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## From music making to affective well-being in everyday life. The mediating role of need satisfaction

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From Music Making to Affective Well-Being in Everyday Life: The Mediating Role of Need  
Satisfaction

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### Abstract

How music can provide a pathway to affective well-being has mostly been investigated with regard to listening to music or music therapy. Comparatively less is known about the effects of active music making on well-being in everyday life or its underlying mechanisms. Self-Determination Theory emphasizes the importance of fulfillment of the needs for autonomy, competence and relatedness for well-being and offers a valuable framework for explaining the postulated link between music making and well-being. In the present daily-diary study, 1,042 hobby musicians (age range 13 to 82 years; 65.3 % female) completed online assessments of their music making, need fulfillment, and positive and negative affect each day for ten consecutive days. Results showed that need satisfaction and positive affect were higher, while need dissatisfaction and negative affect were lower on days when participants reported music making. Multilevel structural equation models indicated that the effect of music making on positive affect was mediated by satisfaction of all three needs, with statistically significant indirect effects via autonomy and competence at both the within- and between person level, and relatedness only at the between-person level. There were no statistically significant mediation effects for negative affect. This study is the first to provide evidence for higher affective well-being of hobby musicians on days of music making. Results further suggest satisfaction of basic psychological needs as a mediating mechanism and emphasize the importance to distinguish between indicators of positive functioning (positive affect, need satisfaction) and negative functioning (negative affect, need dissatisfaction).

*Keywords:* music making, affective well-being, self-determination, ambulatory assessment, daily diary

## From Music Making to Affective Well-Being in Everyday Life: The Mediating Role of Need Satisfaction

Subjective well-being (SWB), and in particular affective well-being, fluctuates dynamically within individuals (e.g., Gruber, Kogan, Quoidbach, & Mauss, 2013) and recent studies have attempted to better understand the predictors of these ups and downs in individuals' daily lives (e.g., Troy, Saquib, Thal, & Ciuk, 2018). As one of the key life domains studied in well-being research, leisure is typically perceived as a core predictor of SWB (Loewe, Bagherzadeh, Araya-Castillo, Thieme, & Batista-Foguet, 2014). In general, it is conceptualized as the amount of activity or time spent away from work and/or participation in leisure as subjectively defined (Newman, Tay, & Diener, 2014). Positive associations with SWB have been reported for several leisure activities, such as visiting family and friends, watching television (Yarnal, Chick, & Kerstetter, 2008), volunteer work (Mojza, Lorenz, Sonnentag, & Binnewies, 2010), using the internet (Koopman-Boyden & Reid, 2009), playing sports or games (Parkes, 2006) and making art (Reynolds & Lim, 2007). A recent meta-analysis by Kuykendall, Tay, and Ng (2015) assessed the relation between leisure engagement and SWB in a total sample of  $N = 11,834$  and reported a mean effect size of  $r = .25$ .

The present study aims to contribute to the extant literature linking leisure activity and affective well-being<sup>1</sup> in two ways: First, it extends prior research by focusing on a previously less well investigated leisure activity: music making in hobby musicians' daily lives.

Utilizing a daily diary method, the present study examines the within-person effects of music making on indicators of affective well-being (positive and negative affect). Second, we aim at

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<sup>1</sup> Whereas we note that different well-being indicators such as life-satisfaction (the cognitive component of SWB; Diener, 1984), vitality, or psychological well-being (a eudaimonic perspective on well-being; see Ryff, 1989) could be highly relevant outcomes of leisure activities and music making, we decided to focus on affective well-being in the present research and therefore target only this specific component of SWB with our study.

examining the mediating processes of the hypothesized positive effects of this leisure activity on well-being. While the overall positive effect of different leisure activities on well-being has been established in previous research (Kuykendall et al., 2015), comparatively less is known about the mediating processes. Drawing upon Self-Determination Theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2017) we examine whether fulfillment of the basic psychological needs for autonomy, competence, and relatedness might explain effects of music making on affective well-being. The next sections are organized as following: First, we summarize prior research on the meaning of music for well-being in individuals' daily lives. Building on this research we delineate the hypothesis that music making as a leisure activity will be positively associated with affective well-being. Next, we introduce fulfillment of basic psychological needs as the postulated mediating mechanism underlying the positive effect of music making on affective well-being. We will then present results of a daily diary study assessing music making, need fulfillment and affective well-being in 1,042 hobby musicians for ten consecutive days.

### **Music In Everyday Life**

When it comes to the relationship between music and health or well-being, MacDonald, Kreutz, and Mitchell (2012) describe four main areas of inquiry: music education, music therapy, community music, and everyday uses of music. In the present work we focus on the latter area. In everyday life, music is an integral part of leisure time for a large part of the population, as it is portrayed as one of the most satisfying and pleasurable everyday activities across time and culture (Mantie & Smith, 2017; Mas-Herrero, Marco-Pallares, Lorenzo-Seva, Zatorre, & Rodriguez-Fornells, 2013). To illustrate the vital role of music in daily life, a recent representative study of 11,000 participants in Germany showed that 87 % regularly listen to music and 38 % visit music concerts. Further, in every sixth household, someone plays an instrument in leisure time (SoMM, 2012).

The ways people can engage with music in leisure time can be passive, such as consuming music, or active, such as making or creating music (Weinberg & Joseph, 2016). Most of previous research about the impact of music in everyday life has focused on passive music engagement, in particular music listening (e.g., Juslin, Liljeström, Västfjäll, Barradas, & Silva, 2008). One of the most often reported functions of music listening is affect regulation, specifically the attempt to increase positive affect (Rickard, 2012). People even engage in music listening with a greater preference than they engage in other everyday leisure activities for this purpose (Lonsdale & North, 2011). Thus far, studies have shown that listening to music is related to well-being as an emotional state (Morinville, Miranda, & Gaudreau, 2013). Psychological mechanisms through which music might evoke emotions in listeners have been hypothesized as brain stem reflex, rhythmic entrainment, evaluative conditioning, contagion, visual imagery, episodic memory, and musical expectancy (Juslin & Västfjäll, 2008). Prior empirical research has reported some evidence for positive associations of music listening with emotional well-being, i.e., more positive affect, less negative affect (Campion & Levita, 2014; Miranda & Gaudreau, 2011). These effects have been further explored with regard to inter-individual differences. Such studies have for example shown that affective reactivity (Saarikallio, Nieminen, & Brattico, 2013), emotion regulation strategy (Chin & Rickard, 2013), and personality traits, specifically neuroticism and extraversion (Karreman, Laceulle, Hanser, & Vingerhoets, 2017), modulate the effectiveness of music listening for enhancing emotional well-being.

In addition to passive music engagement (listening to music), active music engagement via singing (Sanal & Gorsev, 2013), dancing (Koch, Kunz, Lykou, & Cruz, 2014), composing music (Habron, Butterly, Gordon, & Roebuck, 2013), attending music festivals (Packer & Ballantyne, 2010), and playing an instrument (Perkins & Williamon, 2013) has also been associated with enhanced well-being. Although music listening has

certainly formed the core interest of music psychology research for the past decade, Creech, Hallam, Varvarigou, McQueen, and Gaunt (2013) propose that active forms should, in fact, generally account for greater benefits than passive engagement because they support emotional expression, self-exploration, self-esteem and confidence. A nationwide study in Denmark (Ekholm, Juel, & Bonde, 2016) underlines this point showing that people who engaged in singing or playing musical instruments at least one hour per day, were more likely to report good self-rated health than those who were not musically active.

In the context of the effects of active music making on well-being, prior research on music therapy might also be informative. This research has largely demonstrated positive effects of music therapy on well-being (Ghetti, 2011). For example, Fredenburg and Silverman (2014) reported data from a randomized controlled trial, demonstrating positive effects of music therapy on affective well-being (increase in positive affect, decrease in negative affect) in a sample of cancer patients. The positive effect of music therapy on health and well-being outcomes has been corroborated in a plethora of empirical studies (Segall, 2018). However, whether the positive effects found in therapeutic settings transfer to the everyday life context as well, is less well known. If and how active music making as a *hobby* influences affective well-being has received substantially less attention compared to the effects of music therapy.

In conclusion, previous research suggests that active music making might be associated with better emotional well-being. Experimental studies further suggest that there is a causal effect of (active and passive) musical engagement on affect and affective well-being (Fredenburg & Silverman, 2014; Kreutz, Ott, Teichmann, Osawa, & Vaitl, 2008; Zavoyskiy, Taylor, & Friedman, 2016). The present research targets two gaps in the current literature: First, these prior studies have exclusively targeted between-person associations of music making and well-being. For example, in a study by Weinberg and Joseph (2016), those

participants who reported more music engagement reported higher well-being. Notably, these findings cannot answer the question whether within individuals music making is associated with higher-than-usual well-being. To address such questions about the within-person associations of music making and well-being, intensive longitudinal designs (e.g., daily diary studies; ecological momentary assessments) are required (Bolger, Davis, & Rafaeli, 2003; Hamaker, 2012). In order to approach the question if music making is associated with higher well-being on the within-person level, we employed a daily diary study assessing music making and well-being for ten consecutive days in our study participants' day-to-day lives.

Second, prior research has been rather silent with regard to the psychological mechanisms that mediate the association between music making as a hobby and well-being. In other words, comparatively less is known with regard to the question *why* music making might be associated with higher well-being. In a first theoretical review about music and well-being, Croom (2014) claimed that music practice and participation can assist in living a flourishing life with high psychological well-being by impacting emotions, engagement, relationships, meaning, and accomplishment. Conceptually similar factors (agency, belonging, coherence and identity) have been postulated for the effectiveness of music therapy (Ruud, 1997). In the broader context of leisure activities, Newman et al. (2014) conducted a quantitative summary of 363 studies linking leisure to SWB and identified five key psychological mechanisms, including affiliation, autonomy, mastery, meaning and detachment-recovery from work. These hypothesized variables overlap substantially with the needs for autonomy, competence and relatedness as postulated by SDT (Deci & Ryan, 2000; Ryan & Deci, 2017).

SDT's pioneers Ryan and Deci (2017) claim the needs for autonomy, competence and relatedness to be fundamental for the human psyche. Autonomy in this framework is defined as the need to perceive one's behavior as volitional and congruent with one's integrated sense



of self (Deci & Vansteenkiste, 2004). It is enhanced when people feel intentional and authentic in behavior, and reduced when they experience their behavior as driven by pressure, coercion or external rewards (DeHaan, Hirai, & Ryan, 2016). Competence concerns the need to feel efficacy and mastery in dealing with the environment (Deci & Vansteenkiste, 2004). Contexts that offer opportunities to acquire skills and receive informational feedback support the satisfaction of competence (DeHaan et al., 2016). Finally, the need for relatedness refers to a propensity toward connection and belongingness with others (Evans, 2015). Social exclusion and disconnection can thwart the need for relatedness (Deci & Vansteenkiste, 2004).

### **Need Fulfillment as a Mediator of the Music Making-Well-Being Association**

According to SDT, fulfillment of these basic psychological needs is a pathway through which situations and behaviors can influence well-being (DeHaan et al., 2016). SDT's approach stems from organismic theorizing, in which psychological wellness is defined in terms of full and integrated functioning (Deci & Ryan, 1985). The concept of psychological needs, classically and as used in SDT, covers those nutrients that must be attained to maintain growth, integrity, and psychological health (Ryan & Deci, 2017), and constitute an innate part of human nature consistent across time, gender and culture (e.g., Chirkov, Ryan, Kim, & Kaplan, 2003). Numerous studies have supported the crucial role of these basic psychological needs for well-being (Ryan & Deci, 2017). Whenever the needs are satisfied, people flourish; when they are frustrated, well-being is reduced. Experimental studies have widely provided evidence supporting the postulated causal effect of need fulfillment on well-being (e.g., Neubauer, Lerche, & Voss, 2018; Sheldon & Filak, 2008).

In early work, need dissatisfaction was implicitly assumed to be merely the opposite pole of need satisfaction on a single continuum of need fulfillment (DeHaan & Ryan, 2014). However, unsatisfied needs may have different causes and consequences than dissatisfied

needs (Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011). In this realm, need satisfaction has been linked to higher life satisfaction (Meyer, Enström, Harstveit, Bowles, & Beevers, 2007), more positive affect (Ryan, Bernstein, & Brown, 2010) and less negative affect (Liu, Bartholomew, & Chung, 2017). Reversely, people who report dissatisfaction of needs are more likely to engage in suicidal behavior (Britton, van Orden, Hirsch, & Williams, 2014) and to suffer from depressive symptoms (Ng, Ntoumanis, Thøgersen-Ntoumani, Stott, & Hindle, 2013).

Recent psychometric work further supports the empirical findings that need satisfaction and need dissatisfaction should be considered correlated, but distinct constructs (Neubauer & Voss, 2016; Tóth-Király, Morin, Bőthe, Orosz, & Rigó, 2018). Not only do they predict different outcomes, but they are also affected by different predictors. Need supporting environments primarily affect need satisfaction whereas need thwarting environments mainly influence need dissatisfaction (Vansteenkiste & Ryan, 2013). These circumstances comprise work, friendships and in particular leisure activities (Ryan & Deci, 2001). Mediation pathways through need fulfillment in leisure time have been reported in previous research and include non-work activities at the weekend (Ryan et al., 2010), dedication to long-term goals (Jin & Kim, 2017), prosocial behavior (Martela & Ryan, 2016) or hobbies such as sports (Gunnell, Mack, Wilson, & Adachi, 2011).

Hence, these studies suggest that the positive effect of situational circumstances on well-being is mediated via need fulfillment. Specifically, regarding leisure time activities, Gunnell et al. (2011) reported that all three needs mediated the relationship between leisure time physical activity and well-being with competence being the main contributor. Since music engagement is considered an essential leisure activity as well (Mantie & Smith, 2017), it stands to reason for the present study to assume that need fulfillment might play an important role in the effect of music making on well-being as well. Specifically, as leisure

time activities can be considered a need supporting environment, rather than the absence of leisure time being a need thwarting environment (Leveresen, Danielsen, Birkeland, & Samdal, 2012), we expect that music making primarily affects the satisfaction components (i.e., is associated with higher satisfaction of autonomy, competence, and relatedness) rather than the dissatisfaction components (i.e., is not associated with lower dissatisfaction of autonomy, competence, and relatedness).

With regard to competence, music engagement can support fulfillment in setting achievable goals, for example, to perform a Mozart piano concerto or master jazz improvisation, as well as learning the strategies required to achieve them, for example, practicing difficult parts or expanding knowledge about harmonies. In line with this reasoning, Hylton (1981) investigated high school choirs and found the rewarding experience through music to be a byproduct of achievement, and the resulting self-esteem to contribute to positive feelings. Another aspect this study emphasizes is that music making usually occurs in a context of numerous relationships, including music ensembles, teachers, parents, or peers. Thus, music engagement can also aid to fulfill the need for relatedness. Boer and Abubakar (2014) found music rituals within families and peers in Kenya, the Philippines, New Zealand, and Germany to be consistently and strongly related to family and peer cohesion. However, music not only strengthens bonding of existent networks, but also naturally supports social connectedness through new relationships (Evans, McPherson, & Davidson, 2013). Concerning the association of autonomy fulfillment and musical engagement, research has been exclusively carried out within music education. A study by MacIntyre and Potter (2013) found that guitar players experience more autonomy than piano players possibly due to the lack of rigidity and formality in guitar teaching. Music making especially in leisure time provides opportunities for the individual to realize a self-endorsed life because of the great amount of volitional and self-determined choices, for example,

through selection of instrument, teacher, music genre and pieces. Taken together, these considerations suggest that music engagement might represent a need supporting context that facilitates the fulfillment of the three basic psychological needs for autonomy, competence, and relatedness.

### **The Present Study**

With the present research we aimed to examine if music making among hobby musicians in their daily lives is associated with higher affective well-being. We investigated this research question both on the between-person (“Do hobby musicians who on average engage in music making more often report higher average affective well-being?”) and the within-person level of analysis (“Do hobby musicians report higher affective well-being on days on which they engage in music making?”). Building on previous research demonstrating positive effects of leisure activities and music related activities, we hypothesized a positive effect of music making on affective well-being (higher positive and lower negative affect) at the between-person and the within-person level. Additionally, we investigated fulfillment of the basic psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2017) as potential mediators of this effect. Considering music making as an opportunity for need supportive experiences, we expected that the positive effect of music making on affective well-being would be primarily mediated via satisfaction rather than dissatisfaction of the three needs.

## **Methods**

### **Participants and Procedure**

Participants were recruited via contacting hobby and university orchestras, choirs and bands in Germany asking them to spread the study’s invitation to their members by sending an e-mail or handing out the printed version. The same invitation was also posted in online

musician forums. To be included in the study, participants should be actively engaged in music making at least once a week. Participants signed up for the study by sending an e-mail to the corresponding author and received confirmation and more information on the study schedule. As an incentive, participants could obtain an individual feedback when they completed at least 80% of the daily questionnaires (participants received their well-being levels on days with vs. without music making, as well as individual feedback on their personality assessed via the Big Five; see below for measurements). After the recruitment period had ended, an e-mail with an online link to the baseline questionnaire which lasted about 25 minutes was sent to all participants. A week after the last participant had filled in the baseline questionnaire, daily assessments over a period of 10 consecutive days began. Daily assessments started on a Friday in order to obtain a (roughly) balanced number of weekdays and weekends in the study course. Each day at 7 pm, participants received an e-mail containing the link to a 5- to 10-minute survey. They were told to complete the survey before going to bed on the same day. The link was deactivated at 6 am. In total, 1,205 participants (65.2% female), aged 10 to 82 ( $M = 39.7$ ,  $SD = 17.7$ ), filled in at least one questionnaire, whereas 351 (29.1%) finished all 11 questionnaires<sup>2</sup>.

**Sample for analysis.** Of the initial 1,205 participants, 79 did not fill in any of the daily questionnaires. All participants were asked which of the following statements best described their musical activities: (a) “earning one’s living exclusively or mainly by music making”; (b) “partially earning money by music making, but mainly employed elsewhere”; or

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<sup>2</sup> Sample size was not determined in an a-priori fashion because power analysis in a multilevel setting would require knowledge of (or good estimates for) a multitude of (co-)variances on both the within-and the between-person level (Bolger, Stadler, & Laurenceau, 2012). With regard to Level-1 sample size, we chose ten days due to practical constraints: Since no financial compensation could be offered to study participants, we intended to keep the observation period short in order to avoid study drop out due to loss of interest. Ten days had the advantage of capturing a (roughly) even number of weekdays and weekend days and have been used in previous daily diary research investigating the effects of need (dis)satisfaction on well-being (Neubauer, Lerche, & Voss, 2018). Regarding Level-2 sample size, we aimed at compensating for Level-1 sample size in terms of power and aimed to recruit at least 400 participants. However, we did not stop recruitment after this number had been reached and kept recruiting until one week before the (predetermined) start of the daily diary phase.

(c) “making music without intention to earn money”. The 84 participants choosing option (a) were considered professional musicians and therefore excluded from all further analyses. This yielded a final sample of 1,042 participants (65.3% female), aged 13 to 82 ( $M = 39.9$ ,  $SD = 17.6$ ), who self-identified as hobby musicians. Of the potential 10,420 daily observations ( $N$  participants  $\times$  ten days), 8,045 were obtained, yielding an average compliance of 77.2%. The majority of participants was German (94.9%) and belonged to a well-educated middle class: 57.1% reported having a college degree and nearly half of the sample was in employment (47%). Most of the participants were married or in a relationship (62.5%). With regard to the musical background, participants on average had played their instrument for 22.1 years ( $SD = 15.42$ ,  $median = 17$ ) with 5.5 years of music training ( $SD = 4.6$ ,  $median = 5$ ). On a 5-point scale (1 = *less than 2 times a month*, 2 = *once a week*, 3 = *every 2-3 days*, 4 = *daily*, 5 = *several times daily*), they reported playing their instrument on average between one and three times a week ( $M = 2.73$ ,  $SD = 0.8$ ), with a mean duration of a musical activity of 71.4 minutes ( $SD = 44$ ,  $median = 60$ ;  $min = 0$ ;  $max = 540$ ).

During the daily assessments, participants were engaged in music making on average on 5.4 out of 10 days ( $SD = 2.8$ ,  $median = 5$ ). They mostly played the violin (15.8%), followed by piano (13%) and voice (11.1%). On days on which participants engaged in music making, they reported that their music activity lasted for 85.6 minutes on average ( $SD = 76.4$ ,  $median = 60$ ;  $min = 1$ ;  $max = 606$ ) with a modal value of 30 minutes. Most of the time, they practiced music alone (58.8%), but rehearsals in music groups were also frequent (22%). About half of the time, Classical music was played (50.4%); the second most frequent genre played was Rock/Pop (12.1%).

### **Measurements**

**Music making.** On each day, participants were asked about their music making using the question: “Did you actively make music today?” Responses were coded as a dichotomous item (“no” coded as 0, “yes” coded as 1).

**Psychological need fulfillment.** Need fulfillment was assessed using a German Version (Neubauer & Voss, 2016) of the Balanced Measure of Psychological Needs scale (BMPN; Sheldon & Hilpert, 2012). Consisting of 18 items, it measures satisfaction and dissatisfaction of the needs for autonomy (e.g., “My choices expressed my ‘true self’”), competence (e.g., “I took on and mastered hard challenges”), and relatedness (e.g., “I felt a strong sense of intimacy with the people I spent time with”). This scale showed good psychometric properties in a prior daily diary study (Neubauer & Voss, 2018). Participants evaluated on a 7-point Likert scale to what degree each statement applied to them with respect to the present day (ranging from *not at all* to *completely*). Internal consistencies were computed as multilevel coefficient alphas using Geldhof, Preacher, and Zyphur’s (2014) approach (see Table 1). Between-person alphas indicated good consistencies for all scales ( $\alpha$  from .85 to .97); the within-person estimates were in a lower range ( $\alpha$  from .64 to .83).

**Positive and negative affect.** We used the German version (Krohne, Egloff, Kohlmann, & Tausch, 1996) of the Short Form of the Positive and Negative Affect Schedule (I-PANAS-SF; Thompson, 2007) to assess positive and negative affect with five items each. Participants rated on a 5-point Likert scale from *very slightly* to *extremely* how often they experienced a certain affect during the day, for example, “anxious” or “active”. As can be seen in Table 1, internal consistencies were good at the between-person level ( $\alpha$  from .88 to .92) and again lower at the within-person level ( $\alpha$  from .63 to .80).

**Covariates.** Covariates were chosen due to their previous reported impact on need fulfillment and/or well-being (Bucher, Neubauer, Voss, & Oetzbach, 2018; Diener & Suh, 2000; Dwan & Ownsworth, 2017; Neubauer & Voss, 2016; Seligman, 2011; Stevenson &

Wolfers, 2009). On the between-person level, covariates included the baseline variables *age*, *gender* (coded 0 for male and 1 for female), and *relationship status* (single, in a relationship, married, separated/divorced, widowed) as well as the Big Five personality traits *openness*, *conscientiousness*, *extraversion*, *agreeableness* and *neuroticism*, as measured through 21 items by the Short Form of the Big Five Inventory (Rammstedt & John, 2005). Reliability of the Big five scales in the present study was  $\alpha = .69$  (openness),  $\alpha = .71$  (conscientiousness),  $\alpha = .83$  (extraversion),  $\alpha = .65$  (agreeableness), and  $\alpha = .75$  (neuroticism). Furthermore, *stress* was assessed daily with the item “How stressed did you feel today?” on a 5-point Likert scale from *very slightly* to *extremely*.

### Data Analysis

In daily diary designs like that of the present study, the repeated measurements are commonly viewed as hierarchical data where daily observations (Level 1) are nested within individuals (Level 2). Multilevel models (MLM) take this data structure into account and partition the variance of a variable into a within and between component (Asparouhov & Muthén, 2006). Addressing mediation hypotheses with clustered data using MLM has proven to be controversial, therefore Preacher, Zhang, and Zyphur (2011) recommend multilevel structural equation modeling (ML-SEM). ML-SEM allows examining the associations among constructs on the latent level by separating measurement error from true scores on both the between-person and the within-person level. Further, through ML-SEM relations among many variables and a simultaneous estimation of parameters at different levels become possible, avoiding the conflation of between-person and within-person effects and attenuating biases of the indirect effect (Preacher, Zyphur, & Zhang, 2010). In the present study, ML-SEM provided the framework for (a) multilevel confirmatory factor analysis for testing the measurement model of the latent variables (satisfaction and dissatisfaction of each need as well as positive and negative affect), (b) multilevel linear regression analyses of each of the



latent variables on (manifest) music making to examine bivariate associations of music making with the latent constructs and (c) multilevel mediation analysis of music making on positive and negative affect via satisfaction and dissatisfaction of each need.

Since all of these variables were assessed at level 1 (within-person), a 1-1-1 mediation model with random intercepts and fixed slopes was calculated on each within- and between-person level, corresponding to Model I in the terminology introduced by Preacher et al. (2010). Level-specific covariates were included for the mediation analysis as following: age, gender, relationship status (entered as four dummy variables with “single” as the reference category), the Big Five, and stress were added as covariates on the between-person level. Stress and day of week (coded 0 for weekday and 1 for weekend) were added on the within-person level. Figure 1 depicts the relevant regression path coefficients for the study hypotheses. Within each level, residual covariances were modeled between dissatisfaction and satisfaction of each corresponding need, between all satisfaction scales as well as all dissatisfaction scales, and between positive and negative affect. Multilevel structural equation models were estimated using Mplus 6.11 (Muthén & Muthén, 1998-2011); parameters were obtained via robust maximum likelihood estimation (MLR). Model fit was evaluated via the root means square error of approximation (RMSEA), the comparative fit index (CFI), and the standardized root mean squared residual (SRMR). Mediation hypotheses were tested via inspection of the statistical significance of the indirect effects (these were obtained via the MODEL INDIRECT command in Mplus). Data and analysis scripts can be retrieved from <https://osf.io/fpg9e/>.

## Results

Table 2 contains within- and between-person descriptive statistics and correlations of the variables used (a full correlation table including the covariates can be found in Appendix A in the Supplementary Online Material). In general, participants reported higher scores on

positive affect and satisfaction scales in comparison to negative affect and dissatisfaction scales. Both within- and between-person (manifest) correlations altogether indicated relationships as hypothesized: The satisfaction scales, positive affect and music making were positively correlated among each other. Negative associations were found with the dissatisfaction variables and negative affect which correlated positively among each other. Intra-class correlations of .21 and larger imply that more than 20 % of variability in these variables could be attributed to inter-individual differences and thus support multilevel modeling as an appropriate strategy.

### **ML-SEM on Music Making**

The measurement model of the latent variables (satisfaction and dissatisfaction of each need as well as positive and negative affect) yielded adequate model fit (CFI = .89, RMSEA = .04, SRMR<sub>within</sub> = .05, SRMR<sub>between</sub> = .07). All loadings of items on their designated factors were statistically significant. Next, separate multilevel regression analyses for each of the eight latent variables on music making were computed. In these models, the outcome was predicted by music making on both the between-person level and the within-person level. No covariates were included in these models to examine the zero-order association between the latent construct and music making. Model fit was satisfactory for positive affect, need satisfaction and need dissatisfaction. For negative affect, model fit was below the cut-offs that are typically deemed acceptable (CFI = .63, RMSEA = .11, SRMR<sub>within</sub> = .10, SRMR<sub>between</sub> = .11). Modification indices suggested adding a covariance between the residuals for item 1 (“hostile”) and item 2 (“annoyed”) on the within-person level. After these modifications, model fit improved substantially and was deemed acceptable (CFI = .92, RMSEA = .05, SRMR<sub>within</sub> = .04, SRMR<sub>between</sub> = .08). Hence, in all of the following models, this residual covariance has been freely estimated. Results can be found in

Table 3.<sup>3</sup> At both the within- and between-person level, music making predicted positive affect and all satisfaction scales in a positive direction, whereas negative affect and dissatisfaction scales (except competence dissatisfaction) were predicted in a negative direction. Overall, the amount of explained variance was in a small to medium range ( $R^2 < 9\%$ ).

### Mediation Analysis

The mediation model yielded adequate model fit (CFI = .89, RMSEA = .03, SRMR<sub>within</sub> = .04, SRMR<sub>between</sub> = .05). All path coefficients relevant for the mediation of music making on positive and negative affect via need satisfaction and dissatisfaction are reported in Table 4 analogous to Figure 1. Estimates of covariates can be found in the Supplementary Online Material (Appendix B). Results showed that, after controlling for the covariates, music making predicted satisfaction of the needs for autonomy, competence and relatedness at the within- and between-person level (with the exception of the within-person effect on relatedness satisfaction which failed to reach significance,  $p = .07$ ). However, there were no statistically meaningful effects of music making on need dissatisfaction (see path *a*). In turn, positive affect on the within-person level was predicted by satisfaction and dissatisfaction of autonomy and competence, but not relatedness. On the between-person level, autonomy satisfaction, competence satisfaction and dissatisfaction, and relatedness satisfaction were significantly associated with positive affect in the hypothesized direction. For negative affect, only the effects of competence dissatisfaction and relatedness dissatisfaction were statistically significant (the latter effect on the within-person level only). After controlling for mediators and covariates, there were no statistically significant direct

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<sup>3</sup> Note that these analyses would be expected to yield similar results as the correlations reported in Table 2. The main difference between these results and the correlations in Table 2 is that results in Table 3 are based on latent variable modeling which—given correct model specification—removes error variance from the true score variance in positive affect, negative affect, need satisfaction and need dissatisfaction.

effects of music making on positive or negative affect on either the within- or the between-person level (see path  $c'$ ).

Indirect effects of music making on positive and negative affect via need satisfaction and dissatisfaction can be seen in Table 5. As expected, the effect on positive affect was mediated by satisfaction of all three needs ( $p < .05$ ), with autonomy and competence at both the within- and between person level and relatedness only at the between-person level. In summary, results suggest that the positive effect of music making on positive affect on the within-person level is mediated via autonomy satisfaction and competence satisfaction. On the between-person level, the effect of music making on positive affect was mediated via satisfaction of all three needs. There was no evidence for mediation via need dissatisfaction. Further, after controlling for the covariates, no statistically significant effects of music making on negative affect were observed.

### Discussion

The present study investigated the effect of music making on affective well-being in hobby musicians' everyday lives. Building on previous research demonstrating positive effects of leisure activities (Kuykendall et al., 2015) and music in general (Weinberg & Joseph, 2016) on well-being, we hypothesized a positive effect of music making on affective well-being in terms of higher positive affect and lower negative affect both on the between-person and the within-person level of analysis. In addition, we examined fulfillment of the basic psychological needs for autonomy, competence, and relatedness (Ryan & Deci, 2017) as potential mediators of this effect and expected a mediation primarily by satisfaction rather than dissatisfaction of the needs. The daily diary study design and large sample size provided a solid framework for addressing these research questions.

In line with the hypotheses, multilevel structural equation models revealed positive associations of music making with positive affect and need satisfaction scales, and negative

associations with negative affect and dissatisfaction scales on both the within- and between-person level. This extends previous cross-sectional research relating music making to higher affective well-being (e.g., Weinberg & Joseph, 2016) and higher need satisfaction (Evans, McPherson, & Davidson, 2013) to possible conclusions about a positive effect of music making in everyday life: Our findings showed that days on which participants were more likely to engage in music making were days with higher affective well-being, higher satisfaction of the needs for autonomy, competence, and relatedness, and lower dissatisfaction of the needs for autonomy and relatedness. While statistically significant, the observed associations were small ( $R^2$  less than 5% on the within-person level; see Table 3), which is consistent with a recent systematic review on the effects of music interventions on well-being (Daykin et al., 2018). However, small effect sizes are not surprising given that day-to-day fluctuations in affective well-being can be expected to be associated with many factors of which music making is but only one. In the present study, after controlling for a set of covariates (see Table 4), only the effects of music making on positive affect (at the within-person level) and on satisfaction of autonomy, competence, and relatedness (for the latter only at the between-person level) remained statistically significant. Hence, there were no unique effects of music making on negative affect or need dissatisfaction.

With this study, we also aimed to better understand potential mediating mechanisms of the effect of music making on affective well-being. Within the framework of SDT (Deci & Ryan, 2000; Ryan & Deci, 2017) fulfillment of the basic psychological needs for autonomy, competence, and relatedness is understood as the central predictor for psychological integrity and well-being. Based on this account, we hypothesized that music making might be associated with higher affective well-being because it provides hobby musicians with the opportunity to attain fulfillment of these three needs in their day-to-day lives. Given the lack of unique effects of music making on negative affect and need dissatisfaction, there was no

evidence for a mediated effect of music making on negative affect (neither via need satisfaction nor via need dissatisfaction). For positive affect, however, results were consistent with a mediation via need satisfaction: On the within-person level, the effect of music making on positive affect was mediated via satisfaction of the needs for autonomy and competence. This is consistent with the idea that days on which participants engage in music making are days with higher positive affect because these are days on which participants' needs for autonomy and competence are more fulfilled. Of note, there was no indirect effect via relatedness satisfaction. This lack of effect might be explained by the finding that about half of the music episodes reported by our study participants were times at which they engaged in music making on their own: When making music without other individuals being present, music making is not expected to be associated with greater feelings of relatedness towards other individuals. In fact, when being alone during practicing, music making might actually reduce feelings of relatedness on the respective day (because the time spent practicing alone cannot be allocated to spend time with other important people) leading, on average, to a null association between music making and relatedness satisfaction.

On the between-person level, there was some evidence for a mediation of the effect of music making on positive affect via satisfaction of all three needs. Whereas the total effect of music making on positive affect was not statistically significant on the between-person level after covariates had been added (see Table 4), all three indirect effects were statistically meaningful (Table 5). In line with current recommendations in the literature (e.g., Hayes, 2013), we based our findings regarding the mediation effect on the presence of a statistically meaningful indirect effect, rather than on the causal step approach (Baron & Kenny, 1986) which would require a statistically significant direct effect. In light of these considerations, our results provide evidence for a mediation of the effect of music making on positive affect via need satisfaction. This pattern of indirect effects is in line with the idea that participants

who engage in music making more often report higher positive affect because their needs for autonomy, competence, and relatedness are, on average, more satisfied. These findings supplement other cross-sectional research that has yielded evidence for the mediation of psychological need fulfillment in leisure activities (e.g., leisure time physical exercise; Gunnell et al., 2011).

### **Music Making as a Path to the Bright Side of Life**

Our results indicate that the benefits of music making primarily lie in enhancing need satisfaction and positive emotions rather than ameliorating need dissatisfaction and negative emotions. This is in line with previous research that has reported data suggesting that music especially contributes to happiness and positive affective states (Lamont, Eerola, van Goethem, & Sloboda, 2011; North, Hargreaves, & Hargreaves, 2004). Music may thus function rather as a resource for positive emotional states than a buffer against negative experiences. Hence, in terms of the distinction between need supporting and need thwarting conditions, music making can be understood as a need supporting opportunity in hobby musicians' daily lives. Correspondingly, Positive Psychologists like Martin Seligman have argued for decades to strengthen the positive side of life and find what makes peoples' lives fulfilling, not only what relieves misery (Seligman, 2011). The key elements of Seligman's concept of human flourishing (positive emotions, engagement, relationships, meaning and accomplishment; Seligman, 2011) overlap substantially with the main outcomes of music making in the present study. Music making in everyday life thus may represent one of the enabling conditions of individuals' flourishing.

Our findings further highlight the importance of distinguishing between need satisfaction and need dissatisfaction. On a psychometric level, this differentiation has been supported by a multitude of prior research (e.g., Neubauer & Voss, 2016; Tóth-Király et al., 2018). On a theoretical level, need satisfaction and need dissatisfaction (with the latter often

being referred to as need frustration) have been termed the “bright” and “dark” side, respectively, of human existence (Ryan & Deci, 2000; Vansteenkiste & Ryan, 2013). Since SDT strongly emphasizes the active, growth-oriented nature of the human organism with a propensity toward well-being and optimal functioning (Ryan & Deci, 2000, 2017), the tendency to pursue need-satisfying environments and behaviors might be greater than the drive to diminish need-frustrating ones. According to the results of the present study, music making – a leisure activity that is chosen freely by the individual – might therefore represent such a pursuit of need satisfaction.

Need thwarting contexts further are supposed to have effects on different areas (psychopathology and ill-being) than need satisfaction (growth, integrity and well-being) (Ryan & Deci, 2000). For instance, in the sport domain, athletes report higher need satisfaction and well-being in autonomy-supporting contexts and need thwarting and ill-being in controlling environments (Bartholomew et al., 2011). The impact of music making on the bright side of life (PA, need satisfaction) instead of the dark side (NA, need dissatisfaction) suggests that music making might be a need-satisfying context for hobby musicians in their daily lives.

### **Limitations**

A number of limitations of the present work have to be acknowledged: First, statistical mediation does not provide unambiguous evidence for the causal direction. While our hypothesis that music making contributes to increased need satisfaction, which in turn contributes to higher affective well-being, was derived from past research (including experimental work) and theoretical considerations of SDT, we cannot rule out reversed causation with the current data. An alternative explanation could be that high levels of well-being increase the likelihood of individuals engaging in music. Furthermore, confounder variables might account for the observed associations, such that third variables on the



between-person and/or within-person level are causally responsible for both music making and need satisfaction / well-being. We attempted to ameliorate these concerns by including a set of covariates. Nevertheless, experimental approaches inducing music making in hobby musicians' daily lives are ultimately required to gather evidence for potential causal processes. Such studies might, for example, encourage hobby musicians on a randomized sample of study days to engage in music making on this day. Using an instrumental variable approach, such an encouragement design could be used to examine the causal effect of music making on well-being (see [blinded] for an introduction to these designs). Furthermore, future studies might consider assessing music making and well-being several times per day. This might further allow for examining the lead-lag associations between these variables within a day.

Second, the present investigation focused on hobby musicians, therefore the findings must be interpreted within this specific population. Although results indicate a positive effect of active music making on their well-being, they cannot provide conclusions about other forms of music engagement or about the effects of music making in non-musicians in general. Further studies could compare hobby musicians with other samples, for example, people who listen to music or engage in a different hobby, like sports.

Third, although fairly large, the sample of the present study was a convenience sample and it is probably not representative of all hobby musicians. Furthermore, the sample size at Level 1 was relatively small (ten days), and longer observation periods might be necessary to gather a more thorough impression of our study participants' daily lives.

Fourth, our results do not address the question what the 'active ingredients' in the beneficial effect of music making are. It would be worthwhile to better understand, when music making is particularly effective in enhancing need satisfaction and well-being. For example, based on SDT, it can be expected that music making that is intrinsically motivated might have larger effects than music making that is being perceived as forced upon oneself

(in the latter case, music making might actually undermine well-being by increasing autonomy dissatisfaction). Future research should consider ‘zooming in’ on the episodes of music making, by systematically collecting situational variables before, during, and after the music making episode.

Fifth, we acknowledge that there are different instruments available for the measurement of need fulfillment (e.g., the more recently developed scale by Chen et al., 2015). Although we would not expect that such measures would produce different results, future research might consider replication of our findings using different scales. Additionally, we assessed general well-being and need fulfillment (i.e., the overall experiences of the whole day). We considered a general measure of need fulfillment as more appropriate, given our interest in investigating need fulfillment as mediating the effect of music making on well-being. Future research might consider using domain specific measures (assessing need fulfillment during music vs. a control activity) to examine whether domain-specific need fulfillment might moderate the effect of music making (vs. a control activity) on affective well-being.

Sixth, due to the emotion inducing component of music, the present study focused exclusively on affective well-being as the main outcome. How music making and need fulfillment might affect other well-being domains like satisfaction with life, eudaimonic well-being or vitality need to be further explored in future studies.

## **Conclusions**

Music making was positively associated with satisfaction of the basic psychological needs for autonomy, competence, and relatedness, as well as positive affect in a sample of hobby musicians. There were no unique effects of music making on need dissatisfaction and negative affect. Utilizing a daily diary design, the present study examined these effects on both the between-person and the within-person level of analysis. At the between-person level,

satisfaction of all three needs mediated the effect of music making on positive affect. At the within-person level, only autonomy and competence emerged as mediators of the music making - positive affect link. Our findings emphasize the importance of differentiating between the “bright” (satisfaction) and “dark” (dissatisfaction) side of need fulfillment.

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Table 1

*Within- and Between-Person Reliability Coefficients*

		$\alpha_{\text{within}}$	$\alpha_{\text{between}}$
Positive Affect		.80	.92
Negative Affect		.63	.88
Autonomy	Sat.	.67	.85
	Dis.	.64	.86
Competence	Sat.	.78	.94
	Dis.	.66	.92
Relatedness	Sat.	.83	.97
	Dis.	.64	.91

*Note.* Following Geldhof et al. (2014), variances and covariances of the items were calculated at the between- and within-person level. Next, Cronbach's  $\alpha$  was determined as

$$\alpha = \frac{n^2 \bar{\sigma}_{ij}}{\sigma_x^2}$$

with  $n$  as the number of items belonging to one scale,  $\bar{\sigma}_{ij}$  as the average covariance of the items belonging to one scale, and  $\sigma_x^2$  as the variance of the scale score (the sum of the item variances plus two times the item covariances). Sat. = Satisfaction. Dis. = Dissatisfaction.

Table 2

*Summary of Within- and Between-Person Correlations and Descriptive Statistics*

					Autonomy		Competence		Relatedness		<i>M</i>	<i>SD</i>
		Music Making <sup>a</sup>	Positive Affect	Negative Affect	Sat.	Dis.	Sat.	Dis.	Sat.	Dis.		
Music Making <sup>a</sup>		-	.13	-.18	.25	-.16	.14	-.12	.13	-.14	0.54	0.23
Positive Affect		.13	-	-.33	.54	-.30	.50	-.44	.52	-.29	3.55	0.50
Negative Affect		-.05	-.13	-	-.42	.65	-.07	.70	-.32	.63	1.51	0.39
Autonomy	Sat.	.17	.39	-.31	-	-.55	.42	-.43	.54	-.37	5.09	0.70
	Dis.	-.05	-.15	.46	-.48	-	.02	.69	-.31	.64	2.43	0.81
Competence	Sat.	.10	.39	-.01	.20	.09	-	-.11	.37	-.03	3.91	0.80
	Dis.	-.01	-.25	.46	-.31	.42	-.13	-	-.33	.72	2.29	0.72
Relatedness	Sat.	.04	.25	-.19	.40	-.23	.10	-.29	-	-.35	5.54	0.75
	Dis.	-.03	-.13	.39	-.22	.34	-.08	.32	-.20	-	1.91	0.64
<i>SD</i>		0.44	0.60	0.45	0.88	0.99	1.13	0.96	0.96	0.93	-	-
<i>ICC</i>		.22	.42	.42	.39	.40	.33	.36	.38	.32	-	-

*Note.* Table depicts within- and between-person correlation coefficients as well as between-person means and within- and between-person standard deviations. Values in the upper diagonal refer to the between-level, values in the lower diagonal to the within-level. Sat. = Satisfaction. Dis. = Dissatisfaction. ICC = Intra-class correlation.

<sup>a</sup>no music = 0; music = 1.

Table 3

*ML-SEM on Music Making*

		Within			Between			Model fit		
		Estimate	95% CI	$R^2$	Estimate	95% CI	$R^2$	RMSEA	CFI	SRMR within, between
PA		<b>.142***</b>	[.115; .169]	.020	<b>.133**</b>	[.051; .215]	.018	0.027	0.989	0.017,0.017
NA <sup>a</sup>		<b>-.048**</b>	[-.078; -.018]	.002	<b>-.185***</b>	[-.272; -.097]	.034	0.054	0.916	0.040,0.083
Aut	Sat.	<b>.221***</b>	[.189; .252]	.049	<b>.293***</b>	[.210; .376]	.086	0.034	0.989	0.016,0.023
	Dis.	<b>-.066***</b>	[-.096; -.035]	.004	<b>-.156***</b>	[-.242; -.071]	.024	0.017	0.997	0.008,0.025
Com	Sat.	<b>.115***</b>	[.086; .144]	.013	<b>.140**</b>	[.050; .230]	.020	0.016	0.999	0.006,0.019
	Dis.	-.012	[-.040; .017]	.000	<b>-.122**</b>	[-.209; -.034]	.015	0.013	0.998	0.009,0.006
Rel	Sat.	<b>.035*</b>	[.007; .062]	.001	<b>.135**</b>	[.052; .219]	.018	0.011	0.999	0.005,0.014
	Dis.	<b>-.041**</b>	[-.070; -.013]	.002	<b>-.128**</b>	[-.219; -.037]	.016	0.015	0.997	0.006,0.023

*Note.* Table depicts standardized effects and confidence intervals for the effect of music making on latent outcomes on the within- and between-person level plus the model fit statistics. PA = Positive Affect. NA = Negative Affect. Aut = Autonomy. Com = Competence. Rel = Relatedness. Sat. = Satisfaction. Dis. = Dissatisfaction.

<sup>a</sup>One residual covariance on the within-person level was freely estimated to attain acceptable model fit.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

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Table 4

*Path Coefficients of the Mediation Model (ML-SEM) of the Effect of Music Making on Positive and Negative Affect via Need Satisfaction and Need Dissatisfaction*

			a: X→M	b: M→Y		c':	c
<b>X: Music Making</b>				Y <sub>1</sub> : PA	Y <sub>2</sub> : NA	X→Y	
			(R <sup>2a</sup> )				
<b>M<sub>1</sub>: Aut</b>	Sat.	within	<b>.194***</b>	<b>.604***</b>	-.069	-	-
		(.235)	[.164; .224]	[.468; .739]	[-.188; .050]		
	between	<b>.187***</b>	<b>.396***</b>	.015	-	-	
		(.414)	[.106; .269]	[.218; .574]	[-.129; .160]		
	Dis.	within	-.021	<b>.333***</b>	.081	-	-
		(.435)	[-.047; .005]	[.160; .513]	[-.088; .250]		
between	-.010	.163	-.212	-	-		
	(.756)	[-.081; .061]	[-.188; .513]	[-.530; .106]			
<b>M<sub>2</sub>: Com</b>	Sat.	within	<b>.119***</b>	<b>.261***</b>	.063	-	-
		(.027)	[.090; .149]	[.198; .324]	[.001; .125]		
	between	<b>.127*</b>	<b>.177***</b>	.011	-	-	
		(.156)	[.030; .224]	[.076; .278]	[-.068; .091]		
	Dis.	within	.014	<b>-.298***</b>	<b>.436***</b>	-	-
		(.158)	[-.013; .041]	[-.388; -.214]	[.339; .533]		
between	.007	<b>-.388***</b>	<b>.457***</b>	-	-		
	(.506)	[-.072; .085]	[-.597; -.179]	[.251; .663]			
<b>M<sub>3</sub>: Rel</b>	Sat.	within	.025	-.029	.026	-	-
		(.068)	[-.002; .051]	[-.090; .031]	[-.026; .078]		



	between	<b>.117**</b>	<b>.172**</b>	-.009	-	-
	(.289)	[.035; .199]	[.036; .280]	[-.097; .079]		
Dis.	within	-.022	-.036	<b>.266***</b>	-	-
	(.082)	[-.051; .006]	[-.096; .024]	[.171; .361]		
	between	-.028	.073	.134	-	-
	(.279)	[-.120; .064]	[-.092; .237]	[-.054; .322]		
<b>Y<sub>1</sub>: PA</b>	within	-	-	-	.000	<b>.137***</b>
	(.437)				[-.030; .031]	[.109; .165]
	between	-	-	-	-.038	.073
	(.585)				[-.106; .030]	[-.007; .152]
<b>Y<sub>2</sub>: NA</b>	within	-	-	-	-.011	-.018
	(.826)				[-.039; .017]	[-.045; .010]
	between	-	-	-	-.023	-.018
	(.756)				[-.085; .040]	[-.088; .052]

*Note.* Path coefficients are standardized. 95% confidence intervals are reported in parentheses. a represents the effect of music making on a mediator; b represents the effect of the mediator on Positive Affect (PA) / Negative Affect (NA); c' represents the direct effect of music making on PA/NA; c represents the total effect of music making on PA/NA (a x b + c'). Between-covariates include age, gender, relationship, extraversion, agreeableness, conscientiousness, neuroticism, openness, and stress. Within-covariates include stress and day of the week (week day vs. weekend). Results of covariates are not listed here (see Supplemental Online Material Table A1 for results of the covariates). Aut = Autonomy. Com = Competence. Rel = Relatedness. Sat. = Satisfaction. Dis. = Dissatisfaction.

<sup>a</sup>R<sup>2</sup> values include the proportion of variance accounted for by the covariates.

\**p* < .05. \*\**p* < .01. \*\*\**p* < .001.

Table 5

*Indirect Effects from Music Making on Positive and Negative Affect*

		Within		Between	
		Estimate	95% CI	Estimate	95% CI
<b>Outcome: Positive Affect</b>					
Mediators					
Aut	Sat.	<b>.117***</b>	[.085; .148]	<b>.074**</b>	[.027; .122]
	Dis.	-.007	[-.017; .002]	-.002	[-.014; .010]
Com	Sat.	<b>.031***</b>	[.020; .042]	<b>.023*</b>	[.000; .045]
	Dis.	-.004	[-.012; .004]	-.003	[-.033; .028]
Rel	Sat.	-.001	[-.002; .001]	<b>.020*</b>	[.000; .040]
	Dis.	.001	[-.001; .002]	-.002	[-.009; .005]
<b>Outcome: Negative Affect</b>					
Mediators					
Aut	Sat.	-.013	[-.036; .010]	.003	[-.024; .030]
	Dis.	-.002	[-.006; .002]	.002	[-.013; .017]
Com	Sat.	.008	[.000; .015]	.001	[-.009; .012]
	Dis.	.006	[-.006; .018]	.003	[-.033; .039]
Rel	Sat.	.001	[-.001; .002]	-.001	[-.011; .009]

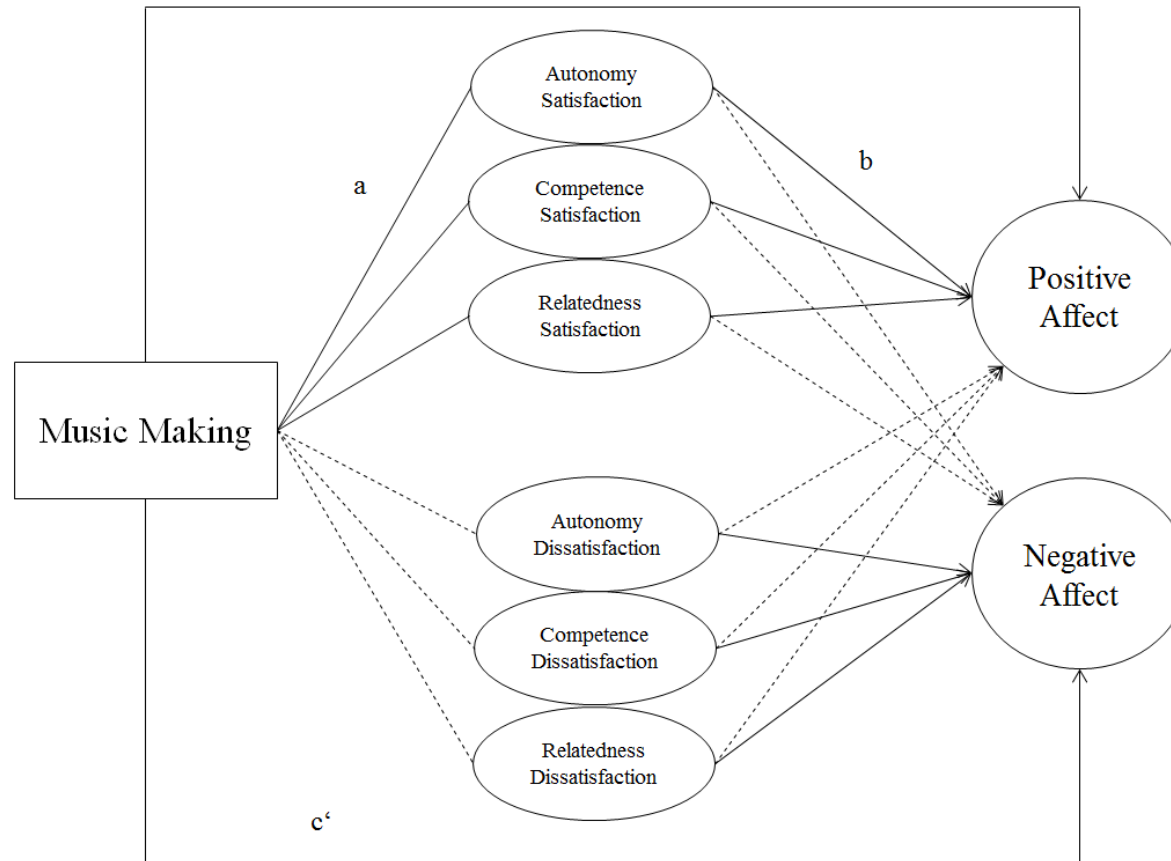
Dis.	-0.006	[-.014; .002]	-0.004	[-.018; .011]
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*Note.* Table depicts standardized indirect effects and 95% confidence intervals at the within- and between-person level. Between-person covariates include age, gender, relationship, extraversion, agreeableness, conscientiousness, neuroticism, openness, and stress. Within-person covariates include stress and day of the week (week day vs. weekend). Aut = Autonomy. Com = Competence. Rel = Relatedness. Sat. = Satisfaction. Dis. = Dissatisfaction.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

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*Figure 1.* Postulated mediation model. a represents the effect of music making on a mediator; b is the effect of the mediator on positive affect (PA) or negative affect (NA); c' is the direct effect of music making on PA/NA after controlling for the mediators.  $a \times b$  then is the indirect effect of music making via the mediator on PA/NA. For better legibility, covariates and covariances are not included in the Figure, but they were included in the model.

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