Received: 19 August 2022 | Accepted: 24 January 2023

DOI: 10.1111/bjc.12412

RESEARCH ARTICLE

the british psychological society
promoting excellence in psychology

# Listening to a popular upbeat song can lead to more adaptive cognitive inferences for stressful events in non-clinical adult populations

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**Abstract**

**Objective:** We tested the effect of music on idiographic cognitive inferences about stressful events.

**Method:** In Study 1 ($n$ = 336), adult participants from the United States were randomly assigned to non-familiar songs that differed by lyrical content and tempo. In Studies 2 ($n$ = 302) and 3 ($n$ = 323), adult participants from the United States were randomly assigned to either a positive, neutral or no-song condition.

**Results:** The results of Study 1 failed to support any of the study hypotheses. Given the null results, we decided to conduct a second study focused on increasing external validity and power (i.e., including fewer experimental conditions). The results of Study 2 showed that adults randomly assigned to a familiar upbeat song condition experienced an increase in positive affect and a decrease in event-specific negative cognitions. A third study was then conducted to replicate the results and rule out a potential confound. Results of Study 3 corroborated the results of Study 2.

**Conclusion:** Taken together (Studies 2 and 3), results indicate it may be useful for future research to test the extent to which familiar upbeat music can be helpful during cognitive restructuring activities in psychotherapy to nudge people to generate more adaptive cognitions.

KEYWORDS
cognitive restructuring, depressive symptoms, lyrics, music, negative inferential style, tempo

  

**Practitioner points**

- Many interventions for depression (e.g., CBT) are focused on changing negative thinking patterns, but the cognitive restructuring process can be difficult to learn and implement.
- There remains a critical need for easy-to-implement and scalable strategies to facilitate the cognitive restructuring process.
- We showed that listening to a popular upbeat song of one's choosing can increase positive affect and provide a small nudge for generating more adaptive cognitive inferences about life stress.

## INTRODUCTION

Depression is a common, recurrent disorder affecting nearly 300 million people worldwide (Institute of Health Metrics and Evaluation, 2021). It is a leading cause of disability in the world and can even be lethal; it is one of the strongest predictors of suicide (Kessler et al., 1999). Additionally, depression is on the rise; there was an 18% increase in diagnoses of clinical depression between 2005 and 2015 (World Health Organization, 2017). It is critical to identify easy-to-use and scalable strategies for decreasing the risk factors that put people at high risk for the disorder.

The purpose of the current research was to determine if music could be used to mitigate cognitive risk for depression. According to the hopelessness theory of depression (Abramson, et al., 1989), some people are at particularly high risk for developing depression because of how they think about life stress. Specifically, some people have a tendency (called a “negative inferential style”) to generate overly negative inferences about the cause, consequences and self-worth implications of stressful life events. When faced with a stressful life event, an individual with a negative inferential style is likely to: (a) attribute the event to stable and global causes; (b) view the event as likely to lead to other negative consequences and (c) construe the event as implying that he or she is unworthy or deficient. Individuals who generate these three types of negative inferences are hypothesized to be at greater risk for depression than people who generate unstable, specific attributions about negative life events.

Research has provided strong support for hopelessness theory's negative inferential style hypothesis (see reviews by Haeffel et al., 2008 and Liu et al., 2015; see also Haeffel & Hames, 2014; Haeffel et al., 2017). Studies consistently show that those with high levels of negative inferential style are at greater risk for developing depressive symptoms and depressive disorders during times of stress than those who exhibit low levels of negative inferential style (e.g., Abramson et al., 1999; Alloy et al., 2006; Haeffel, 2011). Thus, it is not surprising that many interventions for depression are focused on changing these kinds of negative thinking patterns. Indeed, this is the primary goal of cognitive behavioural therapy (CBT; Beck, 1995, 2005), which is the gold standard for treating depression (Lorenzo-Luaces, 2018). Using both cognitive and behavioural strategies, the overarching goal of the treatment is for the client to understand how one's thoughts influence one's mood. The client then learns strategies to change the negative patterns of thinking that maintain their depression, a process called “cognitive restructuring.” According to Lawlor et al. (2022), cognitive restructuring is a deliberate and structured process by which clients identify and challenge the accuracy of their negative thoughts. It is typically accomplished with Socratic-style questioning from the therapist (e.g., would your friend agree with that?) as well as the use of thought and behaviour experiments. Perhaps the most common technique is for the client to serve as a “judge” for their thoughts; using thought record worksheets, the client writes down the evidence “for” and “against” negative thoughts. After considering all the evidence, they then try to generate more realistic cognitive responses (i.e., attribute stress to unstable/specific causes and infer less negative inferences about one's future and self-worth).

However, the cognitive restructuring process can be difficult to learn and implement. The negative inferential style vulnerability featured in the hopelessness theory is a highly entrenched way of thinking about one's world that is difficult to change, and altering thoughts requires cognitive resources and practice. Indeed, Haeffel and Kaschak (2019) compare changing negative inferential style to trying to learn a second language. And it is particularly difficult for people to generate less negative cognitive inferences during episodes of low mood or depression because of mood-congruent thinking (Mineka & Nugent, 1995). People in low moods are more likely to remember and attend to negative information and have difficulty accessing positive memories and information (e.g., Rusting & DeHart, 2000). Thus, there remains a critical need for easy-to-implement and scalable strategies to facilitate the cognitive restructuring process.

We hypothesize that listening to upbeat happy music may be one strategy for helping people generate less stable/global attributions and less negative inferences about their self and future. There is a large empirical literature showing that music can influence mood in both healthy and depressed samples (e.g., Groarke & Hogan, 2018; McCraty et al., 1998; Västfjäll, 2001). Music with a fast tempo generally correlates with an increase in reported positive mood (e.g., Webster & Weir, 2005), whereas music with a slower tempo often correlates with increases in reported negative mood (e.g., Murrock & Higgins, 2009). Moreover, researchers have theorized that lyrics may also be responsible for the positive effects of music. For example, the addition of positive lyrics to instrumental music led to a slight increase in reported positive mood, whereas the addition of negative lyrics to instrumental music increased reported negative mood (Ali & Peynircioğlu, 2006). Finally, there is evidence that music can directly enhance the kind of cognitive skills that are useful for cognitive restructuring. For example, fast-tempo music can increase thought speed, promote idea fluency and facilitate cognitive flexibility (Bottiroli et al., 2014; Chang & Liao, 2016; Pronin & Wegner, 2006; Schellenberg et al., 2007).

Thus, we predicted that music would provide people with an affective and cognitive "nudge" that would facilitate the generation of less stable/global attributions and less negative inferences about their self and future. This is because research shows that upbeat positive lyrical music increases positive affect, which may reduce mood-congruent negative memory bias and allow for easier access to more positive thoughts. Further, music has direct effects on idea fluency, thought speed and cognitive flexibility. It is important to note that the ability to cause even small-to-moderate reductions in negative inferences may be important, as prior work indicates that they can have important downstream implications for risk for future depressive symptoms (Haeffel & Hames, 2014).

To test our hypothesis, we used a 2 × 3 experimental design to determine the effect of tempo (fast or slow) and lyrical content (positive, negative and instrumental) on positive and negative affect as well as negative inferential style and event-specific negative cognitions for an idiographic stressful event (as conceptualized and operationalized by the hopelessness theory of depression). We chose to focus on the negative inferential style risk factor featured in the hopelessness theory of depression specifically because it is a well-articulated theory that has strong empirical support and psychometrically validated measures of negative inferences (Haeffel et al., 2008). We chose to examine both positive and negative affect because prior research supports their affective independence (i.e., positive and negative affect do not appear to be the ends of a single bipolar continuum; Dejonckheere et al., 2021). This study was pre-registered: https://osf.io/jaequ. Please note that this research was originally conceptualized as a single study. However, the results of the single study did not conform to hypotheses; thus, we conducted additional studies in order to clarify, replicate and extend the findings from the first study.

# STUDY 1 – METHOD

## Overview

We used a 2 × 3 experimental design to determine the effect of tempo (fast or slow) and lyrical content (positive, negative and instrumental) on negative inferential style, positive and negative affect and event-specific negative cognitions. We predicted that fast, positive lyrical music would lead to increases in adaptive inferences (i.e., lower negative inferential style and event-specific cognition scores), increases in positive affect and decreases in negative affect, whereas slow, negative lyrical music would lead to opposite effects.

## Power analysis

A power analysis (conducted using G*Power 3.1) with 6 groups showed that a total of 320 participants were needed to detect a small-to-medium effect size ($f = .2$) with a power of .90 and alpha level $p < .05$. The rationale for specifying a small-to-medium effect size was that if the results were to have clinical implications, then they would have to be in this range (as extremely small effect sizes would not be clinically useful).

## Participants

Participants were 336 adults from the United States, ages 18–71 (mean age = 34, $SD = 13$; 158 males, 172 females and 5 unknown). They were recruited using the Prolific online study platform (Peer et al., 2017) and completed the experiment online. All participants were from the United States to ensure similar exposure to musical genres. Sixty-six per cent of participants self-identified as White/European descent ($n = 221$), 12% Asian descent ($n = 40$), 10% Black/African descent ($n = 32$), 6% Latin/Hispanic descent ($n = 19$) and less than 4% of participants endorsed Southeast Asian descent, Native American and "other" respectively. All research procedures were fully consistent with APA ethical guidelines, and the study was approved by the University's Human Subjects Committee. Participants were paid an hourly rate of $9.50 per hour to complete the 5-minute experiment.

## Songs and measures

### Songs

The six cells of the 2 × 3 design were as follows: fast-tempo/positive lyrics ("Tell Her You Love Her"; "We Fell in Love In October"), fast-tempo/negative lyrics ("Bird With a Broken Wing"; "Frail State of Mind"), fast-tempo/instrumental, slow-tempo/positive lyrics ("2002"; "Tie Me Down"), slow-tempo/negative lyrics ("Avenue"; "Lonely Town") and slow tempo/instrumental. Two songs were chosen for each experimental cell with the exception of the no lyric conditions, which had four songs (the instrumental versions of the positive and negative lyric songs from the other conditions). Slow-tempo songs were defined as 80–100 BPM, whereas fast-tempo songs were defined as 120–140 BPM (Kellaris & Rice, 1993). The positivity/negativity of lyric content was determined by text analysis using the Linguistic Inquiry and Word Count program (LIWC; Pennebaker et al., 2015). According to the user manual of the LIWC, the "Tone" construct evaluates the emotional content of the text and a score above 50 indicates a positive emotional tone. Songs considered to have positive lyrics in the study had an average tone of 73, whereas negative lyrics songs had an average tone of 19. Finally, all songs were pilot tested ($n = 51$) to ensure that they were not significantly different with regard to recognizability. Results showed >80% of pilot participants did not recognize any of the songs, which eliminates familiarity as a confound. Most participants will be hearing these songs for the first time, which enables a more internally valid and specific test of the effects of tempo and lyrical content.

### Negative inferential style and event-specific cognitions

The Cognitive Style Questionnaire (CSQ; Haeffel et al., 2008) was used to measure the general negative inferential style featured in the hopelessness theory of depression. The CSQ is a self-report questionnaire that presents participants with 12 hypothetical negative events (six achievements and six interpersonal). Participants imagine the events happening to themselves and then make ratings on the three vulnerability dimensions featured in the hopelessness theory of depression – stability and globality, probable consequences of each event and the self-worth implications of each event. An individual's CSQ score is their average rating across these three dimensions (stability and globality, consequences and self-worth characteristics) for the hypothetical negative life events. Scores can range from 1 to 7, with higher scores reflecting greater levels of negative inferential style (the latent variable). The CSQ has demonstrated strong validity and reliability; it tends to be normally distributed, predicts future depressive symptoms in both non-clinical and clinical populations, demonstrates incremental validity and has internal consistency reliabilities greater than .80 (Haeffel et al., 2003; Haeffel et al., 2007; Haeffel et al., 2008, 2017; Hankin et al., 2004). The current study used a short version of the CSQ with three scenarios. Internal consistency for the short version of the CSQ was similar to that found for the full version; coefficient alpha for this study was .82 pre-music manipulation and .86 post-music manipulation. Test–retest reliability (pre to post) was good; $r = .56$. As in prior work, scores were normally distributed at both time points. Details about factor structure, composite reliability and method invariance for the CSQ can be found in Data S1.

Event-specific negative cognitions were measured with the Particular Inference Questionnaire (PIQ; Haeffel, 2011; Metalsky et al., 1987). Using the same format as the CSQ, the PIQ measures participants' actual (observable) inferences about cause, consequence and self-worth regarding a specific idiosyncratic event; this is different from the CSQ which uses hypothetical scenarios to assess a more general negative inferential style (latent variable). Participants are instructed to "think about the past few days" and write down "the most stressful or negative event that happened during this time." Then, they make ratings on dimensions of stability, globality, the consequences and self-worth implications of the event. Mean-item scores can range from 1 to 7, with higher scores reflecting a greater degree of event-specific negative inferences. Post-music manipulation, participants were instructed to think about the same event they had written pre-music manipulation. The PIQ has demonstrated adequate reliability (coefficient alpha ranges from .5 to .7; Haeffel et al., 2022) and strong construct validity; it tends to be normally distributed, is correlated with negative inferential style as measured by the CSQ (Haeffel, 2011) and predicts future depressive symptoms (Haeffel, 2011; Metalsky et al., 1982, 1987, 1993). Coefficient alpha for this study was .54 for both pre-music manipulation and post-music manipulation. Test–retest reliability (pre to post) was excellent; $r = 77$. As in prior work, scores tended to show a normal distribution (bell-shaped curve) at both time points.

## Positive and negative affects

The PANAS (Watson et al., 1988) was used to measure positive and negative affects. Participants rate the degree to which they feel 20 emotions "right now, that is, in the present moment" on a 5-point Likert scale (1 = "Very slightly or not at all" and 5 being "Extremely"). Scores can range from 10 to 50 with higher scores indicating higher levels of positive and negative affects respectively. The PANAS is one of the most widely used measures of positive and negative affects with strong reliability and validity (e.g., Crawford & Henry, 2004). Internal consistency for the PANAS positive and negative affect scales was similar to that found in prior work; coefficient alpha for both scales in this study was >.85 pre-music manipulation and post-music manipulation. Test–retest reliability (pre to post) for both scales was excellent; $r > .80$ for each scale. As in prior work, scores on the negative affect scale of the PANAS were extremely positively skewed (people tended to score low on negative affect). Scores on the positive affect scale were also positively skewed. Details about factor structure, composite reliability and method invariance can be found in Data S1.

## Procedure

Participants were recruited online via Prolific (Peer et al., 2017). We chose Prolific because samples tend to be more diverse and are more scientifically naive compared to other popular online platforms (Peer et al., 2017). The experiment was created and administered using Qualtrics. After consenting to participate, participants completed a short demographics questionnaire, the CSQ, PIQ and PANAS. They were then randomly assigned to one of the six experimental music conditions in which they listened to one of two randomly assigned songs in the music category to which they were assigned. They then completed the baseline measures again.

## STUDY 1 – RESULTS

We used ANCOVA to test the hypotheses (see Table 1). We conducted an ANCOVA for each dependent variable (four in total), which were post-manipulation positive affect (PANAS-Positive), negative affect (PANAS-Negative), negative inferential style level (CSQ score) and event-specific cognitions (PIQ score) respectively. Baseline scores for the dependent variables were included as covariates to control for any individual differences in initial levels of the independent variable. The independent variables were tempo (fast or slow), lyrical content (positive, negative or no lyric) and their interaction. Levene's test showed that the assumption of equality of variances was met for all analyses (all $p$-values $> .05$).

Contrary to hypotheses, there was no main effect of music condition (i.e., tempo or lyrical content) on positive affect, negative affect, negative inferential style level or event-specific cognitions respectively. There was one significant interaction effect of tempo and lyric on negative inferential style levels ($p = .046$, partial $\eta^2 = .02$); this interaction was not predicted *a priori*, and thus, our probing of the pattern of the interaction was exploratory and should be interpreted with caution. The pattern of the interaction showed that those in the fast-tempo, no lyric condition reported higher CSQ scores than those in the fast-tempo, negative lyric condition ($t = -2.75$, $p = .01$). This was the only significant *post-hoc* comparison and it was no longer significant when correcting for multiple exploratory comparisons (Tukey $p$-value = .07).

## STUDY 2 – METHOD

### Overview

All the hypotheses we tested in Study 1 were refuted. There was no main effect of tempo or lyrical content on negative inferential style, event-specific cognitions or positive and negative affects. The null results indicate that music has no effect on the variables of interest. However, we decided to conduct a second study using a "sledgehammer" approach in which we tried to optimize the study elements to such a degree that if any effect existed, then we would detect it. In Study 1, we focused on internal validity (e.g., controlling for song familiarity, using computerized assessment of lyrics, etc.) to tease apart the potential effects of tempo and lyrics on our outcomes of interest. However, there were no effects to tease apart. Thus, the purpose of Study 2 was to conduct a more powerful design for detecting *any* effect of music on cognition and mood. The rationale is that if we, again, find no effects with an optimized design, then we

**TABLE 1** ANCOVA results for study 1.

| ANCOVA – post-positive | | | | | | |
|---|---|---|---|---|---|---|
| | **Sum of squares** | **Df** | **Mean Square** | ***F*** | ***p*** | **$\eta^2$p** |
| Lyric | 5.62 | 2 | 2.81 | .163 | .850 | .001 |
| Tempo | 58.53 | 1 | 58.53 | 3.398 | .066 | .010 |
| Base Positive | 22169.94 | 1 | 22169.94 | 1287.282 | <.001 | .796 |
| Lyric * Tempo | 59.17 | 2 | 29.58 | 1.718 | .181 | .010 |
| Residuals | 5666.13 | 329 | 17.22 | | | |

**TABLE 1** (Continued)

| **ANCOVA – post-negative** | | | | | | |
|---|---|---|---|---|---|---|
| | **Sum of squares** | **Df** | **Mean Square** | ***F*** | ***p*** | **$\eta^2$p** |
| Lyric | 24.701 | 2 | 12.350 | .5257 | .592 | .003 |
| Tempo | .368 | 1 | .368 | .0157 | .901 | .000 |
| Base Negative | 16714.904 | 1 | 16714.904 | 711.4949 | <.001 | .684 |
| Lyric * Tempo | 79.053 | 2 | 39.527 | 1.6825 | .188 | .010 |
| Residuals | 7729.084 | 329 | 23.493 | | | |
| **ANCOVA – post-vulnerability** | | | | | | |
| | **Sum of squares** | **Df** | **Mean Square** | ***F*** | ***p*** | **$\eta^2$p** |
| Lyric | 2.11 | 2 | 1.057 | 1.26 | .286 | .008 |
| Tempo | 1.10 | 1 | 1.099 | 1.31 | .254 | .004 |
| Base Vulnerability | 127.12 | 1 | 127.125 | 151.22 | <.001 | .315 |
| Lyric * Tempo | 5.24 | 2 | 2.621 | 3.12 | .046 | .019 |
| Residuals | 276.58 | 329 | .841 | | | |
| **ANCOVA – post-event specific** | | | | | | |
| | **Sum of squares** | **Df** | **Mean Square** | ***F*** | ***p*** | **$\eta^2$p** |
| Lyric | .5082 | 2 | .2541 | .5074 | .603 | .003 |
| Tempo | .7118 | 1 | .7118 | 1.4214 | .234 | .004 |
| Base Event Specific | 232.9848 | 1 | 232.9848 | 465.2384 | .001 | .586 |
| Lyric * Tempo | .0653 | 2 | .0326 | .0652 | .937 | .000 |
| Residuals | 164.7585 | 329 | .5008 | | | |

can safely conclude that music does not alter the negative cognitive processes featured in the hopelessness theory of depression.

We created a more powerful study design by focusing on external validity, testing more reasonable hypotheses and having fewer conditions. Rather than using unrecognizable songs, we used familiar, critically acclaimed (Billboard Top 100), upbeat songs. We predicted that participants would respond more strongly (i.e., be more likely to experience an increase in happiness and a decrease in event-specific inferences as evidenced by a larger effect size and statistical significance) to songs that they know and tend to be liked by a lot of people (as operationalized by being at the top of the Billboard chart). Further, participants were allowed to choose the upbeat song to which they would listen (from a list of four songs). We suspect participants would choose a song that they enjoy. Second, we decided to omit the test of music on negative inferential style because this factor is a highly entrenched form of thinking (similar to a native language; Haeffel & Kaschak, 2019). In retrospect, it was likely unreasonable to hypothesize that listening to a single song could change this trait-like style. Rather, we focused on individuals' actual event-specific cognitions about a current stressful event. Finally, we simplified our experimental design to have only three conditions – popular upbeat music, popular neutral music (active control condition) and no music (non-active control condition). Study 2 was pre-registered: https://osf.io/x3rzv.

## Power analysis

An *a priori* power analysis (conducted using G*Power 3.1) with three groups showed that a total of 251 participants were needed to detect a small-to-medium effect size ($f = .25$) with a power of .95 and alpha level $p < .05$. The rationale for specifying a small-to-medium effect size was that if the results were to have clinical implications, then they would have to be in this range (as extremely small effect sizes would not be clinically useful).

## Participants

Participants were 302 adults from the United States ages 18–76 (mean age = 34, *SD* = 12; 138 males, 155 females and 9 others). They were recruited using the Prolific online study platform (Peer et al., 2017) and completed the experiment online. All participants were from the United States to ensure similar exposure to musical genres. Sixty-seven per cent of participants self-identified as White/European descent (*n* = 204), 10% of Black/African descent (*n* = 31), 9% of Asian descent (*n* = 27), 8% of Latin/Hispanic descent (*n* = 12) and less than 4% of participants endorsed Southeast Asian descent, Native American and "other" respectively. All research procedures were fully consistent with APA ethical guidelines, and the study was approved by the University's Human Subjects Committee. Participants were paid an hourly rate of $9.50 per hour to complete the 5-minute experiment.

## Songs and measures

### Songs

We chose four upbeat popular songs: "You Make My Dreams" (Hall & Oates, 1980), "Happy" (Pharrell Williams, 2014), "The Middle" (Jimmy Eat World, 2001) and "I Gotta Feeling" (Black Eyed Peas, 2009). These songs were selected for three reasons: (1) they each appeared in the top 10 of the Billboard Hot 100 between the years 1980 and 2014, (2) they each exceeded a tempo of 120 beats per minute and (3) the lyrics of each song scored above 85 on tone (LIWC; Pennebaker et al., 2015). There were three neutral songs: "Hello" (Adele, 2015), "Let Her Go" (Passenger, 2013) and "Avenue" (H.E.R., 2017). These songs were chosen because they were also popular but did not exceed 80 BPM and scored less than 50 on the LIWC Tone measure.

### Measures

We used the same measures used in Study 1 (with the exception of the CSQ). Internal consistency for the PIQ in this study was similar to that found in prior work for both pre-music manipulation (alpha = .60) and post-music manipulation (alpha = .62). Test–retest reliability (pre to post) was excellent; $r = .84$. As in prior work, scores tended to show a normal distribution (bell-shaped curve) at both time points. Internal consistency for the PANAS affective subscales was, again, similar to that found in prior work; coefficient alpha for both scales in this study was >.85 for both pre-music manipulation and post-music manipulation. Test–retest reliability (pre to post) was excellent; $r > .74$ for both subscales. Scores on the negative affect scale of the PANAS were extremely positively skewed (people tended to score low on negative affect). Scores on the positive affect scale tended to be uniform. Details about factor structure, composite reliability and method invariance for the PANAS can be found in Data S1.

## Procedure

We used the same basic procedure used in Study 1. However, in this study, participants randomly assigned to the positive song condition were allowed to choose one of the four songs to listen to in its entirety. Those randomly assigned to the neutral conditions were randomly assigned to listen to the entirety of one of the neutral songs. And those in the no-song condition were given a "2 minute" break in which they did not hear any songs.

# STUDY 2 – RESULTS

We used ANCOVA to test the hypotheses. In each of the three analyses, the independent variable was music condition (upbeat popular song, neutral song or no song). The dependent variables were post-manipulation PANAS (positive and negative affect) and PIQ (event-specific cognitions) respectively. Baseline scores for the dependent variables were included as covariates to control for any individual differences in initial levels of the independent variable. Follow-up tests used Helmert contrasts, which allowed us to test if the positive song condition differed from the two control conditions (neutral and no song); in addition, Helmert contrasts are orthogonal, which minimizes collinearity between contrasts. Levene's test showed that the assumption of equality of variances was met for the models predicting positive affect ($p = .29$) and event-specific inferences ($p$-values = .27) but not negative affect ($p = .001$; thus, we conducted both a non-parametric ANOVA and logistic regression [using median split for negative affect] to check the robustness of the ANCOVA results reported below; the significant results reported below remained significant for both the non-parametric ANOVA [$F = 11.90, p < .001$] and logistic regression [Wald = 11.78, $p = .003$]).

Results showed a large main effect of music condition on positive affect ($F[2, 298] = 22.00, p < .001, \eta^2 = .13$). As shown in Figure 1, participants randomly assigned to the popular upbeat song condition reported significantly greater positive affect ($M = 30.2$, $SE = .52$) than those in the neutral ($M = 26.4$, $SE = .52$) and no-song conditions ($M = 25.6$, $SE = .53$; Helmert contrast: $t = 6.56, p < .001$). There was no difference in positive affect between the neutral and no-song conditions ($p = .27$). Fifty-eight per cent of participants in the upbeat song condition reported an increase in positive affect compared to 27% and 19% in the neutral and no-song conditions respectively.

Results also showed a medium-sized main effect of music condition on negative affect ($F[2, 298] = 14.10, p < .001, \eta^2 = .09$). As shown in Figure 1, participants randomly assigned to the popular upbeat song condition reported significantly less negative affect ($M = 13.0$, $SE = .36$) than those in the no-song condition ($M = 15.6$, $SE = .37$) and neutral song conditions ($M = 13.7$, $SE = .36$, Helmert contrast: $t = -3.70, p < .001$). However, a simple contrast test showed no difference between the positive and neutral song conditions. Participants in the neutral condition reported significantly less negative affect than those in the no-song condition (Helmert contrast: $t = -3.84, p < .001$). Thirty-six per cent of participants in the upbeat song condition reported a decrease in negative affect compared to 37% and 15% in the neutral and no-song conditions respectively.

Finally, there was a small, but significant, main effect of music condition on event-specific inferences ($F[2, 298] = 3.74, p = .02, \eta^2 = .024$). As shown in Figure 1, participants randomly assigned to the popular upbeat song condition reported significantly less negative event-specific inferences ($M = 3.27$, $SE = .07$) than those in the neutral ($M = 3.52$, $SE = .07$) and no-song conditions ($M = 3.49$, $SE = .07$; Helmert contrast: $t = -2.72$, $p = .007$). There was no difference between the neutral and no-song conditions ($p = .81$). Forty-five per cent of participants in the upbeat song condition reported a decrease in negative event-specific inferences compared to 32% and 31% in the neutral and no-song conditions respectively.

*Post-hoc* exploratory analyses showed the same pattern of findings for negative affect ($F[2, 146] = 13.00, p < .001, \eta^2 = .08$), positive affect ($F[2, 146] = 6.26, p = .002, \eta^2 = .02$) and event-specific inferences ($F[2, 146] = 3.17, p = .04, \eta^2 = .01$) when only including those with initially high levels of negative affect (determined by median split).

# STUDY 3 – METHOD

## Overview

In Study 2, we found that listening to a self-selected popular upbeat song could increase positive affect (~5 point increase on the PANAS) and lead to more adaptive inferences (~ quarter of a point) about a real-life stressful event. However, a confound in Study 2 was that the positive song condition contained

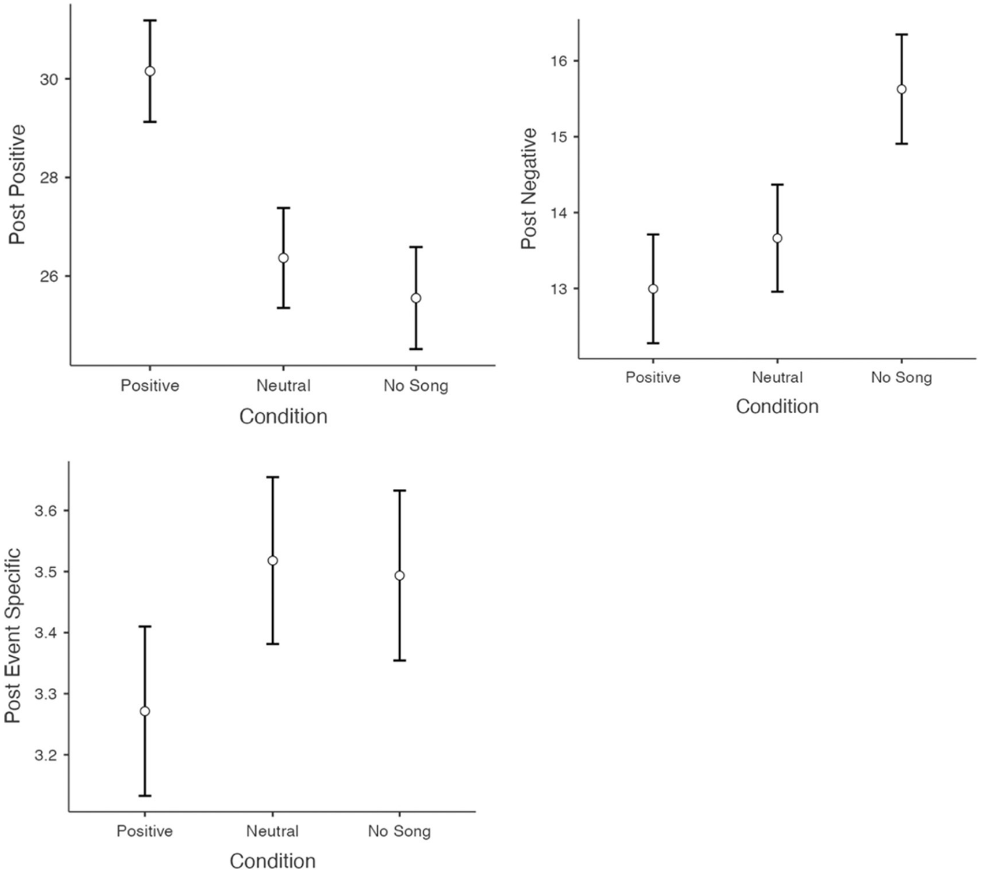


**FIGURE 1** Effect of music condition on negative affect, positive affect and event-specific negative inferences controlling for baseline levels of the dependent variable. Error bars are confidence intervals.

the element of "choice," whereas the neutral song condition did not. The only variable that should differ between conditions is song type (all other factors should be held constant across conditions; further, there is at least some research to indicate that having a small number of choices can increase happiness [Markus & Schwartz, 2010]). The purpose of Study 3 was to eliminate this alternative explanation for the finds and to replicate Study 2. Study 3 was pre-registered: https://osf.io/h9fxt.

## Power analysis

An *a priori* power analysis (conducted using G*Power 3.1) with three groups showed that a total of 251 participants were needed to detect a small-to-medium effect size ($f$ = .25) with a power of .95 and alpha level $p < .05$. The rationale for specifying a small-to-medium effect size was that if music was to have potential clinical implications, then they would have to be in this range (as extremely small effect sizes would not be clinically useful).

## Participants

Participants were 323 adults from the United States ages 18–76 (mean age = 35, *SD* = 13; 153 males, 164 females and six others). They were recruited using the Prolific online study platform and completed the experiment online. All participants were from the United States to ensure similar exposure to musical genres. Sixty-seven per cent of participants self-identified as White/European descent ($n$ = 217), 10% Asian descent ($n$ = 33), 8% Black/African descent ($n$ = 26), 7% Latin/Hispanic descent ($n$ = 24) and <4% of participants endorsed Southeast Asian descent, Native American, Hawaiian and "other" respectively. All research procedures were fully consistent with APA ethical guidelines, and the study was approved by the University's Human Subjects Committee. Participants were paid an hourly rate of $9.50 per hour to complete the 5-minute experiment.

## Materials

We used the same songs and measures featured in Study 2. Internal consistency for the PIQ in this study was similar to that found in prior work for both pre-music manipulation (alpha = .58) and post-music manipulation (alpha = .64). Test–retest reliability (pre to post) was excellent; $r$ = 89. As in prior work, scores tended to show a normal distribution (bell-shaped curve) at both time points. Internal consistency for the PANAS affective subscales was, again, similar to that found in prior work; coefficient alpha for both scales in this study was >.85 for both pre-music manipulation and post-music manipulation. Test–retest reliability (pre to post) was excellent; $r$> 76 for both scales. As in prior work, scores on the negative affect scale of the PANAS were extremely positively skewed (people tended to score low on negative affect). Scores on the positive affect scale tended to be uniform. Details about factor structure, composite reliability and method invariance for the PANAS can be found in Data S1.

## Procedure

We used the same procedure used in Study 2 with one exception; in this study, participants in the neutral condition were also allowed to choose their song (from the list of three neutral songs used in Study 2).

## STUDY 3 – RESULTS

We used ANCOVA to test the hypotheses. In each of the three analyses, the independent variable was music condition (positive song, neutral song or no song). The dependent variables were post-manipulation PANAS (positive and negative affects) and PIQ (event-specific cognitions) respectively. Baseline scores for the dependent variables were included as covariates to control for any individual differences in initial levels of the independent variable. Levene's test showed that the assumption of equality of variances was met for all analyses (all $p$-values > .05).

Results replicated those found in Study 2 and ruled out "choice" as a confound. Consistent with the results of Study 1, there was a large main effect of music condition on positive affect ($F$[2, 319] = 20.40, $p$ < .001, $\eta^2$ = .11). As shown in Figure 2, participants randomly assigned to the popular upbeat song condition reported significantly greater positive affect ($M$ = 30.5, $SE$ = .46) than those in the neutral ($M$ = 27.2, $SE$ = .46) and no-song conditions ($M$ = 26.7, $SE$ = .47; Helmert contrast: $t$ = 6.35, $p$ < .001). There was no difference in positive affect between the neutral and no-song conditions ($p$ = .47). Fifty-two per cent of participants in the upbeat song condition reported an increase in positive affect compared to 31% and 20% in the neutral and no-song conditions respectively.

Results also showed a small-sized main effect of music condition on negative affect ($F$[2, 319] = 4.89, $p$ = .008, $\eta^2$ = .03). Follow-up analyses showed that a significant difference between the neutral ($M$ = 12.9, $SE$ = .31) and no-song conditions ($M$ = 14.0, $SE$ = .32; Helmert contrast: $t$ = −2.50, $p$ = .01). Participants randomly assigned to the upbeat popular song condition ($M$ = 12.7, $SE$ = .31) also reported lower levels of negative affect than those in the neutral and no-song conditions, but the difference fell short of reaching statistical significance (Helmert contrast: $t$ = −1.88, $p$ = .06).

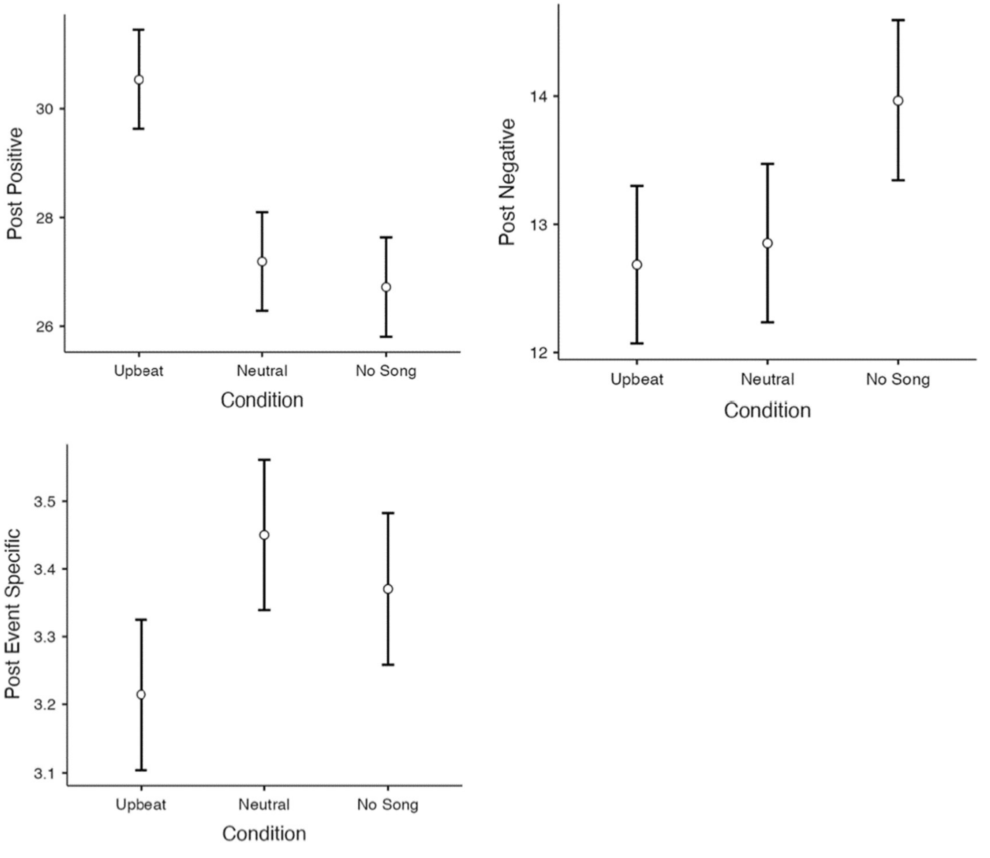


**FIGURE 2** Effect of music condition on negative affect, positive affect and event-specific negative inferences controlling for baseline levels of the dependent variable. Error bars are confidence intervals.

Finally, there was a small, but significant, main effect of music condition on event-specific inferences ($F$[2, 319] = 4.54, $p$ = .01, $\eta^2$ = .03). As shown in Figure 2, participants randomly assigned to the popular upbeat song condition reported significantly less negative event specific inferences ($M$ = 3.21, $SE$ = .06) than those in the neutral ($M$ = 3.45, $SE$ = .06) and no-song conditions ($M$ = 3.47, $SE$ = .06; Helmert contrast: $t$ = −2.84, $p$ = .005). There was no difference in positive affect between the neutral and no-song conditions ($p$ = .32). Forty-seven per cent of participants in the upbeat song condition reported a decrease in negative event-specific inferences compared to 32% and 34% in the neutral and no-song conditions respectively.

*Post-hoc* exploratory analyses showed that the same pattern of findings for negative affect ($F$[2, 147] = 5.51, $p$ < .005, $\eta^2$ = .04), positive affect ($F$[2, 147] = 5.60, $p$ = .005, $\eta^2$ = .02) and event-specific inferences ($F$[2, 147] = 2.90, $p$ = .058, $\eta^2$ = .01) when only including those with initially high levels of negative affect (determined by median split).

## DISCUSSION

We conducted three studies to test the effects of music on positive and negative affect and depression-related event-specific cognitive inferences. The results of the first study did not support any of our hypotheses. Music tempo and lyrical content had no effect on any of the measures of interest. However, prior to abandoning the idea that music could influence cognitive inferences about stressful events, we conducted a second study in which we optimized the experimental design by including fewer conditions and increasing external validity (e.g., allowing participants to choose one of four popular upbeat positive songs). Using this approach, we found that music could cause changes in positive affect, negative affect and event-specific negative cognitions. Nearly 50% of participants reported a decrease in event-specific negative cognitions about a real-world stressful event after listening to an upbeat popular song. We then replicated these findings in a third study (and ruled out the confound of song "choice").

These results are consistent with prior research showing large positive mood effects for upbeat music (Ferguson & Sheldon, 2013; Sereno et al., 2015). Our studies extend this work by showing that music can also cause people to generate more adaptive cognitive inferences about a real-world stressful event in their lives (i.e., attribute stressful events to unstable/specific causes and infer less negative inferences about one's future and self-worth). The effect size was small (a decrease of about a quarter of a point on the measure) but that does not preclude this manipulation from having theoretical and real-world implications. For example, prior research (e.g., Haeffel & Hames, 2014) shows that small changes in levels of negative cognitions can have important implications for future levels of depression symptoms. Further, from a therapeutic standpoint, changing and evaluating negative cognitions in cognitively based interventions can be challenging for clients. It is possible that having clients choose a popular upbeat song during cognitive restructuring homework and exercises may provide enough of a nudge for them to generate one or two more adaptive inferences. Clearly, this hypothesis will need to be tested in future research using clinical samples.

But even if our findings hold in therapeutic and real-world settings, one might still question the importance of this work because people are likely already listening to upbeat popular music (i.e., we are not introducing anything new in their lives). Indeed, the music we used is considered "popular" because of how many people listen to it (as indexed by the Billboard Top 100). However, Taylor and Friedman (2015) showed that people do not choose to listen to positive music when experiencing negative moods. Instead, it is the opposite. Participants in their study showed a preference for mood-congruent music (see also Suslow et al., 2010). This work indicates that people do not naturally choose to listen to music that would help increase their mood and decrease negative cognitions. Thus, encouraging people to forego their natural tendency to listen to sad music during low moods and try an upbeat popular song may be useful. This may be especially true for people with a negative inferential style because they tend to get stuck in ruminative cycles of sad mood and negative cognitions from which they cannot disengage or distract (Abramson et al., 2002). It is possible that sad music would reinforce this ruminative cycle (note, that this may not be the case for people without a negative inferential style [e.g., van den Tol & Edwards, 2015]).

This research had both strengths and limitations. Strengths include the inclusion of three studies with well-powered sample sizes. Further, all three studies were pre-registered with specific hypotheses (to prevent HARKing). However, the generalizability of the findings requires further study. It is possible that the effects of music will not generalize to samples with clinically significant forms of psychopathology. Music may not be enough to nudge the event-specific negative inferences of those with clinical diagnose as their thinking patterns may be more rigid and difficult to alter. Further, all participants were from the United States, and thus, it is critical to replicate the findings with participants from around the world. Preliminary research (Haeffel et al., 2022; Haeffel & Cobb, 2022) indicates that the cognitive vulnerability factor featured in the hopelessness theory may behave differently in non-Western populations (i.e., shows different patterns of vulnerability–depressive symptom associations).

In conclusion, we showed that listening to a popular upbeat song of one's choosing may provide a small nudge for generating more adaptive cognitive inferences about life events (in addition to a large effect on positive affect). Prior research indicates that people do not naturally listen to upbeat music during times of negative mood and stress and, thus, it may be a useful avenue for future intervention research.

## AUTHOR CONTRIBUTIONS

**Elizabeth R. Smith:** Conceptualization; investigation; methodology; project administration; writing – original draft. **Lily M. Brouder:** Investigation; methodology; writing – review and editing. **Ciara E.**

**Lawlor:** Investigation; methodology; writing – review and editing. **Gerald Haeffel:** Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; supervision; visualization; writing – original draft; writing – review and editing.

## FUNDING INFORMATION

The research was funded, in part, by Undergraduate Research Opportunity (UROP) grants from the University of Notre Dame.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## DATA AVAILABILITY STATEMENT

All three studies were pre-registered with data available (https://osf.io/mn8yf/): Study 1: https://osf.io/jaequ; Study 2: https://osf.io/x3rzv and Study 3: https://osf.io/jaequ.

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## SUPPORTING INFORMATION

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**How to cite this article:** Smith, E. R., Brouder, L. M., Lawlor, C. E., & Haeffel, G. J. (2023). Listening to a popular upbeat song can lead to more adaptive cognitive inferences for stressful events in non-clinical adult populations. *British Journal of Clinical Psychology*, *62*, 356–371. https://doi.org/10.1111/bjc.12412