served as an incentive for participants, and on the other hand, allowed researchers to verify that the instruction for the music/flow task were followed correctly. Lastly, as an additional incentive, it was announced in the poster that musicians would receive a payment. Participants of the main experiment received 10 Euros per person, while participants of the shorter pretest received 5 Euros. All participants had normal or corrected to normal vision, were able to see color and were German native speakers. Informed written consent was obtained from all participants prior to the study. Participants of the pretest were not allowed to participate in the main experiment due to familiarity with the pictures.

2.2.1 Pretest sample. Participants of the pretest were all musicians but not necessarily playing in any music groups. They were required to have at least three years of training in an instrument or singing. From the 21 musicians participating in the pretest, three had to be excluded for the following reasons: One participant stated to have had bongo drum training for eight years and showed little interest in the study in general. It was suspected that this particular participant might not have been a musician after all and participated in the study only due its course credit; hence the data was excluded from further analyses. One missing data point concerning mood state prior to the experiment was found for another participant. Moreover, this participant showed a *z*-score of 4.25 for music training, indicating an extreme outlier. Hence, this participant's data was also excluded from further analyses. Another participant was found to be much older than the other musicians (z = 3.59) and had to be excluded as well. The resulting pretest sample consists of N_1 = 18 participants with an average of 25.8 (*SD* = 4.0) years of age, of which 55% were female. Fifty-five-point six percent were still enrolled in university courses while 44 % already had completed a university degree. Participants were mostly wind players (33%), followed by string instrument players (28%), pianists (22%) and drummers (11%). One participant (6%) primarily used the computer as an instrument.

2.2.2 Main experiment sample. Twenty-two musicians participated in the main experiment and nine of them had to be excluded for various reasons. There were seven different music groups with two to four members each group. The members of each music group were tested simultaneously. Unfortunately, in three cases the heart rate recording device did not generate data properly, leading to exclusion of the complete data from these participants. In one case the computer script for pictures presentation did not function properly, which is why the complete data of this participant was also excluded. Two participants were not asked about their mood states prior to the experiment; hence their data had to be excluded as well. One participant showed a tendency towards extreme ratings, indicated by noticeably high standard deviations, and another participant gave descending picture ratings on one scale and ascending ratings on the other scale, and in addition, had consumed alcohol before the experiment according to a self-report. The data of both participants was therefore excluded from further analyses. Lastly, the data of another participant had to be excluded, because it showed an outlier on one of the pre-experiment mood questionnaire scales (i.e., z = 2.21).

The resulting sample consists of N_2 = 13 musicians with a mean age of 29.6 years (*SD* = 7.2), of which 31% were female. They mostly described their respective bands as rock groups (78%) and mostly had band rehearsal every two weeks (64%). Sixty-one-point five percent had a university degree, 23% finished apprenticeship, eight percent were still in training, while another eight percent were self-employed. Participants were mostly string instrument players (77%), followed by drummers (15%) and singers (8%). Due to the lack of formal music education, namely graduation from a music university or conservatory, and because the participants receive only little money on an irregular basis for their music services, this sample is regarded as consisting of semi-professional musicians.

2.3 Materials

2.3.1 Picture set. The subset of 70 neutral pictures (Lang, P.J., Bradley, M.M., & Cuthbert, 2008) depicted urban and rural environmental scenes including some portraits and close-up images of household objects and furniture. Selected pictures were neither low nor high in valence/pleasantness (M = 5.08, Min = 4.23, Max = 5.80) and low in arousal (M = 2.87, Min = 1.72, Max = 4.02). See Appendix for detailed information.

2.3.2 Music and recording equipment. The musical and sound recording equipment for the main experiment was made available by SL and included a guitar and a bass amp, drum set and personal amplifying system (P.A. system) for vocals. Two large diaphragm microphones were used for stereo sound recording. They were connected via an USB-Audio-Interface to a laptop equipped with professional sound recording software.

2.3.3 Questionnaires. Participants' mood states were measured using two different short versions (A and B) of the Multidimensional Mood Questionnaire (MDMQ; German: Multidimensionaler Befindlichkeitsfragebogen or MDBF; Steyer, Schwenkmezger, & Eid, 1997). Each version presents 12 different adjectives, of which four represent either the *Pleasant-unpleasant*, *Awake-sleepy* or *Calm-restless* mood dimension. Items have to be rated on 5-point Likert scales ranging from "1 = not at all" to "5 = very much". Internal consistencies were between Cronbach's α = .73 und α = .89. Authors reported high content, convergent, discriminant, factorial and internal criterion validity. In the main experiment, which had three incidents where mood states were of interest, the order of the versions was A-B-A.

The 'Short' Flow Scale (Martin & Jackson, 2008) was translated into German and adapted for the purpose of the main experiment. SL translated the items into German, then MM translated it back into English. If a translated item was too far off the original, a second translation was made, which then again, was given to MM, repeating the procure until a satisfying result was reached. The questionnaire assesses all nine flow dimension as described by Csikszentmihalyi (1991) (i.e., Challenge-skill Balance, Action-awareness Merging, Clear Goals, Unambiguous Feedback, Total Concentration, Sense of Control, Loss of Self-consciousness, Transformation of Time, Autotelic Experience) with one item each. Items are comprised of complete sentences and participants have to indicate, if the experiences referred to occurred during the music/flow task by choosing a number from "1 = completely not the case" to "7 = completely the case". In Martin & Jackson (2008) the flow scale has been validated for music activities, correlating with external factors of motivation, enjoyment, participation, aspiration, and buoyancy and showed acceptable reliability of α = .82.

In addition, a second flow questionnaire was used, namely the Flow Short Scale

(German: Flow-Kurzskala or FKS; Rheinberg et al., 2003), which captures flow on 10 instead of nine items. Furthermore, it measures Anxiety toward exerting the given task on three items, as well as Task Difficulty, Task Ability and Personal Challenge. Items had to be answered on 7-point Likert scales as well. Note that the FKS does not ask how rewarding the experience was, due to different operationalization of flow and optimal experience. The FKS has three subscales, Task Absorption (German: Absorbiertheit), Task Fluency (German: Glatter Verlauf) and Worry (German: Besorgnis). Internal consistencies were between α = .92 and α = .80 and the measure showed high construct and criterion validity.

A dispositional flow scale was also administered to capture how frequently participants experience flow states in their everyday lives independent from the experiment (L DFS-2; (Jackson, Martin, & Eklund, 2008b). It comprises 36 items, thus evaluating the nine flow dimensions on four items each. Items have to be rated on a 5-point scale from "1 = never" to "5 = always". According to a validation study, reliabilities of subscales were between .79 and .91 and flow was .92 in a combined sample of N = 204 amateur and elite musicians (Sinnamon et al., 2012). Although Sinnamon et al.'s first attempt of validating the L DFS-2 for musicians was successful, they caution against interpreting high flow scores, even calling it "potentially hazardous" (p. 18) because they may be accompanied by low scores on the dimension of Action-awareness Merging and Loss of Self-consciousness in professional musicians, two dimensions which are by definition the most crucial aspects of flow and optimal experience. In contrast to the domain of sports, all nine dimensions however showed high intercorrelations, indicating that they are all of interest when investigating flow in musical activities.

In order to assess participants' music preference, a German version of the Short Test of Music Preferences (STOMP; Langmeyer, Guglhör-Rudan, & Tarnai, 2012) was administered. The questionnaire comprises 15 items, which have to be answered on a 7-point Likert scale and evaluate four different dimensions of music preference: Reflective & Complex, Intense & Rebellious, Upbeat & Conventional as well as Energetic & Rhythmic. Langmayer et al. added Popular German Music (German: Populäre Volksmusik) and New German Wave (German: Neue Deutsche Welle) due to inter-cultural differences in the music industry landscape as well as public taste concerning the genres folk, country and religious music originally proposed by Rentfrow and Gosling (2003). The original factor structure could be replicated and the questionnaire thus proved to be a valid instrument for measuring music preference in the German speaking population. Reliabilities, however, were somewhat poor, ranging from α = .51 for Energetic & Rhythmic to α = .71 for Reflexive & Complex. Given that each dimension is measured on only 4 items (the degree of Cronbach's α is depending also on the number of items; a lower number produces a lower α, see e.g. Tavakol & Dennick, 2011) and music preference is a rather complex construct in contrast to mood state for example, where coefficients were between .73 and .89 despite the low scale item numbers), it may not come as a surprise that only low Cronbach's αs were found.

The Gold Music Sophistication Index (Gold-MSI; Müllensiefen, Gingras, Musil, & Stewart, 2014) reveals information about participants' "musical skills, expertise, achievements, and related behaviours" (p. 2) and was developed to measure the musicality of musicians as well as non-musicians. Thirty-six items have to be answered on a 7-point Likert scale. The best factor model fitting the data was a model of five subfactors, namely Active Engagement, Perceptual Abilities, Musical Training, Singing Abilities and Emotions, and one global factor of Musical Sophistication. Schaal, Bauer and Müllensiefen (2014) developed a German version of the Gold-MSI and were able to replicate the original factor structure. Reliabilities of subscales were acceptable to very good and the global factor of musical sophistication excellent at Cronbach's α = .91. The Gold-MSI questionnaire also asks about participants' general school education and professional training.

Trait emotional intelligence was assessed using a short questionnaire in German consisting of 30 items, which had to be answered on a 7-point Likert scale from "1 = completely disagree" to "7 = completely agree" (TEIQue-SF; Jacobs, Sim, & Zimmermann, 2015). It produces subfactor scores for Well-being, Self-control, Sociability and Emotionality as well as a global score for Emotional Intelligence. Factorial validity as well as acceptable internal consistencies (Cronbach's αs between .58 and .88) could be established in a sample of female occupational therapist.

Internal and External Locus of Control (LOC) were measured using a German questionnaire (Internale-Externale-Kontrollüberzeugung-4 or IE-4; Kovaleva, Beierlein, Kemper, & Rammstedt, 2012). Participants have to indicate their agreement with four statement items (two items per facet) on a 5-point Likert-scale from "1 = completely" not applicable to "5 = completely applicable". The IE-4 showed good factorial validity and test-retest reliability between r = .56 and .64.

Participants' personality was briefly measured using a German version of the 10-item Big Five Inventory (BFI-10; Rammstedt & John, 2007). It measures Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness via self-reports on 5-point scales from "1 = strongly disagree" to "5 = strongly agree". Upon development, it showed lower external validity than its 44-item counterpart however convergent validity and discriminant validity could be preserved. Part-whole and test-retest correlations indicated acceptable to good reliability (German Sample Mean $r = .83$ and $r = .78$, resp.), making the BFI-10 a feasible tool for personality assessment in situations where time is a limited resource.

Emotional Resilience was measured on 13 items, which had to be answered on 7-point Likert scales ranging from "1 = completely disagree" to "7 = completely agree" (RS-13;Leppert, Koch, Brähler, & Strauß, 2008)). The original questionnaire by Schumacher, Leppert, Gunzelmann, Strauss, & Brahler (2005) had 25 items and two subfactors, namely Competence and Acceptance. However, both factors have been dropped in light of new evidence from confirmatory factor analyses and are not included in the short version. Internal consistency of the questionnaire was r = .90 and test-retest reliability was r = .61.

Lastly, a self-designed post-questionnaire (see Appendix) measured the feasibility of the pictures and music/flow tasks, participants' solo and band activities as well as earnings and followers, participants' familiarity with the flow concept, substance use prior to the experiment and stage fright. Items had to be answered on 7-point Likert scales by choosing a category or by inserting words and numbers. One item of the post-experiment questionnaire gave a brief description of flow, followed by the question "Are you familiar with the just described state, respectively, did you experience it during music making before?" to which 85% replied "Yes". Subsequently, those participants rated their experience on a 7-point scale from "1 = very weak" to "7 = very strong", in relation to former experiences. It serves as a reference item for the two standardized state flow scales and will be addressed further in the results section.

2.3.4 Heart rate monitoring equipment. Heart rate was recorded via Polar® Watches RS800CX™ (Polar Electro Inc., Lake Success, NY, USA), which proved to be a valid instrument for researching heart rate variability (e.g., De Rezende Barbosa, Silva, de Azevedo, Pastre, & Vanderlei, 2016; Giles, Draper, & Neil, 2016) and has shown moderate two-week test-retest reliability (Williams et al., 2017). The accompanying sensor straps were comfortably worn around the chest right below the nipple line or breasts. The Polar® Watches were calibrated to capture the signal of one specific senor. They record beat to beat intervals (RR intervals) and thus were able to detect fluctuations of heart beat around an average heart rate.

2.4 Procedure

The study was approved by the Ethics Committee of the University of Vienna (Reference Number 00141) and conformed to guidelines of good practice of the Professional Association of Austrian Psychologists (Berufsverband Österreichischer PsychologInnen, BÖP), American Psychological Association (APA), the European Federation of Psychologists' Associations (EFPA) Metacode of Ethics and the latest version of the Declaration of Helsinki (published 2013). It was conducted at the Department of Basic Psychological Research and Research Methods of the Faculty of Psychology, University of Vienna.

2.4.1 Pretest procedure. In the pretest, participants were welcomed and allocated to a computer desk, where they were briefed on the upcoming tasks and signed a consent form. A vision acuity test and a test for color vision were conducted (Ishihara test). Then, the first short version of the mood questionnaire was administered, followed by the picture task. Seventy neutral pictures (i.e., low on arousal and average in valence/pleasantness) were shown for two seconds each in a random order on a computer screen. Felt arousal (German: Erregung) and valence/pleasantness (German: Angenehmheit) of pictures had to be rated on 7-point Likert scales. Arousal was rated from “1 = very low” to “7 = very high” and valence/pleasantness from “1 = very unpleasant” to “7 = very pleasant”. Participants were asked to rate intuitively and not to spend too much time over-thinking the response. Between each trial, a sentence appeared in the center of the screen for five seconds stating that the next pictures would be presented promptly. Thereby, any affect evoked by the previous picture would have time to decay, prohibiting interferences between triggered responses toward different pictures. Two practice trials familiarized participants with the procedure, which was started by clicking the mouse when finished reading the task instruction. Pictures of the practice trials were fixed. They were chosen in addition to the experimental set of 70 pictures and were also neutral according to the IAPS manual. In response to each picture, 50% of participants had to first indicate their felt arousal by clicking the preferred number presented on the screen and then, on the following slide, indicate how pleasant or unpleasant this very picture made them feel. The order of rating scales was reversed for the remaining 50% of the sample. The experimenter made sure that gender and main instrument was relatively balanced in each group. Subsequently to the picture task, a second version of the mood questionnaire was administered as well as a self-designed post experiment questionnaire. The whole procedure took about 15 minutes. Lastly, participants were debriefed, paid 5 Euro and thanked for their participation.

2.4.2 Main experiment procedure. Participants were welcomed and allocated to a computer desk, where they were briefed on the upcoming procedure and also signed the consent form. However, a paragraph was added to the standard form, stating that by taking part in the study, they were giving permission to make audio-recordings and that recordings could be used for research purposes. When finished, they were asked to put on the heart rate monitoring equipment and to check if the recording device (i.e., Polar watch) captured the signal of the sensor strap. Participants also briefly familiarized themselves with the music equipment and were allowed a quick line-check. Then, a first mood questionnaire was handed out. Next, heart rate recordings, which were made throughout the rest of the experiment, were started simultaneously and followed by a five-minute instrumental warm-up session. During the warm-up, participants were asked to make finger or vocal exercises individually. The idea was to obtain a physiological baseline of musical activity without participants reaching a flow state. After the warm-up, the experimenter started the audio recording and left the room, while the music groups started the music/flow task.

For the music/flow task, participants were instructed to play a slow song and a fast song. They were well-practiced beforehand and the order in which they were played was set by the experimenter in a way that around half played the slow song first and the fast song last and vice versa. The tempi of songs were balanced out in order to account for transfer effects of song emotionality (since fast songs are often pleasant/happy whereas sad songs tend to be slower (Juslin & Laukka, 2003) as well as physical activity on the subsequent pictures rating task. Since the task was to play each song for 10 minutes before moving on to the second song, and most songs had a duration of around three minutes, they were repeated until the experimenter gave the signal that it was time to move on to the next song. All songs were composed by the music groups. At the end of the music/flow task, the experimenter entered the laboratory, stopped the sound recording device and asked the participants to sit down at their computer desk, where they swiftly answered the two flow state scales. Next, a second mood questionnaire was filled out and the picture rating task began. Subsequently, another version of the mood questionnaire was administered.

Unlike in the pretest, in the main experiment participants were asked to wait for the experimenters' signal after completion of the two practice trials in the picture rating task, so that the experimental trials could be started simultaneously. It was crucial for the main analyses of heart rate variability measures that participants had the same time line of events. Filling out the intermediate questionnaires and completing both practice trials took around seven minutes. Picture ratings took about 10 to 15 minutes in total. Next, the questionnaires as previously described (i.e., dispositional flow, music preference, musical sophistication, trait emotional intelligence, locus of control, personality, emotional resilience and self-designed post-experiment questionnaires) were handed out to participants. Lastly, they were debriefed, paid 10 Euro and thanked for their participation. The main experiment lasted around 90 minutes. Figure 2 illustrates the procedure of the main experiment.

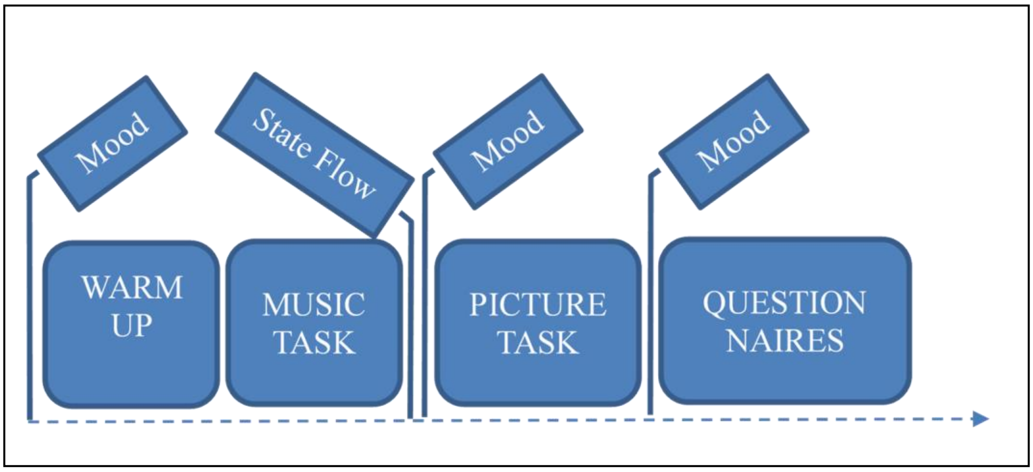

Figure 2. *Procedure of the main experiment.*

2.5 HRV Measurement Tool and Equipment

The collected HRV data was processed using Kubios V 2.2 (Tarvainen & Niskanen, 2012) and first checked for measurement artifacts. Strong artifact correction was applied before the analyses, meaning that RR intervals larger or smaller than 0.15 seconds compared to the local average were replaced by interpolated values using cubic spline interpolation. The 'strong correction' method was most sensitive to artifacts without producing too many false negatives and was applied to the data set of every participant. Linear trend components were removed using the 'smoothness priors' method (λ = 500) comparable to a high-pass filter. Bandwidths for the HRV analyses were at 0.04 to 0.15 Hz for the low frequency (LF) band and 0.15 to 0.4 for the high frequency (HF) band and interpolation of RR series set at 4 Hz by default. Fast Fourier transformation has been applied.

2.6 Statistical Analysis

Due to the small sample size, data was not expected to distribute normally or provide homogeneity of variances between factor steps. Therefore, mostly non-parametric methods were applied, namely *Wilcoxon* tests for testing differences between two related measures and *Friedman* tests for testing between differences of three related measures within participants. *Mann-Whitney U* test were used when group differences of two different groups were examined, and *Kruskal-Wallis H* when interested in simultaneous group comparisons. Spearman's ρ correlations were applied when testing for associations between variables. When testing for differences of heart period and HRV, change scores/within participant differences (Δ) were obtained by subtracting the baseline obtained during the warm-up phase, which in a second step were subjected to between-subjects *Mann-Whitney U* tests. *Repeated-measures ANOVAs* tested for trends of HRV measures across tasks and across picture ratings of the first, second and third minute. Greenhouse-Geisser corrections was employed when the assumption of sphericity was violated. Alpha was set to $\alpha = .05$ and reported p-values are exact and one-tailed when possible.

3. Results

3.1 Descriptive Statistics and Reliability Analyses

Table 1 gives an overview of the mean scores, standard deviations, minimum and maximum scores as well as Cronbach's α reliability coefficient of all standardized questionnaires employed in the pretest, main experiment, or both.

Table 1

Descriptive statistics and reliability coefficients of all standardized questionnaires employed in the pretest, main experiment or both.

		M	*SD*	*Min*	*Max*	α
Multidimensional Mood Questionnaire	Pleasant-unpleasant A [a]	4.53	0.40	3.50	5.00	.587
	Awake-sleepy A [a]	3.90	0.84	2.00	5.00	.845
	Calm-restless A [a]	4.11	0.59	3.00	5.00	.693
	Pleasant-unpleasant B [a]	4.43	0.42	3.75	5.00	.674
	Awake-sleepy B [a]	3.71	1.06	1.25	5.00	.905
	Calm-restless B [a]	4.33	0.61	3.00	5.00	.774
Music Preference	Reflexive & Complex [a]	5.38	1.00	3.00	7.00	.528
	Intense & Rebellious [a]	5.06	1.28	2.25	5.50	.629
	Upbeat & Conventional [a]	3.98	0.94	2.25	5.50	.629
	Energetic & Rhythmic [a]	4.14	1.40	1.00	6.33	.661
Musical Sophistication	Musical Sophistication [a]	89.65	14.18	50.00	110.0	.615
	Active Engagement [a]	42.61	8.93	22.00	61.00	.741
	Musical Perception [a]	53.13	5.24	43.00	61.00	.715
	Musical Training [a]	35.32	6.40	18.00	46.00	.655
	Singing Abilities [a]	31.16	8.09	12.00	44.00	.784
	Emotion [a]	34.45	4.33	21.00	40.00	.674
State Flow	'Short' State Flow [b]	5.26	0.86	3.00	6.67	.739
	Flow Short Scale [b]	5.34	0.87	3.40	6.20	.815

	Task Fluency[b]	5.46	0.95	4.00	6.67	.788
	Task Absorption[b]	5.15	1.14	2.50	6.75	.768
Dispositional Flow	Dispositional Flow[b]	3.88	0.42	3.25	4.81	.915
	Challenge-Skill-Balance[b]	3.90	0.53	3.00	5.00	.715
	Merging of Action and Awareness[b]	4.12	0.38	3.75	5.00	.701
	Clear goals[b]	4.04	0.69	2.75	5.00	.718
	Unambiguous Feedback[b]	3.63	0.56	2.75	4.75	.670
	Concentration[b]	3.90	0.55	2.75	4.75	.708
	Control[b]	3.83	0.45	3.00	4.75	.577
	Loss of Self-Conscious-ness[b]	3.04	1.00	1.25	4.75	.821
	Time Transformation[b]	4.10	0.78	2.25	5.00	.922
	Autotelic experience[b]	4.40	0.73	2.50	5.00	.907
Trait Emotional Intelligence	Trait Emotional Intelli-gence[b]	5.05	1.04	3.13	6.30	.944
	Well-Being[b]	5.64	1.54	1.83	7.00	.937
	Self-Control[b]	4.88	0.86	3.50	6.00	.582
	Emotionality[b]	5.19	1.10	2.88	6.88	.812
	Sociability[b]	4.73	1.39	2.33	7.00	.894
Big Five Inventory	Neuroticism[b]	3.08	0.79	1.50	4.50	.559
	Extraversion[b]	3.19	1.07	1.50	5.00	.736
	Openness [b]	4.58	0.45	4.00	5.00	.364
	Agreeableness [b]	3.12	0.98	1.50	4.50	.684
	Conscientiousness[b]	3.31	0.78	2.00	4.50	.632
	Locus of Control[b]	4.02	0.62	2.75	5.00	.686
	Resilience[b]	5.62	0.79	4.15	6.77	.880

Note:[a] Statistics derived from combined samples (N = 31), [b]Statistics derived from the sample of the main experiment (N_2 = 13).

3.2 Descriptive Statistics of Mood Dimensions

3.2.1 Pretest participants. Since mood states are known to influence valence/pleasantness ratings of pictures (Vuoskoski & Eerola, 2011), they had to be comparable between groups (pretest vs. main experiment). As already stated in the methods section, extreme outliers on at least one of the mood dimensions at the very first mood assessment were excluded from the pretest sample data and main experiment sample data, respectively, to prevent distortion of results. Prior to picture ratings, participants of the pretest were in good to excellent mood (*M* = 4.63, *SD* = 0.26), felt awake (*M* = 4.15, *SD* = 0.69) and calm (*M* = 4.49, *SD* = 0.41). After the picture task, participants mood slightly worsened (*M* = 4.41, *SD* = 0.40) and they felt somewhat less alert and awake (*M* = 3.60, *SD* = 0.17). The calm-restless mood dimension, however, remained roughly the same (*M* = 4.54, *SD* = 0.59). Non-parametric Wilcoxon signed-rank tests were applied to investigate these within-subject differences. They confirmed that mood after the picture task (*Mdn* = 4.50) was not as positive as before the task (*Mdn* = 4.63), $z = -2.22$, $p < .05$, $r = -.52$. Moreover, participants were less awake after the picture task (*Mdn* = 3.75) than at the beginning (*Mdn* = 4.25), $z = -2.83$, $p < .01$, $r = -.67$. Changes on the calm-restless mood dimension showed no significant change, $z = -.43$, *p* = *ns*.

3.2.2 Main experiment participants. Prior to the warm up, participants of the main experiment were in a good to excellent mood (*M* = 4.40, *SD* = 0.52), felt awake and rested (*M* = 3.54, *SD* = 0.92) and were neither nervous nor fully relaxed (*M* = 3.60, *SD* = 0.39). Subsequently to the music/flow task, participants' mood (*M* = 4.46, *SD* = 0.45) and alertness (*M* = 3.85, *SD* = 0.92) did not change substantially. However, participants were somewhat more relaxed (*M* = 4.04, *SD* = 0.53). After having finished the picture task, participants mood (*M* = 4.31, *SD* = 0.63) as well as their alertness (*M* = 3.38, *SD* = 1.30) were relatively stable. The calm-restless mood dimension, however, slightly declined (*M* = 3.79, *SD* = 0.84). Non-parametric Friedman tests were applied to further investigate these differences but revealed no significant differences across the three measurement points (all *p*s = *ns*), hence test statistics are not reported.

3.2.3 Differences between pretest and main experiment participants. The first assessment of mood dimensions revealed that prior to the experiment the participants of the pretest (*Mdn* = 4.50) were significantly calmer (*Mdn* = 3.50), $U = 17.00$, $z = -4.06$, $p < .001$, $r = -1.35$, and more rested, $U = 69.00$, $z = -1.94$, $p < .05$, $r = -.54$, than the participants of the main experiment. This could be due to the fact that the participants of the main experiment were getting prepared to play music. Note that main experiment participants were given an additional mood questionnaire prior to warm-up. Main experiment participants (*Mdn* = 4.00) were not as calm as the pretest participants (*Mdn* = 4.50), $U = 57.50$, $p < .01$, $r = -.44$ before the picture task, which was the second measurement of mood for main experiment participants, but the first measurement for pretest participants. After finishing the picture task, participants of the main experiment were still less calm (*Mdn* = 4.00) than participants of the pretest (*Mdn* = 4.75), $U = 42.00$, $z = -2.70$, $p < .01$, $r = -.50$. All other tests were not significant (all *ps* = *ns*).

3.3 Descriptive Statistics of State Flow and a Comparison to Prior Research

In order to check if the music task successfully induced flow at a magnitude comparable to prior studies involving music performance and flow, in Table 2, mean scores and standard deviations for all nine flow dimensions and the global flow score ($F_{(MJ)}$) (Martin & Jackson, 2008) were compared to findings of De Manzano et al. (2010) and Wrigley & Emmerson (2013). There was a range from fairly low flow (*Min* = 3.00) to very high flow scores (*Max* = 6.67) in the present study.

Table 2

Flow means and standard deviations from the present study (Martin & Jackson, 2008) and prior research.

Flow scales	Present study (N = 13)		De Manzano et al. (2010) (N = 21)		Wrigley & Emmerson (2013) (N = 236)	
	M	*SD*	*M*	*SD*	*M*	*SD*
$F_{(MJ)}$	5.27	1.45	5.66	0.88	4.91	0.80
CSB	5.54	1.61	6.30	0.18	5.05	0.70
AAM	5.15	1.77	5.66	1.01	4.71	0.74
CG	5.77	1.36	5.74	0.78	5.77	0.57
UF	6.31	1.03	6.14	0.65	5.29	0.71
C	5.62	1.12	5.42	1.22	4.94	0.86
SC	4.46	1.45	5.55	1.01	4.59	0.75
LSC	5.38	1.39	6.14	0.72	4.37	0.95
TT	4.54	2.07	4.74	1.13	4.59	0.94
AE	4.62	1.56	5.27	1.18	4.91	0.94

Note. *M* = Mean; *SD* = Standard deviations; $F_{(MJ)}$ = Martin & Jackson (2008) state flow; CSB = Challenge-skill Balance; AMM = Action-awareness Merging; CG = Clear Goals; UF = Unambiguous Feedback; C = Concentration; SC = Sense of Control; LSC = Loss of Self-consciousness; TT = Time Transformation; AE = Autotelic Experience.

3.4 Intercorrelations Between Flow and Its Nine Dimensions

Contributing to the recent discussion, about whether all dimensions matter equally to optimal experience, Table 3 shows the non-parametric Spearman rank correlations between all nine flow dimensions and their relationship to the overall flow score. *Challenge-skill balance, Transformation of Time, Sense of Control, Autotelic Experience* and *Concentration* were the main contributors to *Flow*, whereas *Action-awareness Merging* and *Loss of Self-consciousness* were only marginally related to *Flow*. *Clear Goals and Unambiguous Feedback* were not significantly correlated with the global scale in the current sample.

Table 3

Spearman ρ intercorrelations between flow and its nine dimensions (N = 13).

	$F_{(MJ)}$	CSB	AAM	CG	UF	C	SC	LSC	TT
CSB	$.69^{**}$								
AAM	$.38^{+}$	.36							
CG	.33	-.01	-.26						
UF	.15	.34	.01	-.22					
C	$.61^{*}$	.31	.30	$.43^{+}$	.04				
SC	$.67^{**}$	$.63^{**}$	$.61^{*}$	-.27	.37	$.45^{+}$			
LSC	$.41^{+}$	$.57^{*}$	$.42^{+}$	-.02	.06	$.55^{*}$	$.64^{**}$		
TT	$.70^{**}$	.29	.01	.36	-.17	.17	.11	-.13	
AE	$.58^{*}$	.03	.17	$.54^{*}$	-.08	$.51^{*}$	.10	-.05	$.73^{**}$

Note. $F_{(MJ)}$ = Martin & Jackson (2008) state flow; CSB = Challenge-skill balance; AMM = Action-awareness Merging; CG = Clear Goals; UF = Unambiguous Feedback; C = Concentration; SC = Sense of Control; LSC = Loss of Self-consciousness; TT = Time Transformation; AE = Autotelic Experience
$^{+}$ Trend at $p \leq .10$; * Significant at $p < .05$; ** Significant at $p < .01$

Since research on the physiology of optimal experience used either the revised state flow scale by Martin and Jackson (2008) ($F_{(MJ)}$) or the flow short scale by Rheinberg et al. (2003) ($F_{(R)}$), both operationalizations have been used in this study and correlated with each other. Table 4 reveals that $F_{(MJ)}$ was moderately related to $F_{(R)}$ and its subscale of *Task Absorption (TA)*. However, there was no significant relationship with the second subscale *Task Fluency (TF)*.

According to the self-designed flow reference item, flow during the music/flow task was indicated as normally intense compared to former experiences (M = 4.23, SD = 1.36, *Min*

= 1.00, *Max* = 6.00). *F(MJ)* showed a better correspondence to the self-designed *reference item (REF). TA* was moderately correlated with *REF*, while *TF* correlated only at trend level.

Table 4

Spearman ρ intercorrelations between flow scales of Martin & Jackson (2008), Rheinberg et al. (2003) and the reference item (N = 13).

	$F_{(MJ)}$	$F_{(R)}$	TF	TA
$F_{(R)}$	$.62^{*}$			
TF	.22	$.76^{**}$		
TA	$.61^{*}$	.75	.24	
REF	$.80^{**}$	$.68^{**}$	$.42^{+}$	$.61^{*}$

Note. $F_{(MJ)}$ = Martin & Jackson (2008) state flow; $F_{(R)}$ = Rheinberg et al.'s (2003) flow; TF = Task Fluency; TA = Task Absorption; REF = Reference item
$^{+}$ Trend at $p \leq .10$; * Significant at $p < .05$;** Significant at $p < .01$

3.5 Descriptive Statistics of Flow and Autotelic Experience Groups

3.5.1 Flow scores. According to the correlation analyses based on different flow operationalizations in the previous section, $F_{(MJ)}$ showed better correspondence to the reference item than $F_{(R)}$. Moreover, Rheinberg et al.'s questionnaire does not ask about the autotelic experience inherent in flow, although the dimension is critical to the original concept by Csikszentmihalyi (1991). Thus, for analyzing the HRV and transfer effects of flow on valence/pleasantness of pictures, participants of the main experiment were split into two groups to constitute a *low-flow* and a *high-flow group* based on $F_{(MJ)}$. Although growingly under criticism in recent years, the median split approach was shown to deliver reliable and valid results (Iacobucci, Posavac, Kardes, Schneider, & Popovich, 2015). There was one incidence were flow was exactly at the median (*Mdn* = 5.33), hence data of this particular case was excluded from the analyses of group differences.

High-flow participants had an average state flow of *M* = 5.72 (*SD* = 0.50, *Min* = 5.44, *Max* = 6.67) and number of participants was *N* = 6. *Low-flow* participants scored *M* = 4.67 (*SD* = 0.83, *Min* = 3.00, *Max* = 5.22) and also had a number of *N* = 6. No differences were found between flow groups in respect of age and gender. Moreover, there were no differences on the pleasant-unpleasant, calm-restless or awake-sleepy mood dimensions prior to the warm up (all *p*s = *ns.*), thus possible interferences of mood on subsequent analyses of HRV and picture ratings are therefore ruled out.

3.5.2 Autotelic experience scores. As already addressed in the introduction, investigation of optimal experience may benefit from analyses of single flow dimensions since a model of nine first order factors showed even better fit to the data of the FSS-2 validation study (Jackson, et al., 2004; Moneta, 2012) than the one factor model of global flow. Hence, data was also split along the Autotelic experience (*AE*) median (*Mdn* = 5.00) because this dimension is one of the core dimensions of flow experience. Unfortunately, four participants scored exactly at the median, thus they had to be excluded from the following analyses. *High-AE* participants scored *M* = 6.25 (*SD* = 0.5, *Min* = 6.00, *Max* = 7.00) and had a number of *N* = 4. *Low-AE* participants scored *M* = 3.00 (*SD* 1.00, *Min* = 2.00, *Max* = 4.00) and had a number of *N* = 5. Differences in age, gender and mood dimensions prior to the picture ratings were non-significant (all *p*s = *ns.*), thereby allowing between group comparisons of HRV and picture ratings.

3.6 Heart Rate Variability of Flow and Autotelic Experience

In order to assess differences in heart period and its variability between flow groups during music performance, values of the warm up (no flow task) were subtracted from the measurements of the music performance/flow task within participants. The resulting differences or change scores were compared between groups using Mann-Whitney *U* tests (Table 6). Tozman, Magdas, MacDougall, and Vollmeyer (2015) already pointed out the reliability and validity of change scores. Since there is no non-parametric equivalent to multivariate analysis of variance in SPSS, multiple *U* tests are applied instead while correcting von Type I error inflation using Bonferroni correction ($\alpha_{corr.}$= .005).

3.6.1 Differences in HRV based on flow groups. Neither one of the time domain variables showed significant changes between the two flow groups, when the *p*-value was Bonferroni corrected for multiple comparisons. However, the *z*-value of *Δ*HF indicates that the test would have yielded significant effects if Bonferroni correction would not have been applied.

Table 5

Descriptive statistics and inferential tests of HRV parameters differences based on flow (N = 12).

		Mdn		*U*	*z*	*p*
		Low	High			
Time domain	ΔHP	-84.51	-95.39	14.50	-0.56	.311
	ΔSDNN	-4.68	-6.12	14.50	-0.56	.310
	ΔRMSSD	-3.27	-1.13	14.50	-0.56	.310
	ΔNN50	6.00	13.90	16.00	-0.32	.392
	ΔpNN50	-0.68	-135.37	14.50	-0.56	.310
Frequency domain	ΔVLF power (ms^2)	2.91	13.90	16.50	-0.24	.426
	ΔLF power (ms^2)	-39.93	-135.37	14.50	-0.56	.310
	ΔHF power (ms^2)	-9.40	-83.80	5.50	-2.01	.023
	ΔTotal power (ms^2)	-71.33	-160.39	14.50	-0.56	.310
	ΔLF/HF (ms^2)	0.46	0.90	12.50	-0.88	.208

Note. Low = Low-flow group; High = High-flow group; HP = heart period; SDNN = standard deviation of RR intervals; RMSSD = root mean square of successive differences; NN50 = number of successive RR interval pairs that differ more than 50ms; pNN50 = NN50 divided by the number of RR intervals; VLF = very low frequency; LF = low frequency; HF = high frequency; $\alpha_{corr.}$= .005

3.6.2 Differences in HRV based on AE groups. Analyses between Autotelic Experience (AE) groups revealed no significant changes after Bonferroni correction (Table 7). Here, *z*-values of ΔNN50 and ΔVLF indicate that they would have shown a statistical trend if Bonferroni correction would not have been necessary.

Table 6

Descriptive statistics and inferential tests of HRV parameters differences based on Autotelic Experience (AE) (N = 9).

		Mdn		*U*	*z*	*p*
		Low	High			
Time domain	⊿HP	-39.11	-117.00	6.00	-0.98	.206
	⊿SDNN	-3.95	1.92	6.00	-0.98	.206
	⊿RMSSD	-2.75	-1.76	9.00	-0.25	.452
	⊿NN50	3.00	34.50	2.50	-1.85	.040
	⊿pNN50	-1.09	-0.40	6.00	-0.98	.206
Frequency domain	⊿VLF power (ms^2)	3.22	123.84	3.00	-1.72	.056
	⊿LF power (ms^2)	-11.37	377.91	6.00	-0.98	.206
	⊿HF power (ms^2)	-8.35	-70.24	8.00	-0.49	.365
	⊿Total power (ms^2)	-18.56	248.65	6.00	-0.98	.206
	⊿LF/HF (ms^2)	0.01	0.99	6.00	-0.98	.206

Note. Low = Low-AE group; High = High-AE group; HP = heart period; SDNN = standard deviation of RR intervals; RMSSD = root mean square of successive differences; NN50 = number of successive RR interval pairs that differ more than 50ms; pNN50 = NN50 divided by the number of RR intervals; VLF = very low frequency; LF = low frequency; HF = high frequency; $\alpha_{corr.}$= .005

3.6.3 Repeated-measure ANOVAs of HF and NN50. Although multiple comparisons of HRV parameters yielded no significant differences between the low and high flow and low and high AE groups, respectively, *z*-values indicated that they most likely would have been found for ⊿HF and ⊿NN50, if the test would have had higher statistical power. Therefore, repeated-measures ANOVAs were calculated with task as within-subjects factor (warm up vs. music vs. picture task) for each of the four groups seperately and either HF or NN50 as dependent variable.

3.6.3.1 *HF.* There was no within-subjects effect of task for low-flow participants, $F_{(1.06, 5.29)} = 2.18$, $p = .198$. Also for high-flow participants, the test yielded non-significant results, $F_{(2,10)} = 1.19$, $p = .344$. In case of low-AE participants the test yielded again non-significant results for the main effect of task, $F_{(1.07, 4.27)} = 0.65$, $p = .474$, as was the case for high-AE participants, $F_{(2, 6)} = 1.35$, $p = .328$.

3.6.3.2 *NN50.* There were no effects of task on NN50 for low-flow participants, $F_{(2, 10)}$

= 2.54, p = .129, or high-flow participants, $F_{(2,10)}$ = 1.70, p = .231. The same was true for low-AE participants, $F_{(2, 8)}$ = 1.33, p = .317. For high-AE participants there was an effect of task on NN50 merely approaching trend level, $F_{(1.02, 3.07)}$ = 5.38, p = .101.

3.7 Validation of the IAPS subset

3.7.1 Pretest ratings. In order to validate that the pictures of the IAPS subset were rated as affectively neutral for musicians, that is, average on valence/pleasantness and low on arousal, they were presented to N_1 = 18 musicians with at least three years of musical training. Pictures were indeed rated as being rather neutral, with a valence/pleasantness grand mean of M = 4.56 (SD = 0.32, Min = 3.94, Max = 5.33) and arousal grand mean of M = 3.08 (SD = 0.34, Min = 2.00, Max = 3.83).

3.7.2 Main experiment ratings. When shown to musicians of the main experiment, pictures of the IAPS subsets were rated with a valence/pleasantness grand mean of M = 4.35 (SD = 0.41, Min = 3.25, Max = 5.33) and arousal grand mean of M = 3.08 (SD = 0.29, Min = 2.17, Max = 3.75) in the main experiment.

3.8 Group Based Descriptive Statistics of Picture Rating Scales

3.8.1 Valence/pleasantness ratings. Figure 3 displays the mean ratings of felt valence/pleasantness and arousal for each group over the course of the picture task. Figure 3a indicates that for *valence/pleasantness* linear trends were slightly increasing and more or less parallel for pretest, low and high-flow participants (Figure 3a). However, as pretest (M = 4.56, SD = 0.32, Min = 3.94, Max = 5.33) and high-flow participants (M = 4.50, SD = 0.51, Min = 3.33, Max = 5.83) were fairly similar in average ratings of valence/pleasantness, low-flow participants experienced pictures as non-substantially less pleasant (M = 4.19, SD = 0.62, Min = 2.50, Max = 5.83).

When comparing differences based on AE groups, participants' linear trends of valence/pleasantness were almost perfectly diametrical (Figure 3b). While high-AE participants gave higher ratings at the beginning, they declined over the course of time, meeting with low-AE participants ratings, which, on the contrary, started out substantially lower but increased over time. Accordingly, distributions of valence/pleasantness ratings for high-AE (M = 4.62, SD = 1.33, Min = 1.75, Max = 6.75) and low-AE participants (M = 3.91, SD = 1.46, Min = 1.20, Max = 6.80) were strongly overlapping.

3.8.2 Arousal ratings. In Figure 3c, pretest (M = 3.08, SD = 0.34, Min = 2.00, Max = 3.83) and high-flow participants' *arousal* ratings (M = 2.78, SD = 0.38, Min = 1.67, Max = 3.50) showed parallel trends as was the case for valence/pleasantness, however, this time they remained constant over time. Interestingly, while low-flow participants (*M* = 3.37, *SD* = 0.52, *Min* = 2.00, *Max* = 5.33) started out fairly similar to pretest participants, they experienced an increase of arousal over time reflected in the higher grand mean compared to high-flow and pretest participants.

In respect of AE groups, linear trend lines of arousal showed a similar pattern to those of valence/pleasantness. However, since intercepts were closer to each other and slopes were less steep, they intersected earlier after approximately 30 picture ratings, which was about seven minutes into the task (Figure 3d). Distribution parameters were *M* = 3.13, *SD* = 0.47, *Min* = 1.75, *Max* = 4.00 for high-AE and *M* = 3.09, *SD* = 0.53, *Min* = 1.80, *Max* = 4.20, for low-AE participants.

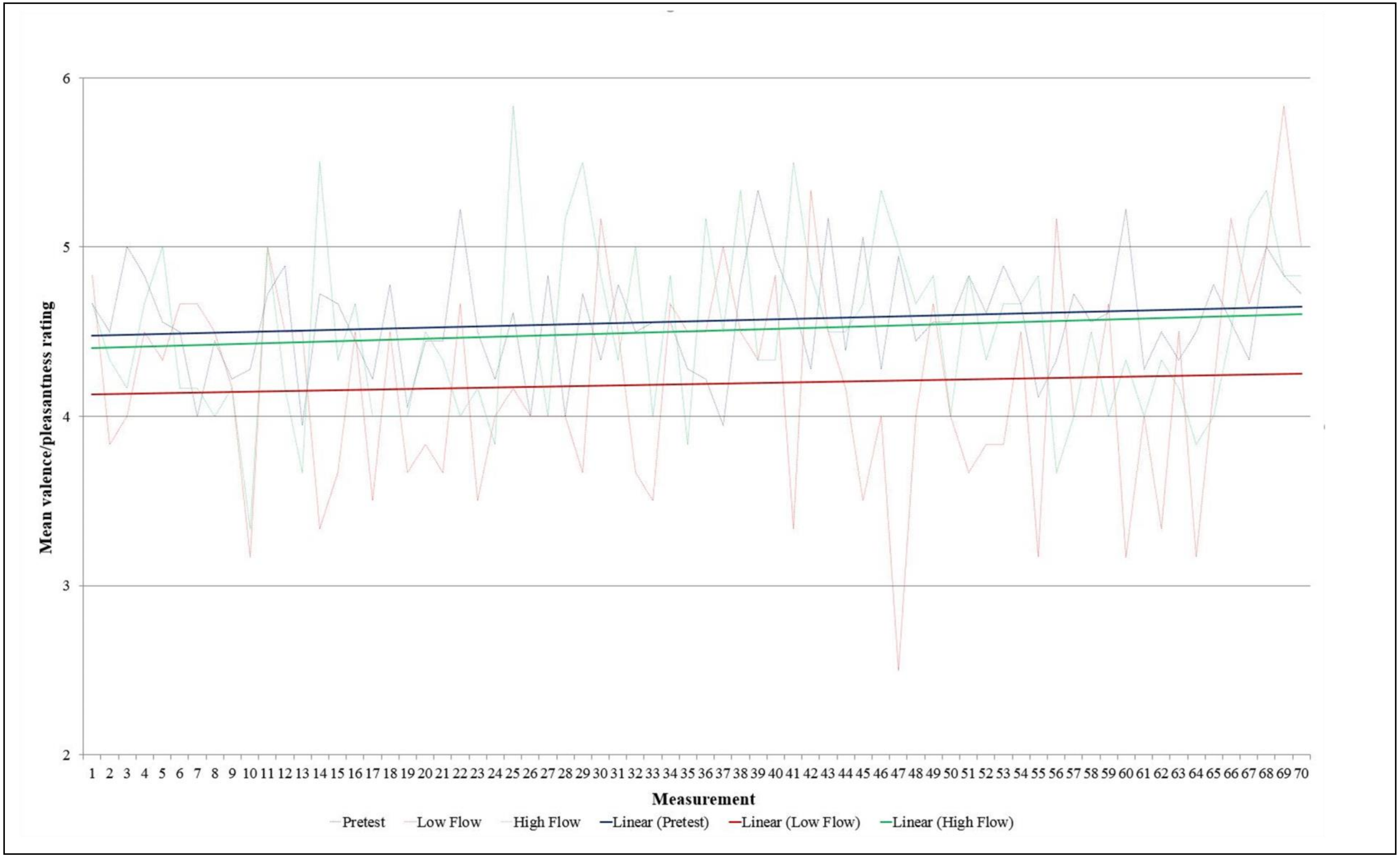

Figure 3a. *Linear trends of pretest, low and high flow participants' ratings of valence/pleasantness.*

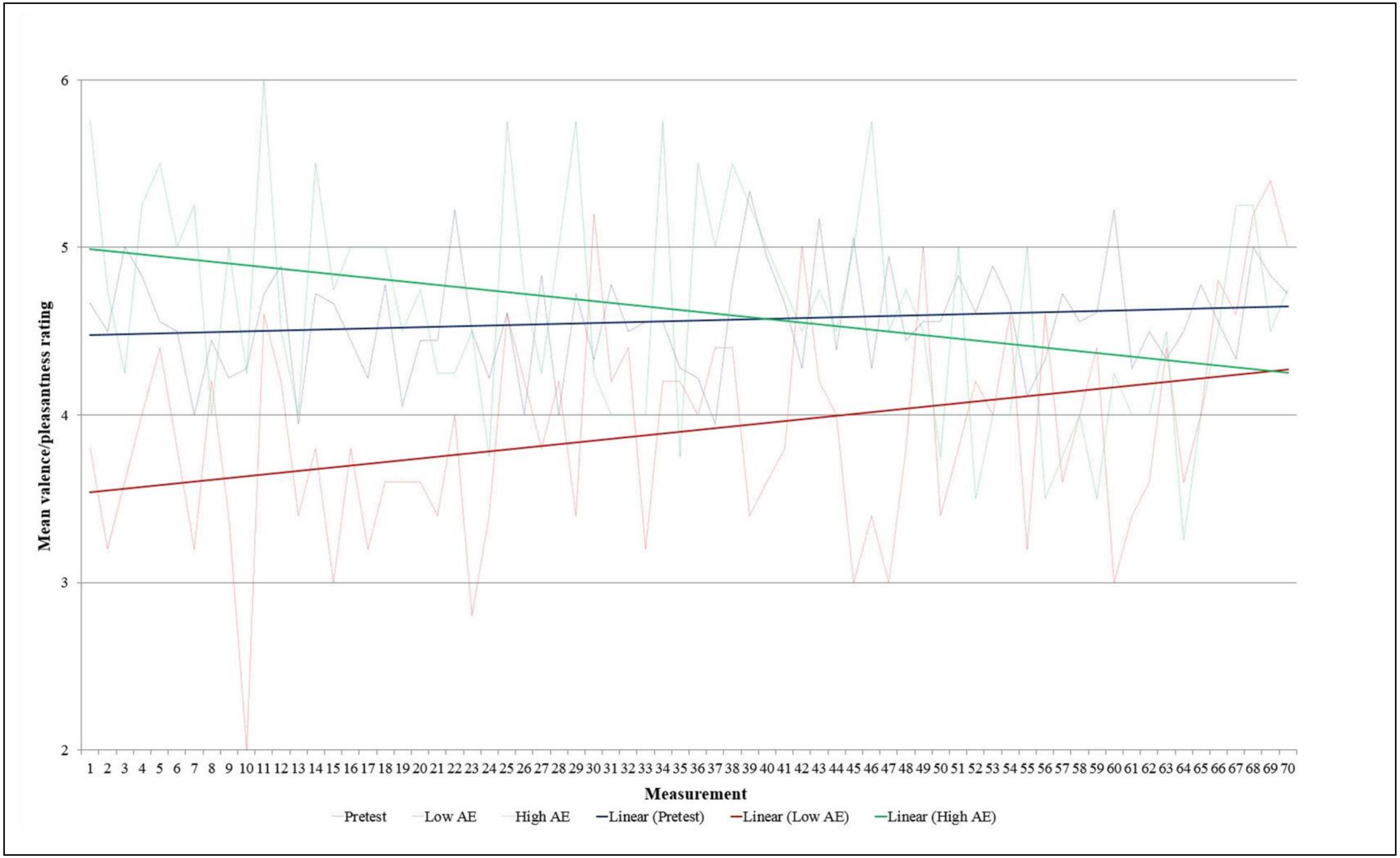

Figure 3b. *Linear trends of pretest, low and AE participants' ratings of valence/pleasantness.*

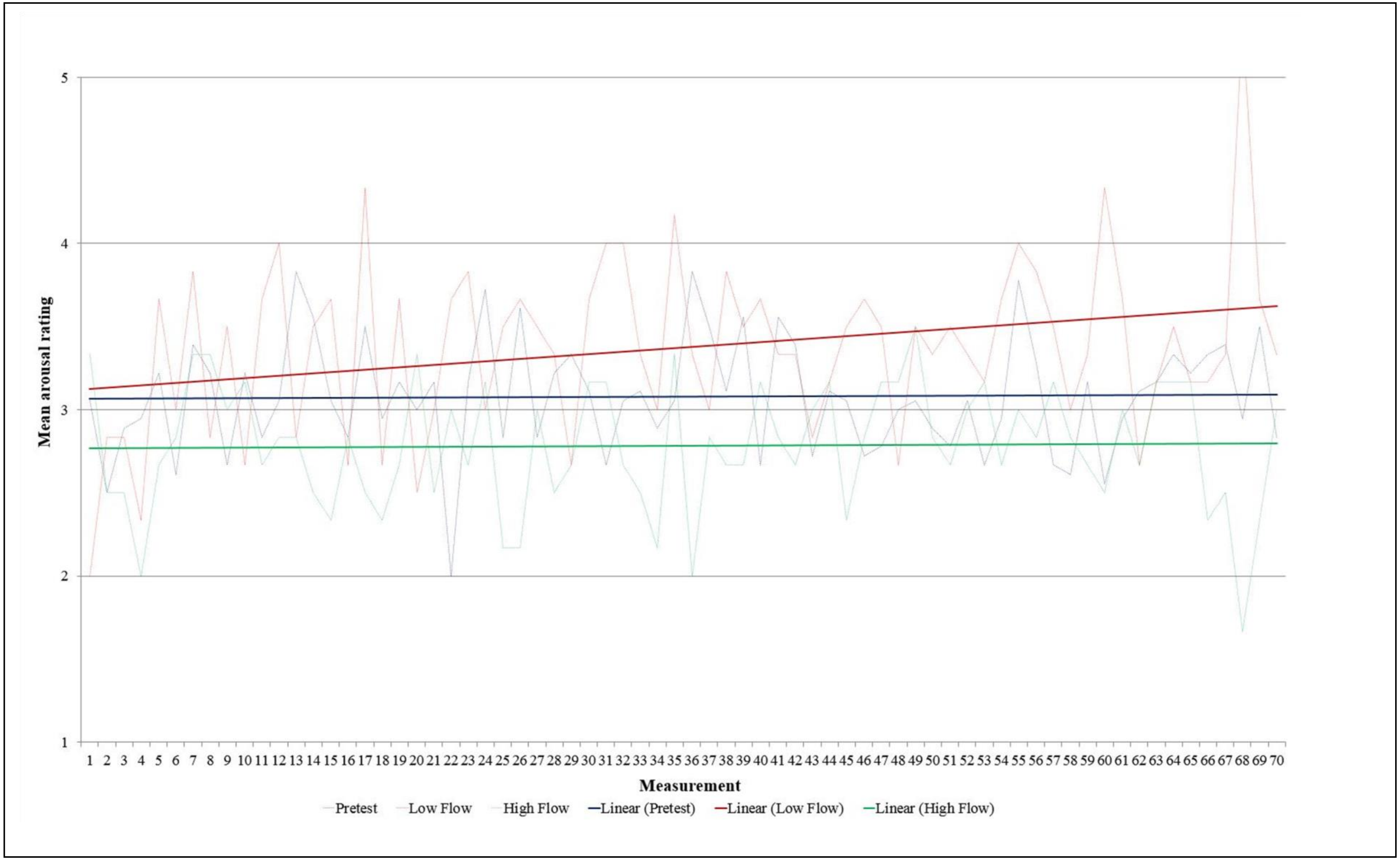

Figure 3c. *Linear trends of pretest, low and high flow participants' ratings arousal.*

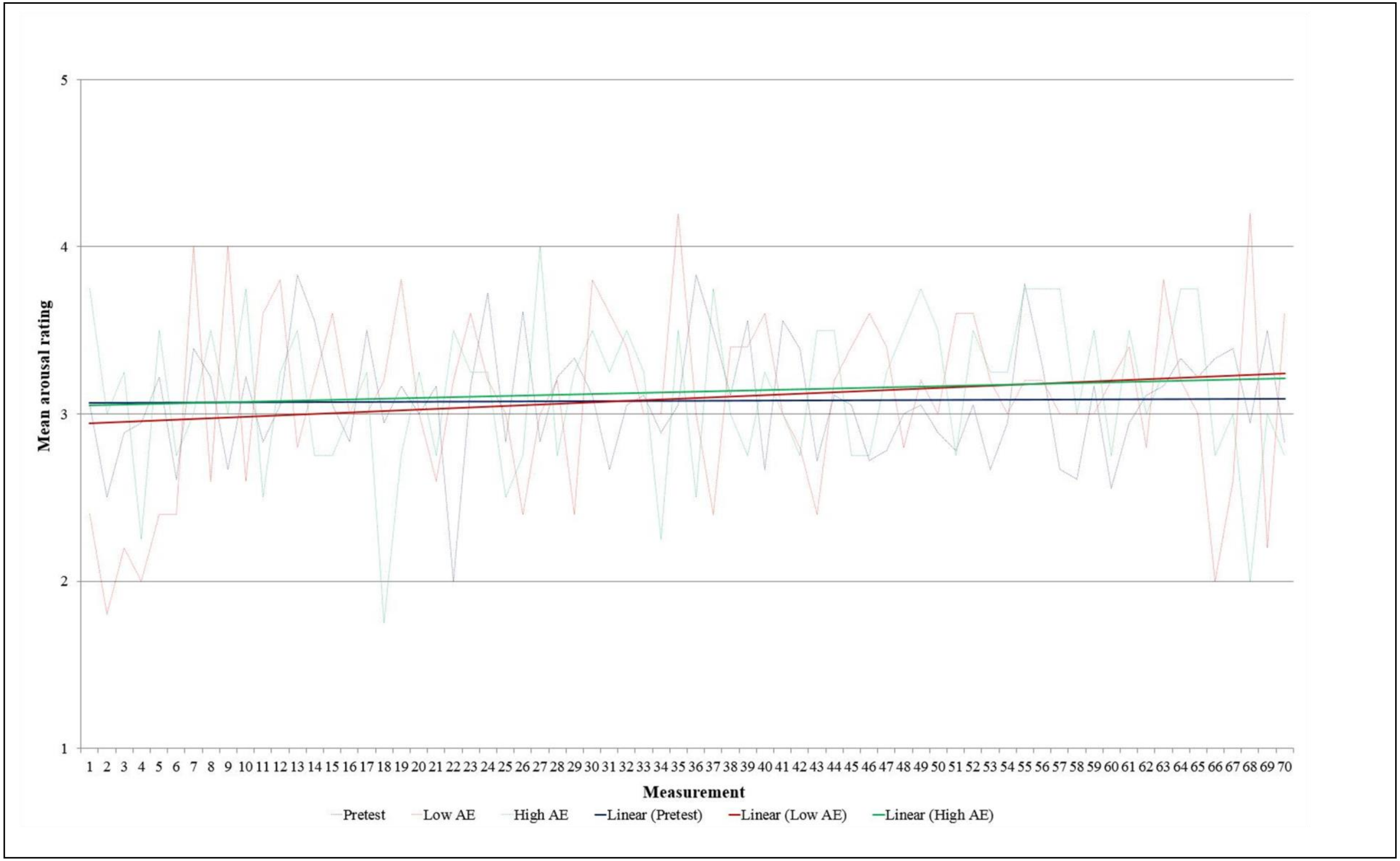

Figure 3d. *Linear trends of pretest, low and high AE participants' ratings of arousal.*

3.9 Transfer Effects of Flow and Autotelic Experience on Affective Ratings of Pictures

To test whether there was a transfer effect of valence/pleasantness and/or arousal from the flow and autotelic experience to the perception of environmental scenes, five pictures were first averaged to obtain mean ratings of the first minute after the picture task had started (picture ratings took about 12 – 15s per trial).

3.9.1 Valence/pleasantness ratings. A comparison between pretest, low-flow and high-flow participants for the first minute was computed using the Kruskal-Wallis *H* test. However, the test yielded a non-significant result, $\chi^2 = 1.39$, $p = .513$. When comparing pretest, low-AE and high-AE participants, the test statistic was significant, indicating that at least one group differed in ratings, $\chi^2 = 6.22$, $p < .05$. Multiple group comparisons revealed that high-AE participants (N = 4) rated pictures as being more pleasant (*Mdn* = 4.80) than low-AE participants (N = 5) (*Mdn* = 3.80), $U = 2.00$, $z = -1.98$, $p = .04$, $r = -.66$. However, since the critical *p*-value was .017 due to Bonferroni correction, the null hypothesis has not been rejected. However, there was a difference between pretest and low-AE participants significant at $\alpha_{corr} = .017$, $U = 14.00$, $p = .009$, $z = -2.32$, $r = -.48$. Pretest participants (*Mdn* = 4.70) showed higher ratings than low-AE participants (see also Figure 4).

3.9.2 Arousal ratings. A comparison between pretest, low-flow and high-flow participants yielded no significant results, as was the case for ratings of valence/pleasantness, $\chi^2 = 1.19$, $p = .567$. Group comparisons based on autotelic experience, however, revealed significant differences in ratings of arousal, $\chi^2 = 6.59$, $p < .05$. Pictures were more arousing for high-AE (*Mdn* = 3.10) than for low-AE participants (*Mdn* = 2.20), $U = 0.00$, $z = -2.47$, $p = .008$, $r = -.82$. Note that p was smaller than the Bonferroni adjusted $\alpha_{corr} = .017$, thus the null hypothesis was rejected. Additionally, as was the case for valence/pleasantness ratings, pretest participants (*Mdn* = 2.90) felt significantly higher arousal than low-AE participants after Bonferroni correction, $U = 16.00$, $z = -2.18$, $p = .014$, $r = -.45$.

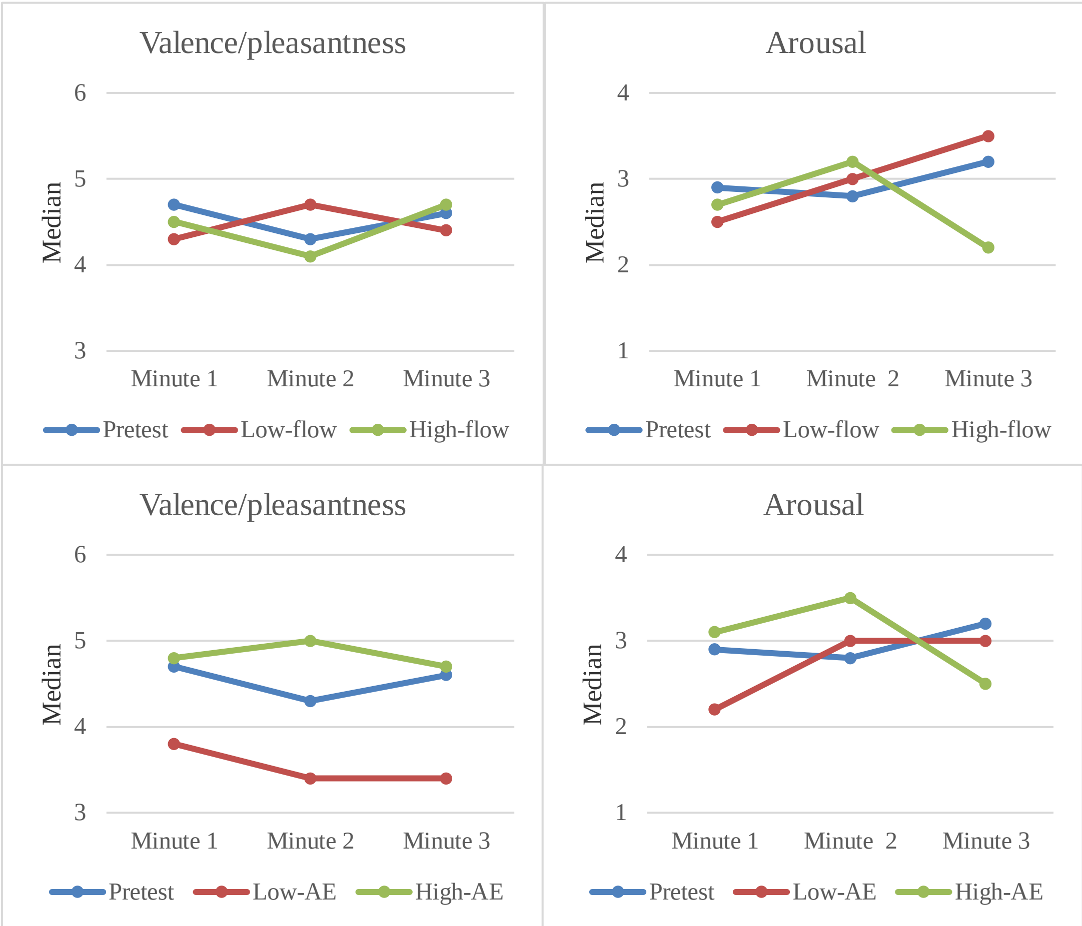

Figure 4. *Group medians of valence/pleasantness and arousal ratings at minute 1, 2 & 3*

3.10 Differences of Valence/pleasantness and Arousal Ratings Over Time

To test whether participants' picture ratings normalized over the course of the following minutes, ratings of pictures 6-10 and 11-15 were also averaged to yield group means for the second and third minute within the task, respectively. First, a within-subjects effect of time interval was analyzed via repeated-measures ANOVAs for each group separately, then between-subjects differences were exposed to Mann-Whitney *U* tests (see Figure 4).

3.10.1 Within-subjects differences of valence/pleasantness. No main effect of time interval on ratings was found for pretest participants $F_{(2, 34)} = 1.51$, $p = .236$. There was also no main effect on ratings of valence/pleasantness for low-flow participants, $F_{(2, 10)} = 0.05$, $p = .836$. For high-flow participants an effect of time was marginally significant, $F_{(2, 10)} = 3.37$, $p = .076$, $\eta_p^2 = .40$. Tests of within-subjects contrasts revealed a cubic trend for high-flow participants, $F_{(1, 5)} = 15.27$, $p < .05$, $\eta_p^2 = .75$ (see Table 7). In case of low-AE participants the effect of time interval was non-significant, $F_{(2, 6)} = 0.68$, $p = .535$, as was the case for high-AE participants,

$F_{(2, 8)} = 0.32$, $p = .739$.

3.10.2 Within-subjects differences of arousal. There was no main effect of time interval on pretest participants ratings of arousal, $F_{(2, 34)} = 2.26$, $p = .120$. For low-flow participants, there was a marginally significant effect of time interval on arousal ratings, $F_{(2, 10)} = 3.44$, $p = .073$, $\eta_p^2 = .41$. Within-subjects contrasts indicated a linear trend, $F_{(1, 5)} = 4.29$, $p = .09$, $\eta_p^2 = .46$ (Table 8). Analyses of high-flow participants revealed no effect of time interval, $F_{(2, 10)} = 0.59$, $p = .571$, as was the case for participants of the low-AE group, $F_{(1, 8)} = 2.93$, $p = .11$, and the high-AE group $F_{(2, 6)} = 0.11$, $p = .902$.

Table 7

Bonferroni adjusted pairwise comparisons of valence/pleasantness ratings based on estimated marginal means (N_{Flow} = 12; N_{AE} = 9).

Group	IV	Comparison	*MD*	*SE*
Pretest	-	Min 1 - Min 2	0.42	0.23
		Min 1 - Min 3	0.12	0.24
		Min 2 - Min 3	-0.30	0.28
Low	Flow	Min 1 - Min 2	0.07	0.34
		Min 1 - Min 3	0.10	0.46
		Min 2 - Min 3	0.03	0.56
	AE	Min 1 - Min 2	0.48	0.31
		Min 1 - Min 3	0.00	0.52
		Min 2 - Min 3	-0.48	0.56
High	Flow	Min 1 - Min 2	0.60	0.28
		Min 1 - Min 3	.033	0.32
		Min 2 - Min 3	-0.57	0.13
	AE	Min 1 - Min 2	0.40	0.47
		Min 1 - Min 3	0.15	0.56
		Min 2 - Min 3	-0.25	0.49

Note. IV = Independent variable; *MD* = Mean difference; *SE* = Standard error

Table 8

Bonferroni adjusted pairwise comparisons of arousal ratings based on estimated marginal means (N_{Flow} = 12; N_{AE} = 9).

Group	IV	Comparison	*MD*	*SE*
Pretest	-	Min 1 - Min 2	-0.10	0.17
		Min 1 - Min 3	-0.34	0.14
		Min 2 - Min 3	-0.24	0.19
Low	Flow	Min 1 - Min 2	-0.43	0.22
		Min 1 - Min 3	-0.80	0.39
		Min 2 - Min 3	-0.37	0.29
	AE	Min 1 - Min 2	-0.53	0.63
		Min 1 - Min 3	-0.03	0.65
		Min 2 - Min 3	0.50	0.29
High	Flow	Min 1 - Min 2	-0.96	0.53
		Min 1 - Min 3	-1.24	0.64
		Min 2 - Min 3	-0.28	0.41
	AE	Min 1 - Min 2	-0.05	0.65
		Min 1 - Min 3	0.20	0.62
		Min 2 - Min 3	0.25	0.44

Note. IV = Independent variable; *MD* = Mean difference; *SE* = Standard error

3.10.3 Between-subjects differences of valence/pleasantness. Similar to the comparison within the first minute of the picture task, a Mann-Whitney *U* test between low and high-AE participants did not reach significance, since the *p*-value was above the Bonferroni corrected *p*-value of .017. The same held true for low-AE and pretest participants at the second minute. At minute three (pictures 11-15), tests yielded no significant results either.

3.10.4 Between-subjects differences of arousal. Despite differences in arousal between low-AE and high-AE as well as low-AE and pretest participants within the first minute of the pictures task, there were no differences between any of the groups later into the task, despite a marginally significant difference between pretest and high-flow participant within the third minute (Table 9 & 10).

Table 9

Bonferroni adjusted multiple comparisons of valence/pleasantness and arousal ratings at 2nd minute (N_{Flow} = 12; N_{AE} = 9).

Scale	Comparison	*U*	*z*	*p*
Valence/ pleasantness	Pretest vs low-flow	47.00	-0.47	.329
	Pretest vs high-flow	39.00	-1.01	.165
	Low-flow vs high-flow	13.50	-0.72	.256
	Pretest vs low-AE	19.00	-1.95	.026
	Pretest vs high-AE	25.00	-0.95	.186
	Low-AE vs high-AE	2.50	-1.85	.040
Arousal	Pretest vs low-flow	54.00	0.00	.504
	Pretest vs high-flow	47.00	-0.47	.328
	Low-flow vs high-flow	17.50	-0.08	.492
	Pretest vs low-AE	44.00	-0.08	.482
	Pretest vs high-AE	27.50	-0.73	.245
	Low-AE vs high-AE	9.500	-0.12	.484

Note. α_{corr} = .017

Table 10

Bonferroni adjusted multiple comparisons of valence/pleasantness and arousal ratings at 3rd minute (N_{Flow} = 12; N_{AE} = 9).

Scale	Comparison	*U*	*z*	*p*
Valence/ pleasantness	Pretest vs low-flow	41.00	-0.88	.197
	Pretest vs high-flow	54.00	0.00	.506
	Low-flow vs high-flow	13.00	-0.81	.236
	Pretest vs low-AE	22.50	-1.70	.050
	Pretest vs high-AE	24.00	-1.04	.155
	Low-AE vs high-AE	3.50	-1.61	.071
Arousal	Pretest vs low-flow	45.50	-0.57	.294
	Pretest vs high-flow	29.50	-1.64	.051
	Low-flow vs high-flow	10.00	-1.29	.113
	Pretest vs low-AE	43.00	-0.15	.449
	Pretest vs high-AE	25.00	-0.94	.184
	Low-AE vs high-AE	6.50	-0.86	.230

Note. α_{corr} = .017

3.11 Flow and Locus of Control, Big Five Personality Factors, Resilience, and Trait EI

There were no significant relationships between state $F_{(MJ)}$ and trait variables except for *Conscientiousness.* However, strong to moderate positive correlations were found for *Dispositional Flow* and *Resilience*, *Internal Locus of Control* as well as *Trait Emotional Intelligence*. Further, *Extraversion*, *Openness* and *Conscientiousness* were positively linked to *Dispositional Flow*, while *External LOC* and *Neuroticism* were negatively correlated (see Table 11).

Table 11

Spearman correlations between dispositional flow, trait EI, resilience, locus of control and personality factors (N = 13).

	$F_{(MJ)}$	DF	ILC	ELC	E	N	O	C	A	RES
DF	.34									
ILC	.24	.69**								
ELC	.00	-.71**	-.42^{+}							
E	.22	.67**	.48^{+}	-.44^{+}						
N	.19	-.40^{+}	-.29	.84**	-.24					
O	.22	.58*	.12	-.29	.34	-.12				
C	.73**	.54*	.53*	-.37	.33	-.13	.41^{+}			
A	-.01	.29	.03	-.48^{+}	.64**	-.38^{+}	.39^{+}	.28		
f	.36	.84**	.54	-.67**	.52*	-.47^{+}	.73**	.67**	.32	
TEI	.23	.64*	.39	-.59*	.88**	-.49^{+}	.47^{+}	.46^{+}	.81**	.59*

Note. DF = Dispositional flow; $F_{(MJ)}$ = Martin & Jackson (2008) state flow; ILC = Internal Locus of Control; ELC = External Locus of Control; E = Extraversion; N = Neuroticism; O = Openness; C = Conscientiousness; A = Agreeableness; RES = Resilience; TEI = Trait Emotional Intelligence.
$^{+}$ Trend at $p \leq .10$; * Significant at $p < .05$; ** Significant at $p < .01$;

3.12 Group Based Descriptive Statistics and Comparisons of Musical Sophistication and Training

3.12.1 Pretest participants. On average, participants of the pretest scored 35.50 (*SD* = 6.42) points on the Gold MSI subfactor of *Musical Training* and 85.89 (*SD* = 15.62) on the general factor of *Musical Sophistication* (Müllensiefen et al., 2014). Only 25% scored higher on the global *Music Sophistication* index and 15% higher on *Musical Training* in a validation study of the Gold MSI questionnaire adapted for the German population (Schaal et al., 2014).

3.12.2 Main experiment participants. Participants of the main experiment scored 35.08 (*SD* = 6.63) on *Musical Training* and 94.85 (*SD* = 10.31) points on *Musical Sophistication*. Ideally, musical expertise and sophistication would have been the same between participants of the pretest and the main experiment so that pictures were optimally validated.

3.12.3 Differences between participants of the pretest and main experiment. *Musical Sophistication* for participants of the pretest (*Mdn* = 90.00) and participants of the main experiment (*Mdn* = 97.00) was similar, $U = 78.50$, $z = -1.54$, $p = .126$, $r = -0.28$, as was *Musical Training* for participants of the pretest (*Mdn* = 35.00) and the main experiment (*Mdn*

= 36.00), $U = 112.00$, $z = - 201$, $p = .851$. Notably, *Active Engagement* of participants in the main experiment (*Mdn* = 46.00) was significantly higher than in the pretest (*Mdn* = 43.00), $U = 59.00$, $z = - 2.33$, $p < .05$. Compared to participants' test scores from (Schaal et al., 2014), both samples were at or above the third quartile in general expertise and training.

3.12.4 Differences between low and high-flow participants. Musical sophistication and expertise were expected to positively relate to flow, the general score of *Musical Sophistication* as well as scores for the subfactors *Training* and *Emotion* were investigated. Non-parametric group comparisons revealed no significant differences in *Musical Sophistication* between high-flow and low-flow participants, $U = 13.00$, $z = -0.80$, $p = .229$. High-flow participants, however, were better trained (*Mdn* = 37.50) than low-flow participants (*Mdn* = 35.00) but the corresponding significance test only reached trend level, $U = 9.50$, $z = -1.38$, $p = .091$, $r = -.40$. Nevertheless, there were significant differences between flow groups namely on the subfactor *Emotions*, $U = 4.50$, $z = -2.17$, $p < .05$, $r = -.63$. Participants, who experienced a more intense state of flow also reported that they were more likely to be using music to evoke emotions, to experience shivers down the spine, were able to communicate evoked emotions, etc. (*Mdn* = 37.50) than participants of the low-flow group (*Mdn* = 34.50). In Marin and Bhattacharya (2013), 89% of the interviewed piano players ($N_{total} = 65$) acknowledged the role of emotions involved in flow induction, even indicating that the dimension of arousal was more important than the dimension of pleasantness in relation to the flow experience.

Note that low-flow participants still scored above the third quartile compared to $N = 641$ participants of the German validation study (Schaal et al., 2014). Thus, according to the self-report, low-flow participants actually were frequently involved in emotional behaviors regarding music. However, high-flow participants were even more so, scoring within the ninth percentile compared to participants of (Schaal et al., 2014). The same was true for AE groups: Participants scoring higher on Autotelic Experience also had a significant more emotional approach to music (*Mdn* = 38.00) than low-AE participants (*Mdn* = 34.00), $U = 2.00$, $z = -1.97$, $p < .05$, $r = -.66$.

4. Discussion

The present study aimed at shedding light on how flow experiences lead to increased subjective well-being and happiness, as postulated by Csikszentmihalyi (1991) and others. It was expected that the affective response connected to flow and characterized by higher arousal and valence, transfers to the experience of subsequent environmental stimuli, thereby increasing the chance of positive emotional outcomes in the future. This may ultimately lead to subjective well-being, happiness and resilience through an upward spiral as postulated by the broaden-and-build theory of positive emotions (Fredrickson, 2001).

The first pair of research questions focused on the psychophysiology of flow during music performance by means of HRV measurements and whether the flow experience transfers to the perception of environmental scenes employing a musicians-validated neutral picture subset. The second pair concentrated on the connection between flow and trait variables, namely personality, emotional intelligence, resilience, locus of control and musical expertise and further, on the relationships between flow dimensions in music performance, and if experimental research on flow can benefit from subset or single dimension approaches.

4.1 HRV measures

In line with the first main hypothesis, the data revealed a tendency of flow being associated with decreased HF power, typically associated with RSA. However, due to lack of statistical power, there was no significant result for flow and differences in HF. De Manzano et al. (2010) found flow to be associated with decreased HF and increased respiratory depth as well as increased LF/HF ratio and total power during piano playing. They argue that “flow might in fact be associated with an increased parasympathetic modulation of sympathetic activity” (p. 307). HF is said to be an index of vagal cardiac control (Cacioppo et al., 2007) and parasympathetic activity within the largely unconscious autonomous nervous system.

Contrary to the first main hypothesis, no decrease of heart period or RMSSD was found. Instead, a tendency of increased VLF in relation to flow between AE groups was revealed, which, however, did not reach significance. Interestingly, Bernston et al. (1997) claim that VLF represents a mixture of sympathetic and parasympathetic rhythms and may be associated with mental workload and baroreceptor function and (Cacioppo et al., 2007). In this respect, it is similar to LF. Others have dubbed it a “dubious measure” with no specific physiological process attributable (Malik, 1996, p. 358). Undoubtedly, psychological correlates to VLF are scarce at this point.

Also, contrary to expectations, a comparison between AE groups revealed again a tendency for differences in NN50, indicating that high-AE participants experienced a higher number of successive RR interval pairs that differ more than 50ms. If anything, NN50 was expected to be decreased during flow states because previous studies on mental stress have found the percentage of NN50 to RR intervals to be lower. However, increased NN50 reflects higher acceleration or deacceleration of heart rate and may be interpreted as an indicator of emotional involvement and bodily responsiveness to the task at hand. Keller et al. (2011) found decreased RMSSD – a related HRV measure – to be decreased in a board game task, in which skills and demands were balanced. This decrease was supposed to reflect increased mental workload.

4.2 Picture Ratings

4.2.1 Ratings of felt arousal. Within the first minute of picture presentation, ratings of arousal were elevated for participants high-AE participants compared to low-AE participants. The effect size indicated a very large effect of flow in music performance on arousal ratings of subsequent visual stimuli (r = -.82). Surprisingly, ratings of arousal where roughly the same for high-AE participants and pretest participants who did not engage in music performance, while low-AE participants where significantly less aroused than pretest participants within the first minute of the picture task. This finding supports the a priori hypothesis that there would be a difference in response to neutral environmental scenes between participants depending on the quality of the flow experience and also the direction of the effect in this comparison was as expected. However, rather implicitly it was assumed that both AE groups (and flow groups for that matter) would feel more arousal in response to pictures than pretest participants, but the difference between pretest participants and low-AE was not as pronounced as it was for high-AE participants. These findings could have perhaps been explained by higher calmness prior to the flow task in the main experiment, but analyses showed that main experiment participants were actually less calm before the picture task. There were no between-subjects differences within the second and third minute of the picture task.

Within-subjects trend analyses revealed a marginally significant effect of time interval on arousal ratings of high-flow participants, and within-subjects contrasts indicated that subjective arousal in response to picture ratings decreased linearly.

4.2.2 Ratings of felt valence/pleasantness. Previously it was found that arousal transfers from the musical to the visual domain, but not valence/pleasantness (Marin et al., 2012). Correspondingly, there were no significant differences in ratings between flow or AE groups in this study. However, it was found that low-AE participants rated pictures within the first minute as being less pleasant compared to pretest participants. Moreover, an unexpected difference between low-AE and high-AE participants occurred within the second minute.

Within-subjects analyses of variance revealed a marginally significant effect of time interval on ratings of valence/pleasantness for high-flow participants. Contrasts revealed a significant cubic trend, indicating that ratings dropped within the second minute.

4.3 Flow and The Autotelic Personality.

When investigating the autotelic personality, which supposedly is linked to trait factors facilitating transformational coping and a more emotion-focused approach to dealing with stressors, it was found that proneness to flow was in fact linked to increased resilience and emotional intelligence, internal locus of control, extraversion, openness to experience and conscientiousness as well as decreased external LOC and neuroticism. These findings are in line with Marin & Bhattacharya (2013) who reported correlates between trait emotional intelligence and dispositional flow ($\beta = 0.29$). Trait EI significantly improved the linear regression model predicting dispositional flow in pianists ($\Delta R^2 = 0.07$). Further, these findings corroborate Huber (2015) who found a significant positive relationship between dispositional flow and resilience ($\beta = 0.25$) as well as internal locus of control ($\beta = 0.26$). The finding on dispositional flow and personality factors are also in line with prior research (Huber, 2015; Ross & Keiser, 2014; Ullén et al., 2012). Moreover, corroborating prior research by Marin & Bhattacharya (2013) and Sinnamon et al. (2012) on dispositional flow among musicians, mean scores for the dispositional flow dimension loss of self-consciousness (3.08) were found to be the lowest among the nine flow dimensions.

There were, however, no relationships between state flow and trait variables except for conscientiousness, and no correlation was found between state and trait flow, which is somewhat puzzling. One reason for the missing link between state and flow trait may be that situational and random factors distorted participants likelihood to reach a state of flow in such a way that trait flow was no longer a significant predictor, since it is a measure in which these factors are balanced out.

Conscientiousness plays a special role because its association to flow seems to be the most stable across various experimental designs and is even correlated with state flow in the present study. Conscientiousness is related to success at work and good health, two outcome variables connected to regular flow experiences (Csikszentmihalyi, 1991).

4.4 Flow and Musical Sophistication

Contrary to expectations, participants of the high-flow and high-AE groups did not have higher musical sophistication than their counterparts in the present study. In case of musical training, analyses revealed a statistical trend in the expected direction. However, it was found that musical activities are especially emotionally charged for high-flow and high-AE participants, compared to their counterparts, as evidence by more frequent emotional responses to music, including specific musical emotions like shivers down the spine (cf. Juslin & Sloboda, 2011). Moreover, they reported being able to communicate musical emotions, which is in line with the associated trait variables, especially trait EI, as discussed in the previous paragraph.

This finding is particularly interesting because it adds to the picture that flow experiences are emotional experiences (Marin & Bhattacharya, 2013). To music therapist it may be reassuring to know that pushing communication about emotions evoked by and expressed in music can enhance the likelihood of entering a state of flow during listening or performing.

A possible explanation for the missing link between flow and the general score of musical sophistication may be that the overall score is drawn mostly from singing abilities and to a lesser extend from musical training and active engagement, while ignoring all but one item concerning emotional behaviors in relation music. The current flow model proposes that flow is more likely in activities that require skills rather than activities that require no skills, given that skills and challenges are balanced. The role of emotion in the construct definition of musical sophistication including scoring on the general scale could be somewhat more pronounced, since understanding, communicating and utilizing emotions is arguably at the core of any activity involving music and therefore of high interest to music psychologists. More research is needed focusing on emotional behaviors such as outlined by Müllensiefen et al. (2014) and professionalism in music to further access the role of emotion in musical sophistication. Further, it stands to question whether the Gold MSI sufficiently covers musical expertise in professionals or if it is better only used when in non-musicians and the general population.

4.5 The Composition of Flow

Challenge-skill Balance, Transformation of Time, Sense of Control, Autotelic Experience and Concentration were the main contributors to flow, whereas Action-awareness Merging and Loss of Self-consciousness were only marginally and Clear Goals and Unambiguous Feedback not at all correlated to the global scale. With Transformation of Time being the strongest contributor to flow, these findings contrast prior literature posing that all dimensions were important in the flow experience (Marin & Bhattacharya, 2013) and that transformation of time plays a subordinate role in the flow experience during music related activity (Fritz & Avsec, 2007; Marin & Bhattacharya, 2013; Sinnamon et al., 2012; Wrigley & Emmerson, 2013).

4.6 Limitations

The present study would have benefitted from a higher number of participants because the statistical analyses of group differences were underpowered. Very large effects would have been needed to yield significant results. The only case where group differences were significant after Bonferroni correction was for ratings of arousal between low-AE and high-AE participants within the first minute of the picture task. It was planned to have a control condition in which participants engaged in picture ratings first and music performance second, and which would have allowed for group comparisons of HRV measures with higher statistical power and a proper control group for picture ratings. However, unfortunately, only a small number of bands were meeting the study requirements, who were also willing to participate. Further, proportionally large parts of the data were unusable, due to equipment malfunctioning, non-compliance with the task instructions, and other reasons. Also, due to the small sample size, generalizability of the findings toward other semi-professional rock and pop music groups is limited.

Further, it might have been better to apply a within-subjects design, namely letting participants repeating a song, while obtaining flow and HRV from every run, and then comparing flow and HRV within subjects, since HRV is sensible to, for example, gender, age and posture (Bernston et al., 1997; Cacioppo et al., 2007). There were no significant gender or age differences between the groups of the present study, but it was not accounted for participant's posture during the music/flow task (standing vs. sitting) and there was a change in posture between the music and picture task.

Participants were mostly standing during music performance but had to be seated during the picture task. Sitting in contrast to standing leads to withdrawal of sympathetic activation and baroreceptor functioning as in lying down.

Moreover, it stands to question, if participants experience of flow was independent from one another, or if there – seemingly more likely – was some kind of networked flow (cf. Gaggioli et al., 2017) or group flow (Hart & Di Blasi, 2015; Sawyer, 2006). Participants data should be independent from one another, when making comparison between groups or correlating variables (Field, 2009). Ideally, groups are not created post-hoc but participants should be randomly assigned to either the experimental or the control group beforehand. All of these methodological problems could have been avoided by testing single participants in a within-subjects design and letting them improvise to jazz playbacks, for example. However, it would not have been possible to investigate beneficial effects of flow during recreational or vocational instrument playing on subsequent emotional appreciation of neutral environmental scenes within an ecologically valid setting.

There were no assumptions concerning the variability on the low frequency band, due to inconsistent findings in previous research, and no effect of flow on LF was found in the present study. Nickel and Nachreiner (2003) argue that 0.1 HRV (LF) does not meet sensitivity and diagnosticity standards to adequately measure mental workload, but rather that it indicates the presence of times pressure such as in 5-minutes board games (Keller et al., 2011), 4-6 minutes games of Tetris (Harmat et al., 2015) and 6-minutes driving simulations (Tozman et al., 2015). In the present study, time pressure during the flow task was rather low because participants had a total of 20 minutes to perform two songs, even leading to song repetitions. Hence, there is plausible suspicion that the lack of any relationship between flow and LF is due to missing temporal constraints in the experimental procedure and that prior findings might be confounded by putting too much time pressure on participants. When time constraints are loosened, so might be the relationship between flow and LF. Further, it stands to question whether investigating flow within the scope of mental workload is a promising approach is because one of the primary assumptions concerning the concept of optimal experience is that actions are fluent and smooth, even in face of difficult challenges, and that we behave routinely with seemingly inexhaustible energy resources. However, the notion of mental workload contains elements of mental strain, which is clearly opposite of optimal experience and flow. De Manzano et al. (2010) have drawn from similarities to effortless attention, which fits to the theory of flow better than mental workload.

4.7 Implications

Several implications for future research could have been derived in the process of working on this master's thesis. First, researchers should be clear about their definition of flow and to which flow model they are referring to. Second, flow tasks should be characterized by personal involvement and meaning to the agent and he or she should not be engaging in the activity for the first time, but ideally, has to be moderately to highly skilled. Third, investigations in search of the psychophysiological flow signature should always include some kind of marker of positive/negative valence.

4.7.1 Precise definitions. The predominant flow model is currently the quadrant model, which postulates that flow activities require a skilled agent and an adequate challenge. It is therefore not appropriate to expect that flow occurs in cases where the agent is unskilled or the activity childishly simple, as long as challenge and skills are balanced. These circumstances may rather lead to apathy, boredom, or relaxation.

Connected to these considerations is the concern that it remains vastly unclear, whether flow is an on/off-state (that there is some kind of threshold, people have to pass to be in the zone), or if flow is a continuum (that people can in fact experience less intense forms of flow). There are theoretical considerations for both: On the one hand, entering an altered state of mind in flow as put forth by Csikszentmihalyi (1991), which might be characterized by a unique psychophysiological signature, speaks for the view of flow as an on/off-state, as some kind of cognitive, emotional, motivational and physiological mode, clearly distinguishable from other, more trivial experiences. On the other hand, however, a less intense form of flow could in line with flow theory be characterized by a high challenge - high skills balance, but moderate to low concentration or less clear goals and feedback, for example, which in turn would speak for a flow continuum.

Moreover, flow as a psychometric construct needs further improvement because it remains unclear whether all dimensions are equally important and should be pronounced to some extent to be able to speak of being in the zone. Further, it remains unclear if flow states are comparable between persons, because one person might have high concentration, autotelic experience and challenge-skill balance, while scoring low on the remaining dimensions, while a different person with the same global score, might have a completely opposite pattern of scoring on the nine contributing dimensions. Profound differences in the quality of subjective flow experiences between participants can partly be accounted for in within-subjects repeated measures of flow. For example, if for one participant having clear goals and unambiguous feedback is generally indispensable, while the other might occasionally be in the zone, as evidenced by high action-awareness merging and loss of self-consciousness, without stringently requiring goals or feedback. Landhäußer and Keller (2012) made a good effort dividing the nine flow dimensions into preconditions and components of the experience, and pointing toward affective, cognitive, behavioral and physiological consequences. They implicate a causal relationship between Clear Goals, Feedback and Challenge-skill balance as preconditions on the one hand and the remaining six flow dimensions on the other.

4.7.2 Ecological validity. Although tempting to experimental researchers, it is most probably not sufficient to let participants engage in a task they have literally no experience in, because the latest flow model requires an at least moderately skilled agent. Flow has extensively been studied in relation to computer games, however, mostly not to tackle negative side effects of flow (Keller et al., 2011; Partington et al., 2009), as mentioned in the introduction section, but rather because it allows high control over the task at hand, for example, by being able to meticulously manipulate task difficulty. Flow experiences are more than just accomplishing any given task without getting bored or being stretched. They have deep personal meaning, are the one of the most, if not *the* most important source for positive emotions in people’s lives and constitute something individuals can build upon, something from which people can grow and flourish and eventually become better people, better citizens and members of their community, and ultimately, better human beings (Csikszentmihalyi, 1991; Fredrickson, 2001; Seligman & Csikszentmihalyi, 2000). Therefore, optimal experience and flow activities should be studied in the field, if possible, or in simulations of the real world, like it was tried to accomplish in the present study. Overly strict experimental designs may lead to distorted results as suggested by the criticism of Nickel and Nachreiner (2003) of the sensitivity and diagnosticity of LF for mental workload. Note that De Manzano et al. (2010) accomplished studying the psychophysiology of flow in an ecologically valid setting, even in a within-subjects design, since runs within the task of playing self-selected piano pieces, was, due to compositional features, naturally time constrained. Participants most likely have not perceived the upcoming end of the run as a time constraint and correspondingly, De Manzano et al. (2010) have not found a relationship between LF and flow.

4.7.3 Psychophysiological markers of valence/pleasantness. As evident from the literature reviewed, it is difficult to find a distinct psychophysiological flow signature, without applying markers of valence/pleasantness, namely electromyography of the zygomaticus major and corrugator superchilii, because it may otherwise be indistinguishable from the psychophysiology of stress. If EMG is not possible, respiratory depth may give an indication of the flow signature, since it was found to be increased in combination with decreased HF, while increased mental effort is accompanied by shallow breathing (De Manzano et al., 2010).

4.8 Conclusion

Flow might signal successful adaptation to adversity in the sense that mastering non-trivial challenges fosters psychological resources and ultimately can lead to subjective well-being and happiness. Flow states are tightly connected to positive emotions and emotional intelligence. Moreover, they have affective consequences, namely, they briefly transfer to the perception of the environment by increasing felt arousal. Understanding the psychophysiology of flow might help explaining positive effects on health but future investigations would be well advised to consult experts from the field of human biology or medicine, due to the subtle mechanisms involved.

5. References

Baker, F. A., & MacDonald, R. A. R. (2013). Flow, identity, achievement, satisfaction and ownership during therapeutic songwriting experiences with university students and retirees. *Musicae Scientiae*, *17*(2), 131–146. https://doi.org/10.1177/1029864913476287

Bernston, G., Bigger, Jr., T., Eckberg, D. L., Grossman, P., Kaufmann, M., Saul, J., … van der Molen, M. W. (1997). Heart rate variability: Origins, methods, and interpretive caveats. *Psychphysiology*, *34*, 623–648.

Cacioppo, J. T., Tassinary, L. G., & Berntson, G. G. (2007). *Handbook of psychophysiology*. Cambridge [England]; New York: Cambridge University Press. Retrieved from http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780511320736

Castaldo, R., Melillo, P., Bracale, U., Caserta, M., Triassi, M., & Pecchia, L. (2015). Acute mental stress assessment via short term HRV analysis in healthy adults: A systematic review with meta-analysis. *Biomedical Signal Processing and Control*, *18*, 370–377. https://doi.org/10.1016/j.bspc.2015.02.012

Chirico, A., Serino, S., Cipresso, P., Gaggioli, A., & Riva, G. (2015). When music “flows”. State and trait in musical performance, composition and listening: a systematic review. *Frontiers in Psychology*, *6*(June). https://doi.org/10.3389/fpsyg.2015.00906

Csikszentmihalyi, M. (1991). *Flow - the psychology of optimal experience* (1st ed.). New York; NY: Harper Perennial.

De Manzano, Ö., Cervenka, S., Jucaite, A., Hellenäs, O., Farde, L., & Ullén, F. (2013). Individual differences in the proneness to have flow experiences are linked to dopamine D2-receptor availability in the dorsal striatum. *NeuroImage*, *67*, 1–6. https://doi.org/10.1016/j.neuroimage.2012.10.072

De Manzano, Ö., Theorell, T., Harmat, L., & Ullén, F. (2010). The psychophysiology of flow during piano playing. *Emotion*, *10*(3), 301–311. https://doi.org/10.1037/a0018432

De Rezende Barbosa, M. P. da C., Silva, N. T. da, de Azevedo, F. M., Pastre, C. M., & Vanderlei, L. C. M. (2016). Comparison of Polar ® RS800G3 ™ heart rate monitor with Polar ® S810i ™ and electrocardiogram to obtain the series of RR intervals and analysis of heart rate variability at rest. *Clinical Physiology and Functional Imaging*, *36*(2), 112–117. https://doi.org/10.1111/cpf.12203

Engeser, S., & Schiepe-Tiska, A. (2012). Historical Lines and an Overview of Current Research on Flow. In S. Engeser (Ed.), *Advances in Flow Research* (pp. 1–22). New York, NY: Springer New York. https://doi.org/10.1007/978-1-4614-2359-1_1

Field, A. P. (2009). *Discovering statistics using SPSS: and sex, drugs and rock "n" roll* (3rd ed). Los Angeles: SAGE Publications.

Fredrickson, B. (2001). The Role of Positive Emotions in Positive Psychology - The Broaden-and-Build Theory of Positive Emotions. *American Psychologist*, *56*(3), 218–226. https://doi.org/10.10.37//0003-066X.56.3.218

Freer, P. K. (2009). Boys' descriptions of their experiences in choral music. *Research Studies in Music Education*, *31*(2), 142–160. https://doi.org/10.1177/1321103X09344382

Fritz, B. S., & Avsec, A. (2007). The experience of flow and subjective well-being of music students. *Horizons of Psychology*, *16*(2), 5–17. https://doi.org/10.1177/0022429411434931

Gaggioli, A., Chirico, A., Mazzoni, E., Milani, L., & Riva, G. (2017). Networked Flow in musical bands. *Psychology of Music*, *45*(2), 283–297. https://doi.org/10.1177/0305735616665003

Giles, D., Draper, N., & Neil, W. (2016). Validity of the Polar V800 heart rate monitor to measure RR intervals at rest. *European Journal of Applied Physiology*, *116*(3), 563–571. https://doi.org/10.1007/s00421-015-3303-9

Harmat, L., de Manzano, Ö., Theorell, T., Högman, L., Fischer, H., & Ullén, F. (2015).

Physiological correlates of the flow experience during computer game playing. *International Journal of Psychophysiology*, *97*(1), 1–7. https://doi.org/10.1016/j.ijpsycho.2015.05.001

Hart, E., & Di Blasi, Z. (2015). Combined flow in musical jam sessions: A pilot qualitative study. *Psychology of Music*, *43*(2), 275–290. https://doi.org/10.1177/0305735613502374

Heller, K., Bullerjahn, C., & Von Georgi, R. (2015). The relationship between personality traits, flow-experience, and different aspects of practice behavior of amateur vocal students. *Frontiers in Psychology*, *6*(DEC). https://doi.org/10.3389/fpsyg.2015.01901

Huber, E. (2015). *Flow - auf der Suche nach der autotelischen Persönlichkeit bei Orchestermusikern* (Unveröffentlichte Diplomarbeit). Vienna, Austria: University of Vienna.

Iacobucci, D., Posavac, S. S., Kardes, F. R., Schneider, M. J., & Popovich, D. L. (2015). The median split: Robust, refined, and revived. *Journal of Consumer Psychology*, *25*(4), 690–704. https://doi.org/10.1016/j.jcps.2015.06.014

Jackson, S. A., & Marsh, H. W. (1996). Development and Validation of a Scale to Measure Optimal Experience: The Flow State Scale. *Journal of Sport and Exercise Psychology*, *18*(1), 17–35. https://doi.org/10.1123/jsep.18.1.17

Jackson, S. A., Martin, A. J., & Eklund, R. C. (2008a). Long and Short Measures of Flow: The Construct Validity of the FSS-2, DFS-2, and New Brief Counterparts. *Journal of Sport and Exercise Psychology*, *30*(5), 561–587. https://doi.org/10.1123/jsep.30.5.561

Jackson, S. A., Martin, A. J., & Eklund, R. C. (2008b). Long and short measures of flow: The construct validity of the FSS-2, DFS-2, and new brief counterparts. *Journal of Sport and Exercise Psychology*, *30*(5), 561–587.

Jackson, S., Eklund, R., & Martin, A. (2004). *The Flow Scales Manual*. Morgantown, WV: Fitness Information Technology.

Jacobs, I., Sim, C.-W., & Zimmermann, J. (2015). The German TEIQue-SF: Factorial structure and relations to agentic and communal traits and mental health. *Personality and Individual Differences*, *72*, 189–194. https://doi.org/10.1016/j.paid.2014.09.003

Juslin, P. N., & Laukka, P. (2003). Communication of emotions in vocal expression and music performance: Different channels, same code? *Psychological Bulletin*, *129*(5), 770–814. https://doi.org/10.1037/0033-2909.129.5.770

Juslin, P., & Sloboda, J. (2011). *Handbook of music and emotion: theory, research, applications* (1st Edition). Oxford: Oxford University Press.

Keller, J., Bless, H., Blomann, F., & Kleinböhl, D. (2011). Physiological aspects of flow experiences: Skills-demand-compatibility effects on heart rate variability and salivary cortisol. *Journal of Experimental Social Psychology*, *47*(4), 849–852. https://doi.org/10.1016/j.jesp.2011.02.004

Keller, J., & Blomann, F. (2008). Locus of control and the flow experience: An experimental analysis. *European Journal of Personality*, *22*(7), 589–607. https://doi.org/10.1002/per.692

Kivikangas, J. M. (2006). *Psychophysiology of flow experience: An explorative study* (PhD Thesis). Helsingfors universitet.

Kovaleva, A., Beierlein, C., Kemper, C. J., & Rammstedt, B. (2012). Eine Kurzskala zur Messung von Kontrollüberzeugung: Die Skala Internale-Externale-Kontrollüberzeugung-4 (IE-4).

Landhäußer, A., & Keller, J. (2012). Flow and its affective, cognitive, and performancerelated consequences. In *Advances in flow research* (pp. 65–85). S. Engeser. Retrieved from doi:10.1007/978-1-4614-2359-1

Lang, P. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist*, *50*(5), 372–385.

Lang, P.J., Bradley, M.M., & Cuthbert, B. N. (2008). International affective picture system (IAPS): Affective ratings of pictures and instruction manual. Technical Report A-8. *Technical Report A-8.*, Technical Report A–8. https://doi.org/10.1016/j.epsr.2006.03.016

Langmeyer, A., Guglhör-Rudan, A., & Tarnai, C. (2012). What Do Music Preferences Reveal About Personality?: A Cross-Cultural Replication Using Self-Ratings and Ratings of Music Samples. *Journal of Individual Differences*, *33*(2), 119–130. https://doi.org/10.1027/1614-0001/a000082

Lazarus, R. S. (1993). From psychological stress to the emotions: A history of changing outlooks. *Annual Review of Psychology*, *44*(1), 1–22.

Leppert, K., Koch, B., Brähler, E., & Strau\s s, B. (2008). Die Resilienzskala (RS)–Überprüfung der Langform RS-25 und einer Kurzform RS-13. *Klinische Diagnostik Und Evaluation*, *1*(2), 226–243.

MacDonald, R., Byrne, C., & Carlton, L. (2006). Creativity and flow in musical composition: An empirical investigation. *Psychology of Music*, *34*(3), 292–306.

Malik, M. (1996). Heart rate variability. *Annals of Noninvasive Electrocardiology*, *1*(2), 151–181.

Marin, M. M., & Bhattacharya, J. (2013). Getting into the musical zone: Trait emotional intelligence and amount of practice predict flow in pianists. *Frontiers in Psychology*, *4*(NOV), 1–14. https://doi.org/10.3389/fpsyg.2013.00853

Marin, M. M., Gingras, B., & Bhattacharya, J. (2012). Crossmodal transfer of arousal, but not pleasantness, from the musical to the visual domain. *Emotion*, *12*(3), 618–631. https://doi.org/10.1037/a0025020

Martin, A. J., & Jackson, S. A. (2008). Brief approaches to assessing task absorption and enhanced subjective experience: Examining “short” and “core” flow in diverse performance domains. *Motivation and Emotion*, *32*(3), 141–157. https://doi.org/10.1007/s11031-008-9094-0

Mitchell, L. A., MacDonald, R. A., Knussen, C., & Serpell, M. G. (2007). A survey investigation of the effects of music listening on chronic pain. *Psychology of Music*, *35*(1), 37–57.

Moneta, G. B. (2012). On the Measurement and Conceptualization of Flow. In S. Engeser (Ed.), *Advances in Flow Research* (pp. 23–50). New York, NY: Springer New York. https://doi.org/10.1007/978-1-4614-2359-1_2

Müllensiefen, D., Gingras, B., Musil, J., & Stewart, L. (2014). The musicality of non-musicians: An index for assessing musical sophistication in the general population. *PLoS ONE*, *9*(2). https://doi.org/10.1371/journal.pone.0089642

Nacke, L. E., & Lindley, C. A. (2010). Affective ludology, flow and immersion in a first-person shooter: Measurement of player experience. *ArXiv Preprint ArXiv:1004.0248*.

Nickel, P., & Nachreiner, F. (2003). Sensitivity and diagnosticity of the 0.1-Hz component of heart rate variability as an indicator of mental workload. *Human Factors*, *45*(4), 575–590.

Partington, S., Partington, E., & Olivier, S. (2009). The dark side of flow: A qualitative study of dependence in big wave surfing. *The Sport Psychologist*, *23*(2), 170–185.

Pates, J., Karageorghis, C. ., Fryer, R., & Maynard, I. (2003). Effects of asynchronous music on flow states and shooting performance among netball players. *Psychology of Sport and Exercise*, *4*(4), 415–427. https://doi.org/10.1016/S1469-0292(02)00039-0

Peifer, C., Schächinger, H., Engeser, S., & Antoni, C. H. (2015). Cortisol effects on flow-experience. *Psychopharmacology*, *232*(6), 1165–1173. https://doi.org/10.1007/s00213-014-3753-5

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal of Research in Personality*, *41*(1), 203–212. https://doi.org/10.1016/j.jrp.2006.02.001

Rentfrow, P. J., & Gosling, S. D. (2003). The do re mi's of everyday life: The structure and personality correlates of music preferences. *Journal of Personality and Social Psychology*, *84*(6), 1236–1256. https://doi.org/10.1037/0022-3514.84.6.1236

Rheinberg, F., Vollmeyer, R., & Engeser, S. (2003). Die Erfassung des Flow-Erlebens. *Diagnostik von Motivation Und Selbstkonzept*, 261–279. https://doi.org/10.1024/1010-0652.18.1.65

Ross, S. R., & Keiser, H. N. (2014). Autotelic personality through a five-factor lens: Individual differences in flow-propensity. *Personality and Individual Differences*, *59*, 3–8. https://doi.org/10.1016/j.paid.2013.09.029

Sawyer, R. K. (2006). Group creativity: Musical performance and collaboration. *Psychology of Music*, *34*(2), 148–165.

Schaal, N. K., Bauer, A.-K. R., & Müllensiefen, D. (2014). Der Gold-MSI: Replikation und Validierung eines Fragebogeninstrumentes zur Messung Musikalischer Erfahrenheit anhand einer deutschen Stichprobe. *Musicae Scientiae*, *18*(4), 423–447. https://doi.org/10.1177/1029864914541851

Schumacher, J., Leppert, K., Gunzelmann, T., Strauss, B., & Brahler, E. (2005). The resilience scale-A questionnaire to assess resilience as a personality characteristic. *Zeitschrift Für Klinische Psychologie Psychiatrie Und Psychotherapie*, *53*(1), 16–39.

Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist*, *55*(1), 5–14. https://doi.org/10.1037//0003-066X.55.1.5

Selye, H. (1957). *Stress beherrscht unser Leben; The stress of life <dt.>* (1. Auflage). Düsseldorf: Econ Verlag.

Sinnamon, S., Moran, A., & O'Connell, M. (2012). Flow Among Musicians: Measuring Peak

Experiences of Student Performers. *Journal of Research in Music Education*, *60*(1), 6–25. https://doi.org/10.1177/0022429411434931

Snyder, C., Lopez, S., & Teramoto Pedrotti, J. (2011). *Positive psychology: the scientific and practical explorations of human strengths* (2nd Edition). Los Angeles, California: SAGE Publications.

Srinivasan, N., & Gingras, B. (2014). Emotional intelligence predicts individual differences in proneness for flow among musicians: the role of control and distributed attention. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.00608

Steyer, R., Schwenkmezger, P., & Eid, M. (1997). *Der mehrdimensionale Befindlichkeitsfragebogen: (MDBF)*. Göttingen: Hogrefe.

Storbeck, J., & Clore, G. L. (2008). Affective Arousal as Information: How Affective Arousal Influences Judgments, Learning, and Memory. *Social and Personality Psychology Compass*, *2*(5), 1824–1843. https://doi.org/10.1111/j.1751-9004.2008.00138.x

Tarvainen, M. P., & Niskanen, J.-P. (2012). Kubios HRV. *Finland: Biosignal Analysis and Medical Imaging Group (BSAMIG), Department of Applied Physics, University of Eastern Finland*.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach’s alpha. *International Journal of Medical Education*, *2*, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Tisdale, A. (2016). *Gaming in Virtual Reality Could Be the Very Real Death of You*. Retrieved from https://www.vice.com/en_us/article/4w5g7d/gaming-in-virtual-reality-could-be-the-very-real-death-of-you-911

Tozman, T., Magdas, E. S., MacDougall, H. G., & Vollmeyer, R. (2015). Understanding the psychophysiology of flow: A driving simulator experiment to investigate the relationship between flow and heart rate variability. *Computers in Human Behavior*, *52*, 408–418.

Ullén, F., de Manzano, Ö., Almeida, R., Magnusson, P. K. E., Pedersen, N. L., Nakamura, J., … Madison, G. (2012). Proneness for psychological flow in everyday life: Associations with personality and intelligence. *Personality and Individual Differences*, *52*(2), 167–172. https://doi.org/10.1016/j.paid.2011.10.003

Ulrich, M., Keller, J., Hoenig, K., Waller, C., & Grön, G. (2014). Neural correlates of experimentally induced flow experiences. *NeuroImage*, *86*, 194–202. https://doi.org/10.1016/j.neuroimage.2013.08.019

Vuoskoski, J. K., & Eerola, T. (2011). The role of mood and personality in the perception of emotions represented by music. *Cortex*, *47*(9), 1099–1106. https://doi.org/10.1016/j.cortex.2011.04.011

Williams, D. P., Jarczok, M. N., Ellis, R. J., Hillecke, T. K., Thayer, J. F., & Koenig, J. (2017). Two-week test-retest reliability of the Polar ® RS800CX ™ to record heart rate variability. *Clinical Physiology and Functional Imaging*, *37*(6), 776–781. https://doi.org/10.1111/cpf.12321

Wrigley, W. J., & Emmerson, S. B. (2013). The experience of the flow state in live music performance. *Psychology of Music*, *41*(3), 292–305.

6. Appendix

6.1 List of Figures

6.2 List of Tables

6.3 Abstract

Positive psychology focuses on strengths and virtues that prevent mental illness. The theory of optimal experiences (or flow) postulates that people can actively increase subjective well-being and happiness by engaging in flow activities. The present study focuses on flow in music performances. First, it tries to contribute to our understanding of the psychophysiological underpinnings of flow by means of cardiovascular measures. Second, it investigates affective consequences of flow on the visual perception of the environment. A pretest sample, consisting of N1 = 18 amateur musicians (55% female), validated a subset of affective environmental scenes by giving ratings of valence/pleasantness and arousal on 7-point scales. Each picture was shown for 2s. A main experiment sample of N2 = 13 (31% female) engaged in group music performance prior to picture ratings. For the main analysis, this sample was further divided into groups which differed regarding their flow states during music playing. In addition, several trait variables connected to the autotelic personality were collected. A transfer of arousal from the flow experience on the perception of neutral pictures was found within the first minute for participants who experienced the performance as more rewarding than their counterparts. No transfer effects of flow on perceived valence/pleasantness reached significance. Flow did not significantly affect HRV measures either. However, evidence indicated that autotelic personalities have healthier, emotion-focused coping styles, and are more outgoing and conscientious. Investigating affective consequences of flow may thus help understand how flow leads to subjective well-being and happiness.

6.4 Zusammenfassung

Positive Psychologie konzertiert sich auf menschliche Stärken und Fähigkeiten, die psychischen Störungen vorbeugen. Die Theorie der optimalen Erfahrung und Flow besagt, dass Menschen aktiv ihr Wohlbefinden und Glück steigern durch Flow Aktivitäten steigern können. Die vorliegende Untersuchung konzentriert sich auf Flow in Musikperformance. Erstens, versucht sie die Kenntnisse der Flow-Psychophysiologie durch kardiovaskuläre Maße zu vertiefen und zweitens, untersucht sie die Auswirkungen von Flow auf die Umweltwahrnehmung. Ein erstes Sample von N_1 = 18 AmateurmusikerInnen (55% weiblich) validierte die Valenz/Angenehmheit und Erregung eines Subsets von affektiven Umweltszenen anhand von 7-Punkt Ratingskalen. Jedes Bild wurde für 2 Sekunden gezeigt. Zur Testung des Hauptexperiments wurden Musikgruppen eingeladen, die vor der Bilderbewertung musizierten (N_2 = 13, 31% weiblich). Für die Hauptanalyse wurden anhand eines Mediansplits Gruppen geschaffen, die sich in Bezug auf ihre Flow-Erfahrung unterscheiden. Darüber hinaus wurde Information über verschiedene Traitvariablen, die mit der autotelischen Persönlichkeit in Verbindung stehen, gesammelt. Bei TeilnehmerInnen, die die Performance als belohnender empfanden, wurde ein Transfer von Erregung von der Flow-Erfahrung auf die Bilder-Bewertung innerhalb der ersten Minute gefunden. Für Valenz/Angenehmeit was kein Transfer signifikant. Flow hatte außerdem keine signifikanten Auswirkungen auf die HRV. Nichtsdestotrotz, zeigte sich, dass autotelische Persönlichkeiten über gesündere, emotionsbasierte Coping-Strategien verfügen und extravertierter und gewissenhafter sind. Die Untersuchung von affektiven Auswirkungen des Flows, kann dem Verständnis davon, wie Flow zu gesteigertem Wohlbefinden und Glück führt, zuträglich sein.

6.5 The IAPS subset

Table 12

The IAPS subset used in the present study

Name	ID	IAPS				PRETEST				EXPERIMENT			
		va-lmn	va-lsd	aromn	a-rosd	va-lmn	va-lsd	aromn	a-rosd	va-lmn	va-lsd	aromn	a-rosd
Adult	2020	5.68	1.99	3.34	1.89	3.72	1.63	3.61	1.30	4.00	1.36	3.23	1.37
NeuWo-man	2038	5.09	1.35	2.94	1.93	5.89	1.41	1.72	0.99	5.38	1.44	2.38	1.21
NeuMan	2102	5.16	0.96	3.03	1.87	5.06	1.03	2.50	1.34	4.46	1.65	2.31	1.14
Man	2190	4.83	1.28	2.41	1.80	4.72	1.56	3.11	1.52	3.92	1.33	3.15	1.66
NeutFace	2210	4.38	1.64	3.56	2.21	3.89	1.45	3.94	1.35	4.08	1.49	3.08	1.59
NeutMan	2214	5.01	1.12	3.46	1.97	4.11	0.99	3.50	1.17	3.31	1.26	3.46	1.45
NeutMan	2215	4.63	1.24	3.38	2.00	4.00	1.41	3.61	1.42	3.23	1.31	2.62	1.50
Butcher	2235	5.64	1.27	3.36	1.92	5.06	1.47	3.94	1.72	5.23	1.93	4.08	1.77
Factory-worker	2393	4.87	1.06	2.93	1.88	3.56	1.07	4.44	1.34	3.62	1.55	4.00	1.80
Couple	2396	4.91	1.05	3.34	1.83	3.67	0.75	4.06	1.39	3.85	1.51	3.23	1.62
Men	2397	4.98	1.11	2.77	1.74	3.67	1.67	3.39	1.64	3.46	1.55	2.77	1.62
ElderlyMan	2480	4.77	1.64	2.66	1.78	5.61	1.30	1.94	1.35	4.31	1.38	2.46	1.39
Neutral-Male	2499	5.34	1.43	3.08	1.73	5.17	1.42	2.83	1.57	5.15	1.41	2.69	1.59
Woman	2513	5.80	1.29	3.29	1.67	4.83	1.83	2.50	1.54	5.00	1.11	2.62	1.39
Quilting	2518	5.67	1.66	3.31	1.88	6.17	1.01	2.72	1.52	5.85	0.86	2.46	1.65
Man	2570	4.78	1.24	2.76	1.92	4.17	0.96	2.89	0.99	4.38	1.15	3.31	1.73
Chess	2580	5.71	1.41	2.79	1.78	5.44	1.12	2.28	1.15	5.38	1.08	2.23	0.89
Shopping	2745.1	5.31	1.08	3.26	1.96	4.06	1.43	4.17	1.46	3.46	1.34	4.00	1.52
Tourist	2850	5.22	1.39	3.00	1.94	4.06	0.97	4.28	1.15	4.15	1.35	3.77	1.53
Teenager	2870	5.31	1.41	3.01	1.72	5.39	1.46	3.72	1.69	5.31	0.91	3.23	1.67
Twins	2890	4.95	1.09	2.95	1.87	2.94	0.97	4.06	1.35	4.08	1.54	3.54	1.45

FoodBas-ket	2980	5.61	1.50	3.09	1.91	5.72	0.87	3.17	1.57	5.46	1.22	3.62	1.50
Mushroo m	5500	5.42	1.58	3.00	2.42	4.83	1.57	3.00	1.33	4.77	1.31	2.46	1.45
Mushroo m	5510	5.15	1.43	2.82	2.18	4.78	1.62	2.67	1.56	4.38	1.08	2.46	1.34
Mushroo m	5520	5.33	1.49	2.95	2.42	4.67	1.33	2.78	1.51	4.15	1.35	2.77	1.42
Mushroo m	5530	5.38	1.60	2.87	2.29	4.94	1.61	2.44	1.57	4.85	1.29	2.85	1.61
Mushroo ms	5533	5.31	1.17	3.12	1.92	4.94	1.54	2.67	1.49	5.00	1.41	2.92	1.54
Mushroo ms	5534	4.84	1.44	3.14	2.03	4.67	1.33	2.61	1.42	4.77	1.42	2.46	1.45
Rolling-Pin	7000	5.00	0.84	2.42	1.79	4.72	1.48	2.67	1.15	4.38	1.27	3.00	1.24
Spoon	7004	5.04	0.60	2.00	1.66	5.11	1.15	2.11	1.24	4.77	1.12	2.69	1.20
Bowl	7006	4.88	0.99	2.33	1.67	4.39	1.60	2.61	1.46	4.23	1.25	2.54	1.45
Mug	7009	4.93	1.00	3.01	1.97	5.50	1.46	2.28	1.37	4.54	1.39	2.62	1.39
Basket	7010	4.94	1.07	1.76	1.48	5.28	1.15	1.83	1.01	4.62	1.39	2.62	1.50
Fan	7020	4.97	1.04	2.17	1.71	4.83	1.71	2.89	1.52	4.77	1.31	3.23	1.85
Stool	7025	4.63	1.17	2.71	2.20	4.39	1.34	2.67	1.41	4.23	1.19	2.54	1.08
Iron	7030	4.69	1.04	2.99	2.09	3.72	1.63	3.28	1.45	2.92	1.07	3.15	1.41
Mug	7035	4.98	0.96	2.66	1.82	4.50	1.42	2.89	1.24	4.46	1.08	3.62	1.33
Shoes	7038	4.82	1.20	3.01	1.96	4.22	1.90	3.28	1.56	3.69	1.81	3.92	1.54
DustPan	7040	4.69	1.09	2.69	1.93	3.22	1.55	3.39	1.34	3.62	1.27	3.23	1.62
Baskets	7041	4.99	1.12	2.60	1.78	5.61	0.95	2.61	1.06	5.23	1.42	2.92	1.59
Hair-Dryer	7050	4.93	0.81	2.75	1.80	3.72	1.24	3.72	1.52	3.54	1.15	3.23	1.53
Candle-stick	7053	5.22	0.75	2.95	1.91	3.89	1.24	3.44	1.42	3.38	0.84	2.92	1.49
Light-bulb	7055	4.90	0.64	3.02	1.83	4.39	1.11	2.94	1.54	4.23	0.89	2.92	1.59
Tool	7056	5.07	1.02	3.07	1.92	3.50	1.21	3.33	1.25	4.31	1.38	3.38	1.33
Keyring	7059	4.93	0.81	2.73	1.88	4.28	1.24	3.17	1.83	4.46	1.01	3.00	1.52
Fork	7080	5.27	1.09	2.32	1.84	4.89	1.15	2.72	1.41	4.46	0.93	2.85	1.17

Book	7090	5.19	1.46	2.61	2.03	5.50	1.07	1.89	0.94	5.62	1.33	2.00	1.24
FireHyd-rant	7100	5.24	1.20	2.89	1.70	5.06	1.03	2.89	1.37	4.15	0.77	2.54	1.34
Hammer	7110	4.55	0.93	2.27	1.70	3.44	1.46	3.44	1.38	3.92	1.69	3.62	1.60
Bus	7140	5.50	1.42	2.92	2.38	4.44	1.38	3.33	1.53	4.69	1.64	3.85	1.61
Umbrella	7150	4.72	1.00	2.61	1.76	5.06	1.13	2.39	1.11	4.62	1.21	3.00	1.41
Fabric	7160	5.02	1.10	3.07	2.07	4.50	1.42	4.33	1.15	4.77	1.25	3.54	1.65
Pole	7161	4.98	1.02	2.98	1.99	4.17	1.26	3.39	1.53	4.46	0.93	3.23	1.12
Light-Bulb	7170	5.14	1.28	3.21	2.05	4.39	1.57	3.06	1.72	3.69	1.38	3.23	1.80
Lamp	7175	4.87	1.00	1.72	1.26	5.00	1.20	2.17	1.21	4.62	1.21	2.31	1.59
Rug	7179	5.06	1.05	2.88	1.97	4.83	1.46	3.28	1.56	5.38	1.00	2.38	1.15
Abstract Art	7185	4.97	0.87	2.64	2.04	4.22	1.18	3.44	1.77	3.85	1.03	3.31	1.43
Abstract Art	7187	5.07	1.02	2.30	1.75	4.06	1.13	3.72	1.41	3.69	1.07	4.00	1.36
Scarves	7205	5.56	1.39	2.93	2.16	5.00	1.25	3.06	1.61	5.23	1.37	2.77	1.12
Clothes-Rack	7217	4.82	0.99	2.43	1.64	3.78	1.40	3.06	1.31	3.38	0.84	2.85	1.51
Plate	7233	5.09	1.46	2.77	1.92	4.83	1.07	2.67	1.25	4.08	1.90	2.46	1.45
Ironing-Board	7234	4.23	1.58	2.96	1.90	3.67	1.37	3.67	1.33	2.62	1.21	3.38	1.69
Fruit	7283	5.50	1.84	3.81	2.01	6.00	1.53	3.83	1.95	6.00	1.04	3.46	1.95
Window	7490	5.52	1.41	2.42	2.23	5.61	1.21	3.00	1.60	5.77	1.19	3.38	2.02
Building	7491	4.82	1.03	2.39	1.90	3.61	1.46	3.28	1.24	3.46	1.45	3.38	1.94
Man	7493	5.35	1.34	3.39	2.08	5.00	1.11	3.33	1.33	5.00	1.11	3.38	1.64
Bridge	7547	5.21	0.96	3.18	2.01	4.83	1.54	3.39	1.70	4.54	1.15	3.15	1.35
Cabinet	7705	4.77	1.02	2.65	1.88	3.94	1.08	2.28	1.37	4.00	1.30	3.00	1.36
Chair	7235	4.96	1.18	2.83	2.00	5.11	1.29	2.50	1.54	4.23	0.89	3.00	1.18
Barbells	7042	5.55	1.23	4.02	2.26	3.44	1.57	3.72	1.52	3.46	1.50	3.62	1.90
Boat	5390	na	na	na	na	na	na	na	na	na	na	na	na
Street	7496	na	na	na	na	na	na	na	na	na	na	na	na

Note. valmn = Valence mean; valsd = Valence Standard deviation, aromn = Arousal mean, arosd = Arousal standard deviation; Boat and Street were practice pictures

6.6 Study invitation

universität wien

Fakultät für Psychologie

Einladung

Sehr geehrte Damen und Herren,

wir laden Sie herzlich ein, an der Studie „*Musizieren und Bildbewertung*" teilzunehmen. Sie ist Teil einer empirischen Masterarbeit und wird von [redacted] und [redacted]

Sie hatten uns in unserer Vorerhebung im Frühjahr diesen Jahres per Mail die Erlaubnis erteilt, Sie erneut kontaktieren zu dürfen. Die Planung der Studie ist nun abgeschlossen und wir sind momentan auf der Suche nach Bands, die dazu bereit wären, in den Räumlichkeiten der psychologischen Fakultät der Uni Wien ([redacted]) ähnlich wie bei einer Musikprobe gemeinsam zu musizieren. Es werden ausschließlich Gruppen (keine Einzelpersonen) teilnehmen können. Sie würden dabei Brustgurte sowie Pulsuhren zur Messung Ihres Herzschlags tragen. Außerdem würden Sie Ihre Gefühle, die bei der Präsentation verschiedener Bilder ausgelöst werden, bewerten. Wir bitten um Ihr Verständnis zum jetzigen Zeitpunkt nicht mehr über Ziel und Inhalt der Studie preisgeben zu können. Gerne klären wir Sie später nach Ihrer Teilnahme über alle Aspekte der Untersuchung auf. Die Ethikkommission der Universität Wien hat der Durchführung zugestimmt. Es sind keine Risiken, Beschwerden oder Begleiterscheinungen zu erwarten.

Für die Teilnahme werden Sie gebeten, uns vorab zwei Stücke Ihres Repertoires zu nennen, die sich möglichst in Bezug auf das Tempo unähnlich sind. Sie sollten jedoch beide Stücke sehr gerne und mehr oder weniger fehlerfrei spielen können. Aufgrund der aktuellen Ausstattung unseres Testlabors, ist es uns derzeit nur möglich max. 4 Personen gleichzeitig zu testen. Bei einer Gruppengröße von über 4 Personen wäre eine Teilnahme daher nur möglich, wenn Sie die Größe zeitweilig reduzieren könnten. Die Teilnahme dauert ungefähr 60-70 Minuten und wird mit 10 Euro pro Person vergütet. Vor Ort befindet sich Equipment zur Verstärkung von Stimme, Gitarre und Bass, ein Schlagzeug, eine Cajon sowie ein E-Piano. Sie können auch gerne Ihre eigenen Instrumente mitnehmen.

Die Terminvereinbarung findet individuell statt. Eine Teilnahme ist von Anfang September bis Mitte Oktober möglich. Wenn wir Ihr Interesse geweckt haben, dann würden wir uns freuen, wenn Sie sich per Mail an [redacted] oder telefonisch unter [redacted] melden.

Vielen Dank für Ihren Beitrag zur Wissenschaft. Ohne Sie wäre dieses Projekt nicht möglich!

Mit freundlichen Grüßen,

[redacted]

[redacted]

[redacted]

6.7 Letter of consent

Probandeninformation und Einwilligungserklärung

zur Teilnahme an der Studie

<u>Musizieren und Bildbewertung</u>

Sehr geehrte/r ProbandIn!
Wir laden Sie ein, an der oben genannten Studie teilzunehmen. Die Aufklärung darüber erfolgt in einem ausführlichen Gespräch.

Ihre Teilnahme an dieser Studie erfolgt freiwillig. Sie können jederzeit ohne Angabe von Gründen aus der Studie ausscheiden. Die Ablehnung der Teilnahme, oder ein vorzeitiges Ausscheiden aus dieser Studie hat keine nachteiligen Folgen für Sie.

Experimentelle Studien sind notwendig, um verlässliche neue Forschungsergebnisse zu gewinnen. Unverzichtbare Voraussetzung für die Durchführung einer Studie ist jedoch, dass Sie Ihr Einverständnis zur Teilnahme an dieser Studie schriftlich erklären. Bitte lesen Sie den folgenden Text als Ergänzung zum Informationsgespräch mit dem Versuchsleiter sorgfältig durch und zögern Sie nicht, Fragen zu stellen.

Bitte unterschreiben Sie die Einwilligungserklärung nur

wenn Sie Art und Ablauf der Studie vollständig verstanden haben,

wenn Sie bereit sind, der Teilnahme zuzustimmen und

wenn Sie sich über Ihre Rechte als Probandin dieser Studie im Klaren sind.

Zu dieser Studie, sowie zur Probandeninformation und Einwilligungserklärung, wurde von der zuständigen Ethikkommission eine befürwortende Stellungnahme abgegeben.

1. Was ist der Zweck der Studie?

Der Zweck dieser Studie ist es herauszufinden, ob sich Interaktionen bei der Wahrnehmung von Musik und Bildern ergeben, und falls ja, wie diese in Bezug auf die emotionale Verarbeitung zu interpretieren sind.

2. Wie läuft die Studie ab?

Diese Studie wird an der Fakultät für Psychologie der Universität Wien durchgeführt.
Vor der Aufnahme in diese Studie werden Sie auf das Zutreffen aller Einschlusskriterien und das Fehlen aller Ausschlusskriterien hin überprüft und gebeten, diese Einverständniserklärung zu unterschreiben.

Einschlusskriterien sind:

- Alter ab 18 Jahre
- Frauen und Männer

Ausschlusskriterien sind:

- Nicht ausreichende Sehschärfe
- Bestehen einer Rot-Grün-Schwäche
- NichtmusikerInnen

Ihre Teilnahme an dieser Studie wird **einen Termin** mit der Dauer von **ca. 60 – 70 Minuten** in Anspruch nehmen. Die Studie besteht insgesamt aus mehreren verschiedenen Teilen. Ein Teil besteht darin, Fragebögen in Papierform auszufüllen. Dabei wird Ihnen ein Befindlichkeitsfragebogen vorgelegt sowie Pulsuhren und Brustband angelegt.

Ein weiterer Teil besteht darin, gemeinsam zu musizieren. Hierbei werden anonymisierte Tonaufnahmen gemacht, die der späteren wissenschaftlichen Auswertung dienen und nicht kommerziell verwendet werden. Das Musizieren findet unter Ausschluß der Öffentlichkeit statt und wird nach 20 Minuten vom Testleiter unterbrochen. Nach Beendigung des Musizierens wird Ihnen erneut ein Befindlichkeitsfragebogen sowie ein Fragebogen zum Musikerleben während des Musizierens ausgeteilt.

Der letzte Teil besteht aus einer Computertestung. Hierbei werden Ihnen Bilder von Umweltszenen präsentiert, die Sie anhand zweier Emotionsskalen bewerten sollen. Nach Beendigung dieser Aufgabe, wird wieder ein Befindlichkeitsfragebogen ausgefüllt. Sie werden auch einige Persönlichkeitsfragebogen ausfüllen. Die Pulsuhr sowie der Brustgurt werden während des ganzen Versuchsablaufs getragen.

3. Worin liegt der Nutzen einer Teilnahme an der Studie?

Der direkte Nutzen liegt darin, dass Sie später die Aufnahmen Ihrer Session erhalten sowie eine Aufwandsentschädigung von 10 Euro. Der indirekte Nutzen der Studie besteht darin, dass Sie mit Ihrer Teilnahme dazu beitragen, Grundlagen des menschlichen Verhaltens wissenschaftlich besser zu verstehen.

4. Gibt es Risiken, Beschwerden und Begleiterscheinungen?

Es sind keine Risiken, Beschwerden und Begleiterscheinungen zu erwarten.

5. Hat die Teilnahme an der Studie sonstige Auswirkungen auf die Lebensführung und welche Verpflichtungen ergeben sich daraus?

Die Teilnahme hat keine Auswirkungen auf Ihre Lebensführung.

6. Was ist zu tun beim Auftreten von Symptomen, Begleiterscheinungen und/oder Verletzungen?

Sollten im Verlauf der Studie irgendwelche beschwerlichen Symptome oder Krankheiten auftreten, müssen Sie diese dem Studienleiter und/oder seinen Mitarbeitern mitteilen.

7. Wann wird die Studie vorzeitig beendet?

Sie können jederzeit, auch ohne Angabe von Gründen, Ihre Teilnahmebereitschaft widerrufen und aus der Studie ausscheiden, ohne dass für Sie dadurch irgendwelche Nachteile entstehen.
Ihr Studienleiter wird Sie über alle neuen Erkenntnisse, die in Bezug auf diese Studie bekannt werden, und für Sie wesentlich sein könnten, umgehend informieren. Auf dieser Basis können Sie dann Ihre Entscheidung zur **weiteren** Teilnahme an dieser Studie neu überdenken.
Es ist aber auch möglich, dass Ihr Versuchsleiter entscheidet, Ihre Teilnahme an der Studie vorzeitig zu beenden, ohne vorher Ihr Einverständnis einzuholen. Die Gründe hierfür können sein: Sie können den Erfordernissen der Studie nicht entsprechen oder der Versuchsleiter hat den Eindruck, dass eine weitere Teilnahme an der Studie nicht in Ihrem Interesse ist.

8. In welcher Weise werden die im Rahmen dieser Studie gesammelten Daten verwendet?

Sofern gesetzlich nicht anders vorgesehen, haben nur die Prüfer und deren Mitarbeiter Zugang zu den vertraulichen Daten, in denen Sie namentlich genannt werden. Diese Personen unterliegen der Schweigepflicht. Jedoch werden diese Daten zum ehest möglichen Zeitpunkt anonymisiert (Erstellung eines Codes).
Die Weitergabe der Daten erfolgt ausschließlich zu statistischen Zwecken und Sie werden darin ausnahmslos nicht namentlich genannt. Auch in etwaigen Veröffentlichungen der Daten dieser Studie werden Sie nicht namentlich genannt.

9. Entstehen für die Probanden Kosten? Gibt es einen Kostenersatz oder eine Vergütung?

Durch Ihre Teilnahme an dieser Studie entstehen für Sie keine Kosten. Sie erhalten für Ihre Teilnahme eine entgeltliche Entschädigung von 10 Euro.

10. Möglichkeit zur Diskussion weiterer Fragen

Für weitere Fragen im Zusammenhang mit dieser Studie steht Ihnen die Studienleitung gern zur Verfügung. Auch Fragen, die Ihre Rechte als Proband in dieser Studie betreffen, werden Ihnen gerne beantwortet.

Name der Kontaktperson: [redacted]
Erreichbar unter (Bürozeiten): [redacted]

11. Sollten behandelnde Ärzte von der Teilnahme an der Studie informiert werden?

Bitte informieren Sie uns über alle aktuellen ärztlichen Behandlungen vor Studienbeginn bzw. sobald diese beginnen.

12. Einwilligungserklärung

Bitte lesen Sie dieses Formular sorgfältig durch und fragen Sie, wenn Sie etwas wissen möchten oder nicht verstehen.

Name des Probandes in Druckbuchstaben: ....

Geb.Datum: .... Code: ....

Ich erkläre mich bereit, an der Studie
„*Musizieren und Bildbewertung*“ teilzunehmen.

Ich bin von Herrn/Frau .... ausführlich und verständlich über die Ziele, den Ablauf der Studie sowie über mögliche Belastungen und Risiken, sowie über Wesen, Bedeutung und Tragweite der Studie, sich für mich daraus ergebenden Anforderungen aufgeklärt worden. Ich habe darüber hinaus den Text dieser Probandenaufklärung und Einwilligungserklärung, die insgesamt 4 Seiten (inkl. dieser) umfasst, sorgfältig gelesen. Aufgetretene Fragen wurden mir vom Versuchsleiter und/oder dessen Mitarbeitern verständlich und genügend beantwortet. Ich hatte ausreichend Zeit, mich zu entscheiden. Ich habe zurzeit keine weiteren Fragen mehr.

Ich werde den Anordnungen, die für die Durchführung der Studie erforderlich sind, Folge leisten, behalte mir jedoch das Recht vor, meine freiwillige Mitwirkung jederzeit zu beenden, ohne dass mir daraus Nachteile entstehen.

Ich bin zugleich damit einverstanden, dass meine im Rahmen dieser Studie ermittelten Daten aufgezeichnet werden. Zu jedem Zeitpunkt kann ich verlangen, dass meine Daten vernichtet werden. Eine Begründung dafür ist nicht erforderlich.

....

(Datum und Unterschrift des Probanden)

....

(Datum, Name und Unterschrift des verantwortlichen Versuchsleiters)

(Der Proband erhält eine unterschriebene Kopie der Probandeninformation und Einwilligungserklärung, das Original verbleibt im Studienordner des Studienleiters.)

6.8 Main experiment post-experiment questionnaire

Fragebogen

Es folgen einige allgemeine Fragen zum Ablauf der Studie.
Bitte machen Sie einen Kreis um die Antwortalternative, die Ihnen am ehesten entspricht!

Die Präsentationszeit der Bilder war …	zu kurz … zu lang 1 2 3 4 5 6 7
Die Gefühle, die die Bilder bei mir ausgelöst haben, waren in der Regel …	sehr schwach … sehr stark 1 2 3 4 5 6 7
Mir ist es schwer gefallen, meine Gefühle in Bezug auf die Bilder zu bewerten.	trifft überhaupt nicht zu … trifft vollkommen zu 1 2 3 4 5 6 7
Mir war klar, wie der Bilder-Task zu bearbeiten gewesen ist.	trifft überhaupt nicht zu … trifft vollkommen zu 1 2 3 4 5 6 7
Das Setting hat es mir erschwert, wie gewohnt musizieren zu können.	trifft überhaupt nicht zu … trifft vollkommen zu 1 2 3 4 5 6 7
Wie würden Sie die Musikrichtung Ihrer Band am ehesten beschreiben? (Bitte nur eine Option!)	Electronic Popular Rock World Urban Jazz Klassik Sonstiges, und zwar:
Wie lange sind Sie bereits Mitglied dieser Band?	___________ Jahre und __________ Monate
Wie oft proben Sie mit dieser Band in etwa?	(fast) täglich 2-3 mal die Woche 1 mal die Woche ca. alle 2 Wochen
Welches Instrument haben Sie heute gespielt?	Bitte Instrument eintragen:

War dieses Ihr Hauptinstrument?	Ja Nein
Sind Sie ebenfalls (Background-)SängerIn in Ihrer Band?	Ja Nein
Haben Sie in der Testung auch gesungen?	Ja Nein Teilweise
Wenn Sie soeben mit „Teilweise“ geantwortet haben, in welchem Song haben Sie gesungen?	1. Stück 2. Stück
Spielen Sie noch regelmäßig in einer anderen Band?	Eine weitere zwei weitere mehrere nein regelm. Jam-Sessions

Einer der heutigen Fragebögen zielte darauf ab, Ihr Flow-Erlebnis zu erfassen. Im psychologischen Sprachgebrauch bezeichnet „Flow“ einen veränderten Bewusstseinszustand, der durch tiefe Tätigkeitsabsorption – das völlige Verschmelzen mit der ausgeführten Handlung – gekennzeichnet ist. In einem solchen Zustand rückt die Wahrnehmung der Umwelt und der eigenen Person in den Hintergrund, was als sehr positiv und beglückend erlebt wird. Oft ist die empfundene Freude ein Grund dafür, die Handlung zu wiederholen, selbst wenn scheinbar kein großer objektiver Nutzen damit verbunden ist.

Ist Ihnen ein solcher Zustand vertraut bzw. haben Sie ihn bereits einmal beim Musizieren erlebt?	Ja Nein Weiß nicht
Wenn ja, wie würden Sie Ihr heutiges Musik-Flow-Erlebnis im Vergleich bewerten?	sehr schwach sehr stark 1 2 3 4 5 6 7
War der Flow vergleichbar stark in beiden Stücken bzw. in welchem Stück war er stärker?	in beiden Stücken gleich stärker im 1. Stück stärker im 2. Stück
War Ihnen vorher der Begriff „Flow” bereits geläufig? Wenn ja, wie hätten Sie ihn nach Ihrem Verständnis beschrieben?	(Bitte Text einfügen!)

Wie häufig stellt sich Flow beim Musizieren alleine oder mit anderen ein?		niemals						immer
	alleine	1	2	3	4	5	6	7
	mit anderen	1	2	3	4	5	6	7

Wie häufig stellt sich Flow in folgenden Situationen ein? (Unzutreffendes bitte streichen!)		niemals						immer
	Üben (alleine)	1	2	3	4	5	6	7
	Band-Probe	1	2	3	4	5	6	7
	Solo-Auftritt	1	2	3	4	5	6	7
	Band-Auftritt	1	2	3	4	5	6	7
	Improvisation	1	2	3	4	5	6	7
	Jamming	1	2	3	4	5	6	7
	Einstudieren neuer Stücke	1	2	3	4	5	6	7
	Generalprobe	1	2	3	4	5	6	7
	Komposition	1	2	3	4	5	6	7
	Musik hören	1	2	3	4	5	6	7
Stellt sich Flow bei Ihnen auch während anderer Tätigkeiten ein? Wenn ja, bei welchen?	(Bitte Text einfügen!)							
Welche der folgenden Substanzen haben Sie heute bereits zu sich genommen?	Alkohol Psychopharmaka (z.B. Anti-Depressiva)	Psychoaktive Drogen (inkl. Cannabis) Keine						
Wie häufig verspüren Sie starkes Lampenfieber vor einem Auftritt?	niemals							immer
	1	2	3	4	5	6	7	

Wie ausgeprägt war Ihr Lampenfieber heute?	sehr schwach sehr stark 1 2 3 4 5 6 7
Haben Sie ein abgeschlossenes Instrumental-/Gesangsstudium?	Ja Nein Wenn Studium abgebrochen, wie viele Semester wurden absolviert? ____________
Wie viele Gigs hatten Sie in den letzten 12 Monaten in etwa?	Anzahl: ____________________________
Wie viele Facebook-Likes hat die Band, mit der Sie heute teilgenommen haben?	Likes: _______________________
Wie viel Gage bekommen Sie pro Auftritt/Person im Durchschnitt?	Euro: ________________________________
Sind Sie derzeit bei einer Plattenfirma unter Vertrag?	Ja Nein
Haben Sie bereits Tonträger veröffentlicht?	Ja, und zwar ____________ CDs und ______________ Vinyl und ____________________ Sonstiges Nein, aber kostenpflichtige digitale Veröffentlichung Nein, aber gratis digitale Veröffentlichung (Soundcloud, Youtube, etc.) Nein
Werden Sie auch als Einzel-KünstlerIn gebucht?	Ja Nein
Wollen Sie uns noch etwas mitteilen? Wenn ja, was?	(Bitte Text einfügen!)

6.9 Pretest post-experiement questionnaire

Fragebogen

1) Es war mir klar, wie die Bilder-Bewertungsaufgabe zu bearbeiten gewesen ist.

trifft überhaupt nicht zu ☐ ☐ ☐ ☐ ☐ *trifft vollkommen zu*

2) Die Präsentationszeit der Bilder war …

zu kurz ☐ ausreichend ☐ zu lang ☐

3) Bitte erläutern Sie in einem Satz oder stichpunktartig, was Sie unter *Valenz* der Bilder verstanden haben.

____

____

4) Mir war unklar, wie die Bilder-Bewertungsaufgabe zu bearbeiten gewesen ist.

trifft überhaupt nicht zu ☐ ☐ ☐ ☐ ☐ *trifft vollkommen zu*

5) Bitte erläutern Sie in einem Satz oder stichpunktartig, was Sie unter *Erregung* der Bilder verstanden haben.

____

____

6) Es ist mir schwer gefallen, meine Erfahrung der Bilder anhand der beiden Skalen zu bewerten.

trifft überhaupt nicht zu ☐ ☐ ☐ ☐ ☐ *trifft vollkommen zu*

7) Die Emotionen, die die Bilder bei mir auslösten, waren in der Regel …

sehr schwach ☐ ☐ ☐ ☐ ☐ *sehr stark*

8) Ist Ihnen etwas ungewöhnliches bei der Bewertung der Bilder aufgefallen? Wenn ja, was?

____

____

____

____

___

9) Mir ist es sehr leicht gefallen, meine Erfahrung der Bilder anhand der beiden Skalen zu bewerten.

trifft überhaupt nicht zu ☐ ☐ ☐ ☐ ☐ *trifft vollkommen zu*

10) Anmerkungen, Kritik:

____

____

____

____

___

Vielen Dank für Ihre Teilnahme!

6.10 Information concerning musical equipment

Liste Equipment

Erinnerung: Sie sollten wenn möglich auf Ihren eigenen Instrumenten spielen, d.h. eigene Gitarren mitbringen, Blasinstrumente, Gesangs-Mikrofone, Effektgeräte etc. Es kann notfalls auf Ersatz-Equipment zurückgegriffen werden. In einem solchen Fall geben Sie bitte rechtzeitig per Mail Bescheid!"

Ständig verfügbares Equipment (keine Anfrage nötig):

Gitarrenamp Peavey Rage 158
Bassamp Stagg 20 BA
Drumset (Bass Drum, Snare, 1 Tom, Floor Tom, Ride, Crash)
P.A.

Zusätzliches Equipment (auf Anfrage):

2.Gitarrenamp
E-Piano
Akkordeon (Weltmeister, Ramona, Kleine Klaviatur)
Cajon
Akustik-Gitarre (3/4, spanish)
E-Gitarren
E-Bässe
Gesangs-Mikrofon (Kodec)

6.11 Study promotion on wordpress.com

Liebe Musikerin, lieber Musiker, liebe Band,
Wir würden Sie gerne herzlich zur Studie „Musizieren und Bildbewertung“ einladen (s. „Einladung“ im Anhang). Vorab einige wichtige Informationen:

Wer kann teilnehmen?

Wir laden Bands (keine Einzel-MusikerInnen) ein, die **maximal 4 Mitglieder** haben oder für die Testung ihre Mitgliederzahl zeitweilig auf 4 reduzieren könnten. Sie sollten **2 Songs im Repertoire** haben, die Sie gerne und möglichst fehlerfrei spielen können. Außerdem sollte das Tempo der Songs sich möglichst unähnlich sein, d.h. ein Songs sollte eher schnell sein und einer eher langsam. Es sind Eigen- sowie Fremdkompositionen erlaubt. Sie werden jedes Stück für ca. 10 Minuten spielen. Die Reihenfolge wird am Tag der Testung bestimmt. Wir sind an einem **breiten Spektrum von MusikerInnen** interessiert, d.h. Alter, Musikrichtung, Ausbildung, etc. dürfen variieren.

Wo finden die Testungen statt?

Die Testungen finden in den Labors der psychologischen Fakultät an der Universität Wien statt. Die Adresse lautet: [redacted]. Treffpunkt ist der Hof unserer Fakultät. Im Anhang finden Sie einen Umgebungsplan, sowie eine Beschreibung, wie Sie zum Treffpunkt finden. Wir haben für Sie Verstärker, Drumset und ähnliches bereitgestellt (siehe „Equipment“ im Anhang). Sie sollten jedoch nach Möglichkeit Ihre eigenen Instrumente mitbringen.

Wann finden die Testungen statt?

Als Zeitraum für die Testungen ist Anfang September bis Mitte Oktober vorgesehen. Die Terminvereinbarung findet individuell statt und wir versuchen Ihnen soweit wie möglich entgegenzukommen. Idealerweise findet eine Testung unter der Woche am nachmittag bzw. frühen Abend statt. Am Wochenende wäre eine Testung auch früher möglich. Wenn Sie Ihr Interesse an unserer Untersuchung per Mail anmelden, dann kommunizieren Sie bitte mit Ihren Band-KollegInnen und machen Sie uns **3 Terminvorschläge, an denen alle oder die Mehrzahl Ihrer KollegInnen Zeit haben.**

Was bekommen die Versuchspersonen als Gegenleistung?

Unsere finanziellen Mittel sind begrenzt und das Equipment muss teilweise gemietet werden. Trotzdem wollen wir Ihnen **10 Euro pro Person** als Entschädigung für Ihren Zeitaufwand und Ihre Mühe zahlen. Die Testung wird voraussichtlich **60 – 70 Minuten** in Anspruch nehmen.

Wir hoffen, Ihr Interesse für unsere Studie geweckt zu haben. Wenn Sie teilnehmen möchten, dann schicken Sie uns ein Mail als Antwort auf dieses Einladungsschreiben. Ihre Mail sollte unbedingt beinhalten: *Name der Band, Anzahl Personen, Instrumente, 3 Terminvorschläge* für September bis Mitte Oktober, an denen alle Band-

Mitglieder Zeit haben (bitte vorher kommunizieren) sowie eine Liste an *zusätzlichem Equipment*, das Sie benötigen würden.

Vielen Dank im Voraus. Sollte Sie noch Fragen haben oder falls Ihnen noch etwas unklar ist, bitte zögern Sie nicht, uns zu kontaktieren!

Mit freundlichen Grüßen

6.12 Poster advertisement