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WORKING TO THE BEAT: A SELF-REGULATORY FRAMEWORK LINKING MUSIC CHARACTERISTICS TO JOB PERFORMANCE

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With changes in musical technology, it is increasingly common for employees to listen to music at work. Research from a wide variety of scientific fields has demonstrated that music affects our behavior through various physiological, affective, and cognitive processes. Despite this abundance of research, the organizational sciences have largely ignored the implications of listening to music at work. We draw on self-regulation theory to argue that characteristics of music (i.e., musical key, tempo, complexity, volume) influence job performance through cognitive self-regulatory processes (i.e., executive functions). We explain how music, via its physiological and affective consequences, can influence executive functions, and how, in turn, this impacts various task performance outcomes. We conclude by describing implications for organizations with regard to allowing or even encouraging employees to listen to music at work and offer suggestions for future research.

Music has been a feature of many work environments for centuries. Factory workers, agricultural laborers, sailors, and miners sang work songs to help maintain productivity and boost morale (Uhrbrock, 1961). In the mid twentieth century, advances in music technology, combined with the development of programmable music by the Muzak Corporation, made music available in the office environment (Jones & Schumacher, 1992). Today, with the expansion of online music-streaming services and portable music devices, the number of employees listening to music of their own choosing has grown dramatically. Many employees listen to music during working hours. Indeed, during an average work week, workers listen to music about 30 percent of the time (Haake, 2011; Spherion, 2006).

That said, very little is known about the effects of music on behavior and cognition at work. Research from other scientific fields (i.e., neuroscience, education, medicine, marketing and advertising, cognitive and social psychology, etc.) has found that music affects a wide variety of human behavior and cognition. For instance, music has many positive effects, such as facilitating learning (Chin & Rickard, 2010; Ferreri & Verga, 2016; Schlichting & Brown, 1970), reducing stress (de la Torre-Luque, Díaz-Piedra, & Buela-Casal, 2017), and regulating our emotions (Randall, Rickard, & Vella-Brodrick, 2014). Yet music can be distracting and can impair concentration (Furnham & Allass, 1999), increase the occurrence of errors and mistakes (Ransdell & Gilroy, 2001), increase tension and psychological distress (Cusick, 2008), and even encourage aggressive behavior (Greitemeyer, 2009).

Many of these findings seem to have implications for the use of music at work, but actual research examining the impact of music on job performance is lacking. Almost all of the field research on music at work that does exist is quite dated, and its findings are inconclusive. For instance, some empirical work found that listening to music reduced employee errors and improved overall productivity (Fox & Embrey, 1972; Gatewood, 1921; Kerr, 1946; Kirkpatrick, 1943). Other early research, however, found that music either had no effect on or even harmed performance (Gladstones, 1969; Henderson, Crews, & Barlow, 1945; Jensen, 1931; Newman, Hunt, & Rhodes, 1966). Oldham, Cummings, Mischel, Schmidtke, and Zhou (1995) argued that preselected background music, as was

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used in early studies, limited employee control over the type of music played, and this may explain why previous research found conflicting results. These researchers found that compared to those who chose not to listen to music while working, employees who listened to music of their own choosing demonstrated significant increases in job performance, organizational satisfaction, and reduced turnover intentions over a four-week period. Although some more contemporary studies conducted outside the organizational sciences have found results similar to those of Oldham and colleagues (e.g., Lesiuk, 2005, 2008, 2010), others have found that even with choice there is still variation in the effects of music on cognitive outcomes (Cassidy & MacDonald, 2009; Huang & Shih, 2011; Perham & Sykora, 2012).

These recent findings—along with past inconsistencies in the effects of music on work-related outcomes—may be explained by inherent qualities of music that elicit different behavioral responses over and above simple familiarity. The sound that we identify as music is made up of several subcomponents, such as musical key, tempo, rhythm, melody and harmony, and so forth, and these characteristics produce different physiological and affective[1] responses, which lead to changes in behavior and cognition. For example, Husain, Thompson, and Schellenberg (2002) digitally altered both the key and tempo of Mozart's Sonata K. 448 (originally in D major with a tempo of 120 BPM) and found that different versions of the same song (fast-minor, slow-major, and slow-minor) yielded different affective and physiological reactions. Along with other research (e.g., Sutton & Lowis, 2008), these findings highlight that different music characteristics have unique consequences for internal processes. Yet the past work from organizational scholars focuses almost exclusively on the consequences of presence versus absence of music, with little consideration of the music characteristics that produce or the mechanisms that transmit these effects. What is missing is a coherent theoretical model of how and why different characteristics of music affect task performance. To address this issue, we develop a theoretical framework using self-regulation to explain how characteristics of music positively or negatively affect job performance (see Figure 1).

We argue that characteristics of music influence self-regulatory processes—specifically, working memory and inhibitory control—by influencing attentional breadth. Working memory and inhibitory control then affect cognitive and behavioral outcomes at work. We first briefly describe relevant self-regulation theory and processes. Next we introduce the characteristics of music and describe how and why these characteristics affect self-regulatory processes. We then present several novel propositions as to how combinations of different musical characteristics influence different aspects of task performance through their effects on self-regulatory processes. We also discuss the potential moderating factors that likely affect how music impacts self-regulatory processes. Finally, we elaborate on the implications of our model for both theory and practice and discuss potential avenues for future research.

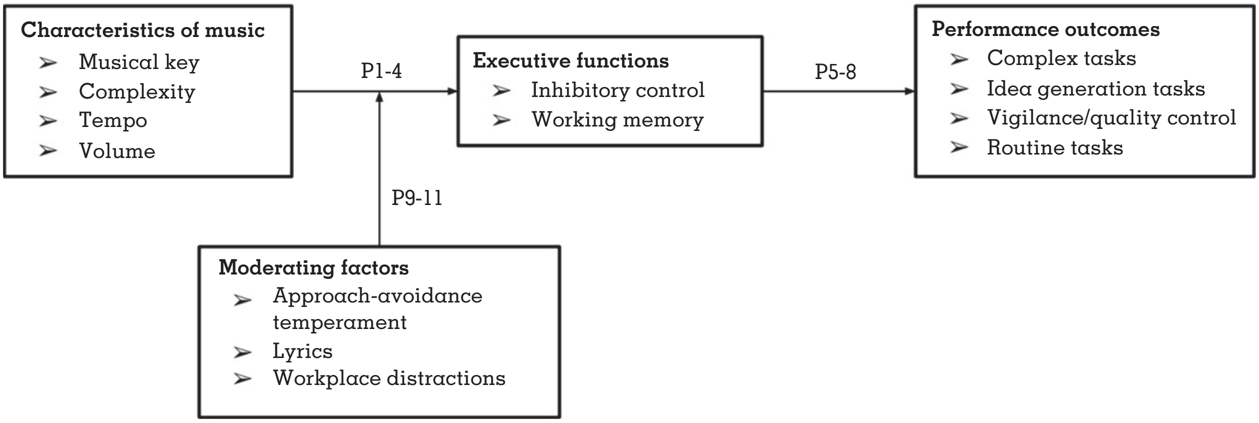
SELF-REGULATORY PROCESSES AS EXECUTIVE FUNCTIONS

When discussing the role of music in daily life, authors consistently make reference to the role of music as a mechanism to change the status of the self (e.g., DeNora, 1999). For instance, people listen to music to regulate or alter their moods and emotions (Saarikallio & Erkkilä, 2007), behavior (Ünal, de Waard, Epstude, & Steg, 2013), and thoughts (Kushnir, Friedman, Ehrenfeld, & Kushnir, 2012). These frequent associations between music and internal adjustments to the self suggest that music is important for self-regulation.

Self-regulation reflects a fundamental capacity to regulate and control one's emotions, thoughts, and behavior (Vohs & Baumeister, 2004). Although there are various processes by which self-regulation occurs, researchers are increasingly drawing links between self-regulation and executive functions (Diamond, 2013; Hofmann, Schmeichel, & Baddeley, 2012; Schmeichel, 2007), specifically viewing executive functions as high-order cognitive processes that enable self-regulation and that are called on in situations where concentration and active attention are required (Diamond, 2013). These capabilities are housed in the prefrontal cortex (PFC)—the primary

[1]The terms *positive affect* and *negative affect* were originally used to indicate emotional states that are also high in arousal (Watson & Clark, 1988). However, these terms are now commonly used to refer to valence more generally. This is how we intend the terms as well. We also note that music is capable of affecting mood and triggering specific emotions. Thus, we use the terms *mood, emotion,* and *state affect* interchangeably, which is consistent with previous literature.

FIGURE 1
Conceptual Model of the Effects of Music Characteristics on Job Performance Via Self-Regulatory Processes



neural area responsible for controlling thoughts, emotions, and behavior (Banfield, Wyland, Macrae, Munte, & Heatherton, 2004).

The executive functions that seem most relevant for understanding the effects of music characteristics on performance are inhibitory control and working memory. *Inhibitory control* refers to the ability to block competing goals, temptations, and distracting thoughts and/or emotions in order to facilitate selective (i.e., goal-oriented) attention (Baumeister, Bratslavsky, Muraven, & Tice 1998; Diamond, 2013). Inhibitory control is also needed for stimulus selection and error detection (Berger & Posner, 2000). *Working memory* facilitates goal-directed behavior by actively holding and maintaining goal-relevant information in short-term memory, as well as updating and manipulating existing information in response to new rules, demands, or priorities (Baddeley, 2012; Engle & Kane, 2003). Working memory is also essential for cognitive flexibility and task switching (Diamond, 2013).

Inhibitory control and working memory are independent but complementary processes that rely on the same resource—namely, attention (Baddeley, 2003; Kaplan & Berman, 2010). Attention refers to the activation and accessibility of cognitive representations (e.g., information, stimuli, goals; Bosco, Allen, & Singh, 2015) and is limited in capacity (Kahneman, 1973). Attention is similar to the beam of a spotlight: it can be narrowly focused or broadly distributed (Easterbrook, 1959; Wachtel, 1967). When attention is broad, people focus on a large range of stimuli and are more aware of task-irrelevant information. In contrast, people focus on a small range of stimuli and filter irrelevant stimuli from their awareness when attention is narrow. Breadth of attention is influenced by our emotions and experience of arousal. As we discuss later in the article, the valence of emotions influences attentional breadth such that positive emotions broaden and negative emotions narrow attention (Derryberry & Reed 1994; Fredrickson, 2001). Likewise, attention is broad when arousal is low and narrow when arousal is high[2] (Easterbrook, 1959).

Breadth of attention controls the balance of task-relevant or -irrelevant information in our conscious processing (e.g., Conway & Engle, 1994; Cowan & Morey, 2006), and this balance of informational cues can enable or hinder executive functions. Updating and incorporating new information into one's thinking or action plans, playing with ideas and considering alternatives, or making connections between disparate ideas

[2]Although, in principle, nonlinear effects among emotion, arousal, and attention exist (Blair & Ursache, 2011), there is no empirical evidence to suggest that characteristics of music generate levels of valence and arousal that will produce counterproductive levels of attentional scope. For one, the vast majority of people do not listen to extremely fast or dynamic music (i.e., greater than 150 BPM; Mitchum, 2016). For another, although music induces emotional responses, these responses are not the same degree of intensity as emotions generated, say, from finding an intruder in your house or learning you won the lottery (Eerola & Vuoskoski, 2013). Hence, we focus on the first part of the putative inverted-U relationship and, thus, our propositions are linear.

requires greater access to and awareness of a variety of informational sources (e.g., one's environment, the task itself, internal feelings and memories). In contrast, sustaining attention and suppressing intrusive thoughts and emotions require limited access to and awareness of non-task-related information. Narrow attention enables inhibitory control because the range of informational cues is limited to those that are task related; thus, one can better maintain task-relevant information. Limited attention, however, is counterproductive for working memory capabilities because a broader array of informational cues is needed to update existing information and make connections between different ideas. In this article we propose that music influences executive functions by affecting attentional breadth. Specifically, characteristics of music (musical key, complexity, tempo, and volume) can differentially broaden or narrow attention through their individual effects on emotional valence and arousal. The resulting breadth of attention, in turn, fuels executive control over the cognitions and behaviors that lead to performance.

THE EFFECT OF MUSIC CHARACTERISTICS ON EXECUTIVE FUNCTIONS

In this section we introduce and define the various musical characteristics explored in the article and the mechanisms by which these characteristics influence self-regulatory processes. Our selection of characteristics is not intended to be exhaustive; instead, we focus on the characteristics most relevant for employee performance. We also restrict our framework to objective, as opposed to subjective (e.g., familiarity, preference), characteristics of music. We remind the reader that these characteristics are experienced simultaneously and build on each other to create what we call music. We cannot have tempo without rhythm, key without pitches—they are interconnected. Hence, although we discuss the characteristics and their effects of self-regulatory processes separately for ease of understanding, we examine their combined effects later in the article. Table 1 presents a summary of the relations described in this article. We also created a website (www.workingtothebeat.com) where readers can listen to the examples mentioned in our article as they read it to better understand the differences among musical characteristics. This website also includes supplemental material about music theory and summarizes the proposed immediate and distal outcomes of different characteristics.

Musical Key and Musical Complexity

Musical key (i.e., key signature or modality) is a central characteristic of music; it establishes the tonality of a song. Western music[3] is largely composed in either major or minor keys. One of the main distinctions between a major and minor key is the distance between the first and third scale tone within that musical scale. In a major scale the third scale tone is an interval or distance of a major third above the starting note (or "tonic") of the scale. Examples of songs in a major key include Beyoncé's "Halo," Chopin's "Nocturne in E-flat major," and John Lennon's "Imagine." In a minor scale the third scale tone is a minor third above the tonic. Led Zeppelin's "Stairway to Heaven," Michael Jackson's "Billie Jean," and Beethoven's "Moonlight" Sonata (adagio sostenuto) are all in a minor key.

Musical complexity refers to characteristics that may impact the perceived intricacy of a song—specifically, the melodic and harmonic structure of a piece, as well as the degree of dynamic variation (Levitin, 2007). *Melody* refers to the succession of notes that forms the main musical theme played throughout a song (Levitin, 2007). Simple melodic lines ("Twinkle, Twinkle, Little Star") feature small intervals between pitches, repetitive phrases, and simple rhythmic structures. Complex melodic lines typically feature large intervals (an octave, a ninth, etc.) between notes (e.g., the interval between the words "God" and "on high" in "Bring Him Home" from *Les Misérables* is an octave), the use of nondiatonic notes (i.e., a note that is not part of or "native" to the established key as indicated by the use of chromatics to raise or lower the pitch; e.g., the first note in the line "But the tigers come at night" in "I Dreamed a Dream" from *Les Misérables*, is an E natural, which is nondiatonic in the song's key of E-flat major), or complicated rhythmic patterns (e.g., Ravel's "Concerto in G major for Piano and Orchestra").

[3] It should be noted that our arguments and the research presented in this article focus on the effects of Western music as opposed to non-Western music. Western music and non-Western music share many characteristics but also have significant differences. Humans, however, have a similar response to music regardless of culture (Balkwill & Thompson, 1999).

TABLE 1
Proximal Consequences of Musical Characteristics

Music Characteristic	Definition	Physiological Responses	Affective Responses
Musical key	Establishes the tonal quality of a song and is either major or minor	Music in a minor key activates the thalamus, retrosplenial cortex, brainstem, cerebellum, and amygdala. Music in a major key activates the anterior cingulate cortex, nucleus accumbens, and the ventral tegmental area and triggers the release of neurochemicals (i.e., dopamine) associated with moods and emotions.	Major key music generally induces positive affect, whereas minor key music induces negative affect. This occurs through the physiological mechanisms described and through evaluative conditioning and meeting or violations of ingrained musical expectations.
Musical complexity	Refers to the combination of melody, harmony, and dynamic variation that influences perceptions of simplicity or complexity	High-complexity music activates neural regions (i.e., thalamus, brainstem, and left hemisphere of the amygdala) that are associated with negative emotions. Low-complexity music activates neural regions (i.e., nucleus accumbens, the anterior cingulate, and the subcallosal cingulate) and triggers the release of neurochemicals associated with pleasure and reward, such as dopamine.	Musical complexity elicits affect through the physiological mechanisms described and through conditioning and meeting or violations of musical expectations. High-complexity music generally elicits negative affect, whereas low-complexity music elicits positive affect.
Tempo	The beat or speed at which music is played; measured in beats per minute (BPM)	Tempo activates the brainstem and cerebellum to influence arousal by increasing or decreasing heart rate, blood pressure, respiratory rate, and other physiological processes. This occurs through the principle of entrainment.	When combined with characteristics that influence emotional valence (i.e., musical key and/or complexity), tempo facilitates the experience of discrete emotions (e.g., happiness, sadness, fear, calmness) by changing arousal levels.
Volume	The decibel level at which music is played or listened to	Volume levels influence arousal levels by increasing or decreasing heart rate, blood pressure, respiratory rate, and other physiological processes.	

Harmony refers to a secondary melody that parallels the main theme and/or to the chord structure that accompanies and complements the melody (Levitin, 2007). A chord refers to a harmonic set of three or more notes that are played simultaneously. Chords can be major, minor, augmented, or diminished (examples of each can be found in the Characteristics of Music section of the website). Compared to major or minor chords, augmented and diminished chords tend to sound very jarring or discordant (Blood, Zatorre, Bermudez, & Evans, 1999; Virtala & Tervaniemi, 2017). The use of augmented and diminished chords, as well as chords with more than three notes (e.g., dominant seventh chords) and nonstandard chord progressions, enhances the perceived complexity of the music. The Beatles' "Strawberry Fields Forever" features chords and deceptive cadences that are incongruent with the vocal melody, thus creating a high level of complexity (as opposed to, say, "Love Me Do").

Dynamic variation refers to volume or tempo changes within a given song. For changes in volume, composers and songwriters use specific markings to indicate to musicians whether sections of the song should be played softly or loudly and whether volume changes should be sudden or gradual. For instance, the first several lines of the overture from the opera *Le Nozze di Figaro* are played very quietly (piano) and then very loudly (fortissimo) at the climax of the musical phrase. Regarding changes in tempo, composers use the term *accelerando* to indicate that the tempo for a section of the song should get faster (relative to the original tempo) or the term *ritardando* to make the tempo slower. Our perceptions regarding the complexity of a song is influenced by its dynamics. Generally, people perceive music that features many changes in tempo and/or volume (e.g., Grieg's "In the Hall of the Mountain King") as more complex than music that features little changes in tempo and/or volume (e.g., Cyndi Lauper's "Girls Just Wanna Have Fun" is at a constant loud volume; Satie's "Gymnopédie No. 1" is at a constant soft volume).

How musical key and complexity influence state affect. Musical key and complexity are largely responsible for the valence or hedonic tone of our emotional responses to music. Movies, TV shows, and even commercials utilize these characteristics to manipulate the emotions of viewers. The theme from *The Godfather,* written in a minor key, conveys a feeling of melancholy that mirrors the film's plot. The title theme song from *Star Wars*, which is in a major key, is a bold opening statement suggesting the hope and optimism characterizing the message of the film. The theme from *Jaws* begins with the main theme of repeated half steps, which establishes a sense of foreboding. As the score develops, a swirling new melodic line develops, but all while the leitmotif of repeated half steps continues underneath to instill a sense of fear and panic.

Research has consistently found that listening to music in a major key elicits a positive emotional response, whereas a minor key elicits a negative emotional response (Hunter, Schellenberg, & Griffith, 2011; Thompson, Schellenberg, & Husain, 2001). For example, Sutton and Lowis (2008) duplicated and digitally altered a Handel sonata originally in F major to F minor. Participants listened to both versions and rated the major key version of the piece as emotionally positive and the minor key version as emotionally negative. Similarly, music that is low in complexity generally elicits a positive emotional response, whereas highly complex music elicits a negative emotional response (Blood et al., 1999; Pallesen et al., 2005).

There are several mechanisms by which musical key and complexity produce emotional responses. One is through the activation of neural structures and the release of neurochemicals responsible for emotional reactions. According to dopaminergic pathway theory, increases in dopamine levels are related to increases in positive affect, and mesolimbic dopamine activity mediates cognitive processes controlled by the PFC (Ashby & Isen, 1999). The left and right hemispheres of the brain govern the experience of positive and negative emotions: left frontal activity is associated with the experience of positive emotions (i.e., joy and happiness), whereas right frontal activity is associated with the experience of negative emotions (i.e., anger and sadness; Davidson & Irwin, 1999; Harmon-Jones & Sigelman, 2001). Left frontal activation is thought to induce positive affect because of its close relationship with the mesolimbic dopamine system (Tomarken & Keener, 1998). Conversely, negative affect is associated with the release of stress hormones, such as cortisol and norepinephrine (Hanson, Maas, Meijman, & Godaert, 2000).

Listening to music in a major key enhances left frontal activation and the synthesis of dopamine; positron emission tomography (PET) scans show that music triggers the release of dopamine during peak emotional experiences (Sutoo & Akiyama, 2004). Low-complexity music also elicits feelings of positive affect by activating the nucleus accumben and the subcallosal cingulate, as well as elevating dopamine levels (Blood et al., 1999). In contrast, listening to music in a minor key generates greater right frontal activation (Schmidt & Trainor, 2001) and activates neural areas responsible for eliciting fear and alarm responses (e.g., the thalamus and amygdala; Pallesen et al., 2005). Activation of these neural regions suppresses the release of dopamine and increases the release of stress hormones (i.e., adrenaline and cortisol), which prompt aversive responses such as fear, revulsion, and so forth (Berger, 2011). Likewise, listening to high-complexity music elicits stronger activations of the thalamus and left hemisphere of the amygdala, which produce negative emotional reactions (Blood et al., 1999; Pallesen et al., 2005).

In addition to physiological mechanisms, musical key and complexity can induce positive or negative affect through evaluative conditioning and expectancy effects (Juslin & Västfjäll, 2008). Conditioning refers to the repeated pairings between an initially neutral conditioned stimulus and an affectively valenced unconditioned stimulus. The conditioned stimulus, after the pairing, is then able to conjure the same affective state as the unconditioned stimulus. When these characteristics are repeatedly paired with specific emotionally laden stimuli (e.g., major key paired with positive emotional stimuli), this can lead to a conditioned response in listeners (Juslin & Västfjäll, 2008). The musical examples described earlier are clear examples of evaluative conditioning: in the case of the theme from *Jaws*, minor key and high complexity are paired with a fear-inducing stimulus (i.e., shark attack) to elicit similar emotional reactions.

Finally, musical key and complexity can influence affect by the degree to which the music either fulfills or violates ingrained expectations regarding its attributes. Within every culture there exist expectations about the organization of music (i.e., the structure of melody and harmony). Over the course of music history, this led to the development of common melodic and harmonic structures and progressions that are heard in almost every genre of Western music. Even nonmusicians hold unconscious expectations about the form and function of a piece of music, which are established through schemas and learned associations (Krumhansl, 2002; Meyer, 1956; Steinbeis, Koelsch, & Sloboda, 2006). Music that meets these expectations elicits positively valenced feelings. Composers and songwriters, however, frequently bend or outright break these rules and expectations. The degree to which music matches or deviates from these ingrained expectations leads individuals to appraise the music as positive or negative in tone. Violations of musical expectations, like those common in music with greater complexity (e.g., Rachmaninoff's "Morceaux de Fantaisie"), trigger negative appraisals and induce feelings of anxiety, fear, or general negative emotions (Blood et al., 1999; Pallesen et al., 2005).

Proposition 1a: Musical key influences the valence of emotional responses. Specifically, music in a major key triggers positive affect, whereas music in a minor key triggers negative affect.

Proposition 1b: Musical complexity influences the valence of emotional responses. Specifically, there is a negative relationship between complexity and valence such that emotional valence becomes more positive as musical complexity decreases.

How musical key and complexity influence executive functions. The valence or hedonic tone associated with musical key and complexity affects working memory and inhibitory control by influencing attentional scope (e.g., Jefferies, Smilek, Eich, & Enns, 2008). Positive affect facilitates working memory by broadening the scope of attention, incorporating more features and events from the environment into one's thinking (Fredrickson & Branigan, 2005; Rowe, Hirsh, & Anderson, 2007). When in a positive affective state, people demonstrate greater verbal fluency (Phillips, Bull, Adams, & Fraser, 2002), make more novel associations between disparate or unrelated ideas (Isen, Johnson, Mertz, & Robinson, 1985), and exhibit more flexible categorization and thinking (Isen, Daubman, & Nowicki, 1987). The broadening of attention due to positive emotions, however, hinders inhibitory control, leading to difficulty sustaining selective attention (Rowe et al., 2007), ignoring distractions (Biss & Hasher, 2011; Vanlessen, Rossi, De Raedt, & Pourtois, 2013), and inhibiting prepotent responses (Dreisbach & Goschke, 2004; Phillips et al., 2002).

In contrast, negative affect narrows attention (Derryberry & Reed 1994; Gasper & Clore, 2002). People engage in more constrained and analytical thinking when experiencing negative emotional states (Schwarz & Bless, 1991). Further, negative affective states are related to greater anchoring effects such that one becomes fixated on an idea and cannot see alternative solutions (Lyubomirsky, King, & Diener, 2005), thus compromising cognitive flexibility (Mitchell & Phillips, 2007). This reduced capability to incorporate new information should hinder working memory because it requires the ability to detect, update, and incorporate new information (e.g., Ikeda, Iwanaga, & Seiwa, 1996; Kensinger & Corkin, 2003).

Broadening or narrowing of attention due to emotional valence occurs for several reasons. One is the activation of the neural networks that underlie attention in response to emotional stimuli (Jiang, Scolaro, Bailey, & Chen, 2011). Negative affect triggers the release of norepinephrine and its binding to receptors in the frontal and parietal regions of the right hemisphere, which is responsible for sustained selective attention (Fan, McCandliss, Sommer, Raz, & Posner, 2002; Garavan, Ross, & Stein, 1999). Positive affect corresponds to the release of dopamine (Ashby & Isen, 1999). Dopamine is believed to regulate the executive control system of attention by binding to dopaminergic receptors in the anterior cingulate cortex and the dorsolateral prefrontal cortex (Ashby & Isen, 1999; Bush, Luu, & Posner, 2000). Increased levels of dopamine are associated with greater activation of these regions and subsequent improvements in working memory capabilities (Floresco & Phillips, 2001).

Another reason is that emotions provide important signals about the immediate situation and influence how we attend to features within the surrounding environment (Schwarz & Clore, 1983). Positive affect signals the absence of a threat; the situation is safe enough that the diffusion of attention does not pose any foreseeable risks (Park & Banaji, 2000; Wegener & Petty, 1994). Negative affect, in contrast, signals that the situation is threatening or problematic and requires our immediate and focused attention (Fredrickson, 2001; Park & Banaji, 2000).

Because different music characteristics elicit different affective responses and, as a consequence, influence attentional availability, we argue that they can differentially impact working memory and inhibitory control. Specifically, working memory is facilitated when people listen to major key and/or low-complexity music because these characteristics generate positive emotional responses, which increase attentional availability. Working memory is inhibited when people listen to minor key and/or high-complexity music because these characteristics generate negative affect, which narrows attention to limit variety of stimuli. Yet the narrowing of attention triggered by these characteristics is likely to have benefits for inhibitory control. Listening to major key and/or low-complexity music impairs inhibitory control because music of this type expands attention through the generation of positive affect to increase awareness of irrelevant stimuli and potential distractions.

> *Proposition 2a: Major key music elicits positive affect and broadens attention. These, in turn, facilitate working memory but impair inhibitory control. Minor key and/or high-complexity music elicits negative affect and narrows attention. These, in turn, facilitate inhibitory control but impair working memory.*

> *Proposition 2b: Low-complexity music elicits positive affect and broadens attention. These, in turn, facilitate working memory but impair inhibitory control. High-complexity music elicits negative affect and narrows attention. These, in turn, facilitate inhibitory control but impair working memory.*

Tempo and Volume

When we listen to music, we often tap a foot, clap our hands, or nod our heads to the beat or pulse of the music. How quickly or slowly we engage in these movements is an indication of *tempo,* which is the speed at which a piece of music is played, measured in beats per minute (BPM). Generally, a song is considered to have a fast tempo if it is about 120 BPM or more. Songs such as Duke Ellington's "It Don't Mean a Thing," Pharrell William's "Happy," and the third movement of Beethoven's "Moonlight" Sonata (presto agitato) all have tempos faster than 140 BPM. Moderately paced songs, such as Alicia Key's "Girl on Fire," Simon & Garfunkel's "Cecilia," and the Beatles' "Yesterday," are about 100 BPM. Songs are categorized as slow if they have a tempo less than 80 BPM. For example, Ray Charles's version of "Georgia on My Mind," Elton John's "Can You Feel the Love Tonight," and Chopin's "Nocturne in D-flat major" are all slower than 70 BPM. The *volume* at which we listen to music is measured in decibels (dB).

How tempo and volume influence arousal. Listening to music commonly elicits a sensation of chills or a tingling across the skin. This physiological response to music is an example of arousal. Manifestations of arousal include increased heart rate, higher blood pressure, pupil dilation, and increased skin conductance. Tempo and volume induce arousal through synchronization of neural activity, based on the principle of entrainment (Bernardi, Porta, & Sleight, 2006; Khalfa, Roy, Rainville, Dalla Bella, & Peretz, 2008). Tempo can act as a synchronizer when its speed matches resting heart rate, about 80 BPM (Yehuda, 2011). Once in synch, increases or decreases in tempo should have corresponding increases and decreases in arousal. For example, blood pressure, heart rate, respiratory rate, and other indicators of arousal increase while listening to music with fast tempos and decrease while listening to music with slow tempos (Bernardi et al., 2006; van der Zwaag, Westerink, & van den Broek, 2011). Workplace research has shown that employees exhibit higher levels of chemical indicators of arousal such as cortisol and norepinephrine when working in noisy environments (i.e., greater than 85 dB; Miki, Kawamorita, Araga, Musha, & Sudo, 1998).

Proposition 3a: Tempo influences arousal. Specifically, there is a positive relationship between tempo and arousal such that arousal levels increase as tempo increases.

Proposition 3b: Volume influences arousal. Specifically, there is a positive relationship between volume and arousal such that arousal levels increase as volume increases.

How tempo and volume influence executive functions. Tempo and volume affect executive functioning by influencing the availability of attention through changes in arousal (Jefferies et al., 2008). At low levels of arousal, key neurotransmitters such as norepinephrine and dopamine are also low, decreasing activation of the motivation neural systems (Arnsten & Li, 2005) and reducing synaptic activity in the frontal lobes (Blair & Ursache, 2011). As arousal levels increase, levels of these neurochemicals increase, enhancing synaptic activity in the PFC (Robbins & Arnsten, 2009). As such, higher levels of arousal narrow attention and reduce the range of informational cues that people use from their surroundings (Easterbrook, 1959; Kahneman, 1973). Lower levels of arousal broaden attention and expand the range of stimuli and environmental cues people attend to.

The relationship between arousal and attention suggests that music that elicits different levels of arousal may differentially affect working memory and inhibitory control. Specifically, music that is slow and/or played at a low volume likely facilitates working memory but impairs inhibitory control because these characteristics lead to low arousal and expanded attention; a broader range of attention enhances flexibility of thought and the merging of ideas. Listening to fast and/or highly dynamic music likely facilitates inhibitory control but impairs working memory because these increase arousal to narrow attention; a narrower range of attention reduces the presence of distracting cues and cultivates concentration.

Proposition 4a: Listening to music with a slow tempo decreases arousal levels and broadens attention. These, in turn, facilitate working memory but impair inhibitory control. In contrast, music that is fast in tempo increases arousal levels and narrows attention. These, in turn, facilitate inhibitory control but impair working memory.

Proposition 4b: Listening to music at a low volume level decreases arousal levels and broadens attention. These, in turn, facilitate working memory but impair inhibitory control. Listening to music, conversely, at a higher volume level increases arousal levels and narrows attention. These, in turn, facilitate inhibitory control but impair working memory.

CONSEQUENCES OF MUSIC ON JOB PERFORMANCE OUTCOMES

Executive functions form the foundation of several higher-level cognitive abilities, such as planning, reasoning, and problem solving, which are important for successful task performance (Drasgow, 2013). Yet the need for inhibitory control and working memory for successful performance varies depending on the type of task. For instance, complex problem-solving tasks engage both inhibitory control and working memory capabilities, whereas idea generation tasks rely mainly on working memory. This implies that the cognitive load of a task dictates the breadth of attention needed for successful execution (Beal, Weiss, Barros, & MacDermid, 2005). We contend that listening to music with particular characteristics can optimize attentional breadth for a given task: certain characteristics expand or narrow attention (via affect and arousal) and, in turn, facilitate or impede executive functions. Specifically, we propose that the combination of different characteristics can facilitate both working memory and inhibitory control, facilitate one while impeding the other, or impede both to influence different performance outcomes (see Figure 2).

We identified four task types (idea generation, complex, vigilance/quality control, and routine) that vary in attentional and executive control demands and, thus, are likely differentially affected by music characteristics. These task types are also common across a wide range of jobs, occupations, and industries. Indeed, many employees encounter each of these types of tasks in the

FIGURE 2
How Characteristics of Music Combine to Influence Work-Related Tasks.

Characteristics of music	Major key, low complexity, fast tempo, high volume	Major key, low complexity, slow tempo, low volume	Minor key, high complexity, fast tempo, high volume	Minor key, low complexity, slow tempo, low volume
Impact on executive functions	WM enabled IC enabled	WM enabled IC impaired	WM impaired IC enabled	WM impaired IC impaired
Performance outcomes	Complex tasks	Idea generation tasks	Vigilance tasks	Routine tasks

Note: WM = working memory; IC = inhibitory control

course of a workday. For example, for a journalist writing a story, there is an idea generation phase (What would be an interesting topic or issue?), various complex phases associated with writing the story, vigilance phases (copy editing), and routine phases like accepting changes from the copy-editing phase. Table 2 provides an illustrative example of the different task types and the different combinations of music characteristics that would facilitate performance on those tasks.[4] In the following section we explain the attributes of each task type and the attentional and executive function demands required. We then describe and present formal propositions about how different combinations of music characteristics optimize performance on different tasks through their effects on attention and executive function.

Idea Generation

Drawing on our hypothetical example of a journalist, the first part of that process is idea generation: the writer brainstorms various ideas for a story or for a new angle on an existing one. Idea generation refers to the ease with which individuals produce new and original ideas (e.g., brainstorming) and is a key stage of the creative process (Amabile, 1996; Lubart, 2001; Shalley, Zhou, & Oldham, 2004). This phase involves recalling previously stored categories of information from long-term memory, developing links between categories, and transforming and synthesizing information into new forms to produce new ideas or products (Ward, Smith, & Finke, 1999). Divergent thinking dominates the ideation stage of the creative process (Cropley, 2006; Zeng, Proctor, & Salvendy, 2011). Here the goal is not necessarily to solve a problem but, rather, to play with ideas and to discover new connections. Idea generation depends on working memory because divergent thinking requires shifting and making connections between mental sets (Benedek, Jauk, Sommer, Arendasy, & Neubauer, 2014). Inhibitory control, however, is likely counterproductive for ideation-focused tasks because selective attention precludes flexible thinking. The optimal attentional range for ideation tasks, therefore, is broad to facilitate working memory and minimize engagement of inhibitory control capacities.

Music that is in a major key and low in complexity expands attention and facilitates working memory by inducing positive affect. Positive

[4] We wish to make clear that in our model we assume that the characteristics combine in an additive, as opposed to multiplicative, manner. It is possible, however, that characteristics of music interact with one another. This would be an important component of empirical tests of the model.

TABLE 2
An Illustrative Example of the Effects of Music in the Process of Writing a Story

Task	Key Features	Optimal Combinations of Music Characteristics	Example Song
Ideation: Developing new ideas for a story	Reframing current knowledge and ideas on topic; making connections between different sources of information	Major key (WM) Low complexity (WM) Slow tempo (WM) Low volume (WM)	Mariah Carey's "Always Be My Baby"
Complex: Writing and rewriting the article	Refining and selecting ideas, resolving contradictions between information sources, integrating new information into existing ideas	Combination 1: • Major key (WM) • Low complexity (WM) • Fast tempo (IC) • High volume (IC) Combination 2: • Major key (WM) • High complexity (IC) • Fast tempo (IC) • Low volume (WM) Combination 3: • Major key (WM) • High complexity (IC) • Slow tempo (WM) • High volume (IC) Combination 4: • Minor key (IC) • High complexity (IC) • Slow tempo (WM) • Low volume (WM) Combination 5: • Minor key (IC) • Low complexity (WM) • Fast tempo (IC) • Low volume (WM) Combination 6: • Minor key (IC) • Low complexity (WM) • Slow tempo (WM) • High volume (IC)	Combination 1 • Marvin Gaye's "Ain't No Mountain High Enough" Combination 2 • Mozart's "Horn Concerto No. 4 in E-flat major" Combination 3 • Chopin's "Nocturne in D-flat major" Combination 4 • Beethoven's "Moonlight" Sonata (adagio sostenuto) Combination 5 • Lady Gaga's "Bad Romance" Combination 6 • Theme from *Schindler's List*
Vigilance: Copy editing and formatting	Looking for typos and grammatical errors; meeting formatting requirements	Minor key (IC) High complexity (IC) Fast tempo (IC) High volume (IC)	Rimsky-Korsakov's "Flight of the Bumblebee"
Routine: Accepting changes	Clicking "accept" in Word	Combination 1: • Minor key (IC) • Low complexity (WM) • Fast tempo (IC) • High volume (IC) Combination 2: • Minor key (IC) • Low complexity (WM) • Slow tempo (WM) • Low volume (WM) Combination 3: • Major key (WM) • Low complexity (WM) • Fast tempo (IC) • Low volume (WM) Combination 4: • Major key (WM) • High complexity (IC) • Fast tempo (IC) • High volume (IC)	Combination 1 • Metallica's "Whiplash" Combination 2 • Adele's "Hello" Combination 3 • James Brown's "I Got You (I Feel Good)" Combination 4 • Overture from Bizet's *Carmen*

Note: Any combination of music characteristics should benefit routine tasks; the examples given are those that would be harmful to other task types but not routine tasks. We include examples with lyrics because these are well-known songs that have the relevant characteristics. We expect that performance while listening to these songs would be worse than the examples without lyrics. The initials in parentheses next to each characteristic indicate which executive function is facilitated by that characteristic (WM = working memory; IC = inhibitory control).

emotions are strongly related to performance on measures of divergent thinking and idea generation (e.g., Unusual Uses Task, brainstorming tasks; Isen et al., 1987; Vosburg, 1998). Positive emotions expand the range of attentional scope to facilitate the forming of associations between disparate ideas or categories and to enhance the fluency and frequency of idea generation (Tidikis, Ash, & Collier, 2017). Music that is in a minor key and high in complexity induces negative affect, which limits the flexibility aspects of working memory (Lyubomirsky et al., 2005) and should impair performance on tasks that require production of novel ideas. Finally, inhibitory control impairs performance on ideation-intensive tasks. Higher arousal levels narrow attention and enhance inhibitory control, which reduce cognitive flexibility. Listening to music with a slow tempo and at a low volume would reduce arousal levels and enhance working memory capabilities. We propose that listening to music that is in a major key, low in complexity, slow in tempo, (e.g., Mariah Carey's "Always Be My Baby"), and at low volume level should result in the attentional breadth that would optimize performance on ideation tasks.

> *Proposition 5: Listening to music that is in a major key, low complexity, slow in tempo, and played at a low volume optimizes attentional breadth to meet the executive functioning requirements for idea generation tasks. This combination of characteristics facilitates working memory but undermines inhibitory control to enhance performance on tasks that emphasize idea generation.*

Complex Tasks

Complex tasks are those that have unknown or uncertain alternatives, interrelated and conflicting elements, the possibility of multiple means-ends, and/or the existence of subtasks (Terborg & Miller, 1978). Complex tasks typically require workers to identify and clarify the source of problems, form judgments about the probability of certain outcomes, and select between multiple alternative solutions. Returning to our journalist, there are several complex elements in writing a news story. Based on the ideas generated from brainstorming, the writer then must determine which ideas are the most compelling, collect and review information from a variety of sources (e.g., interview notes, documents, public datasets, etc.) to find support for and/or potential criticisms of those ideas, write and rewrite to integrate this information to generate a compelling narrative, and so on. Complex tasks are often ambiguous and difficult and, as such, impose high cognitive demands on workers (Campbell, 1988).

Working memory and inhibitory control are both crucial for the successful completion of complex tasks (Diamond, 2013). The sources of complexity within a task influence the information processing capacity, information diversity, and rate of information change needed for successful execution (Campbell, 1988). In other words, complex tasks require an optimal range of attention to facilitate both working memory and inhibitory control. Working memory is critical for higher-order cognitive processes such as reasoning and problem solving and facilitates integration of knowledge and past experiences into decision making and planning (Diamond, 2013). To perform well on complex tasks, one must actively maintain goal representations while continually updating and manipulating existing information, as well as make connections between seemingly unrelated ideas to generate new knowledge. Yet complex tasks also require inhibitory control: one must determine the source of the problem, identify which possible paths are viable, and selectively attend to information that facilitates the achievement of that path goal. This implies that attention needs to be broad enough to engage working memory capabilities but also narrow enough so that individuals ultimately select the appropriate action or solution.

With regard to music, complex task performance should be facilitated when listening to combinations of music that facilitate *both* inhibitory control and working memory. As we describe in Table 2, this could be any one of several combinations. We focus on Combinations 1 and 4 to illustrate our arguments, but the underlying logic remains the same for all of the combinations in question. Combination 1, which is major key, low in complexity, fast in tempo (e.g., Marvin Gaye's "Ain't No Mountain High Enough"), and high in volume, is beneficial for complex tasks. The combination of major key and low complexity elevates feelings of positive affect and broadens attention, facilitating working memory capabilities. To execute complex tasks successfully, however, one's attention needs to be narrow enough to facilitate inhibitory control without compromising working memory. Listening to a song with a fast tempo and increasing the volume counterbalances the effects of key and complexity by narrowing attention to enhance inhibitory control. Listening to music with a very slow tempo and at a soft volume would impair inhibitory control, making it difficult for individuals to systematically evaluate multiple alternative solutions and select the best one because of the presence of too many distracting or irrelevant informational cues. Thus, the combination of major key, low complexity, fast tempo, and high volume allows for the optimal breadth of attention needed to facilitate both working memory and inhibitory control; this combination facilitates the active maintenance of task goals, allows individuals to make connections between different categories, and yet enables individuals to selectively attend to task-relevant information and evaluate various possible outcomes.

Combination 4, which is minor key, high in complexity, slow (e.g., Beethoven's "Moonlight" Sonata [adagio sostenuto]) and at a soft volume, would also facilitate performance on complex tasks. The slow tempo and decrease in volume would lower arousal levels. This, in turn, would broaden attention, which should facilitate working memory. This would allow individuals to consider alternative path goals and possible solutions to a problem. Listening to music that is in a minor key and high in complexity increases negative affect, which facilitates inhibitory control through the narrowing of attention. The experience of negative emotions encourages more effortful decision-making styles, such as maximization, which is useful in new or ambiguous situations (Lyubomirsky et al., 2005). Thus, by listening to music that induces negative affect (i.e., minor key, high complexity), individuals are likely to be more analytical of these possible solutions and persist in identifying the most feasible and efficient solution to a problem. In sum, combinations of characteristics that lead to facilitation of both working memory and inhibitory control should enhance performance on complex tasks (see Table 2). As such, we offer a more general proposition rather than list the specific combinations.

Proposition 6: Listening to music whose combinations of characteristics optimize attentional breadth to facilitate both working memory and inhibitory control enhances performance on complex tasks.

Vigilance and Quality Control Tasks

Tasks that emphasize quality control and vigilance require extreme focus and sustained attention with minimal distractions. Such requirements are seen in air traffic control, navigation, surveillance, and other jobs where mistakes and errors can have devastating consequences. These sorts of tasks require that one monitor the environment, identify potential sources of error, and act quickly to circumvent negative consequences. Returning to our intrepid journalist, the copy-editing and formatting component of manuscript revision would constitute a vigilance/quality control task. As such, it would require a narrow scope of attention and continual allocation of attention toward the target stimulus. This suggests that inhibitory control is necessary for achieving quality and vigilance goals. Inhibitory control is needed for sustained, focused attention; it also plays a critical role in error detection and conflict resolution (Diamond, 2013). Although working memory is needed for problem solving, vigilance/quality control tasks are typically well defined in their structure and have clear rules or guidelines for how to resolve problems or mistakes (Stuss, Shallice, Alexander, & Picton, 1995). The potential sources of error are also well known and can usually be anticipated. Thus, working memory is not as essential for such tasks. Further, a diffuse attentional scope would increase the presence and awareness of irrelevant and distracting informational cues, which would deteriorate task performance.

The attentional demands required for vigilance and quality control tasks suggest that characteristics of music that limit attentional breadth would be beneficial for performance on these types of tasks. Listening to music that is in a minor key and highly complex narrows attentional scope to enhance inhibitory control by stimulating negative affect. Negative emotions tend to promote constrained and analytical thinking, whereas positive affect impairs decision making by promoting satisficing, heuristics, and short-term gain over long-term rewards (Lyubomirsky et al., 2005; Schwartz et al., 2002). These effects may be further enhanced when paired with a particular tempo and level of volume because these characteristics increase arousal (Corhan &

Gounard, 1976; van der Zwaag et al., 2011), which narrows attention. Based on these arguments, we propose that listening to music that is in a minor key, complex, fast in tempo, (e.g., Rimsky-Korsakov's "Flight of the Bumblebee"), and played at a higher volume should produce the narrow attention needed for vigilance and quality control tasks.

Proposition 7: Listening to music that is in a minor key, high in complexity, fast in tempo, and high in volume optimizes attentional breadth to meet the executive functioning requirements of vigilance and quality control tasks. This combination of characteristics facilitates inhibitory control but undermines working memory to enhance performance on tasks that emphasize vigilance.

Routine Tasks

Routine tasks are generally those that are performed frequently by the worker, require little attentional or mental effort, and tend to be monotonous and boring in nature (Campbell, 1988). Performance on these tasks tends to be fast and automatic. In the context of getting a news article ready for print, a routine task would be accepting minor changes and suggestions. Researchers argue that executive functions are needed for tasks that are complex and ambiguous, require novelty or generation of new knowledge, and/or require sustained attentional focus (Diamond, 2013). Thus, for tasks that are routine, engagement of high-order cognitive processes is not necessary; the cognitive demands of such tasks are minimal. Put differently, the need for working memory and inhibitory control is low for routine tasks. In this case the kind of music one listens to when performing routine tasks really does not matter, since there are no demands for working memory or inhibitory control.

However, we propose that there are particular combinations of musical characteristics that likely harm performance on any type of task *except* routine ones. Specifically, any combination of characteristics that does not fully optimize inhibitory control or working memory, which are needed for vigilance and ideation tasks, respectively, or optimize both inhibitory control and working memory, which are needed for complex tasks, should be fine for routine tasks. Consider, for instance, Combination 2, which is minor key, low complexity, slow tempo, (e.g., Adele's "Hello"), and played softly. Performance on vigilance tasks is likely to be impaired because attention is too broad to optimize inhibitory control. Yet performance on ideation tasks will also be lower because although attention will be broad while listening to music with these characteristics, the increase in negative affect (due to minor key) will reduce cognitive flexibility. Finally, performance on complex tasks will be lower while listening to songs with this combination because there is an imbalance between inhibitory control and working memory: inhibitory control is not optimized to an equal degree as working memory; thus, individuals are more likely to be distracted by irrelevant task demands or stimuli. As such, we propose that the only type of task performance that is unharmed while listening to music with these combinations of characteristics is one that is routine.

Further, some tasks that are initially complex or novel become routine (and, in a sense, simple) through proceduralization (Ackerman, 1987). This suggests that combinations of music characteristics that are harmful for performance on complex tasks no longer are once these tasks become proceduralized. The characteristics that were a debilitating distraction when the task was novel serve as a welcome distraction that allows one to cope with boredom once the task has become routine. For instance, learning to drive for the first time is complex because of the multiple and simultaneous activities that need to occur (e.g., steering, braking, signaling). Because of this complexity, listening to a song that is, for instance, in a minor key, high complexity, fast tempo, and loud in volume would be a bad idea (e.g., "Beat It"). As these elements of driving performance become routine, demands on attention are decreased dramatically, and the same song would not present any problems. In fact, on a long drive that same song might be helpful. Empirical evidence supports this idea: novice surgeons performed worse on a surgery simulation when listening to music, whereas more experienced surgeons experienced no decrements in their performance while listening to music (Miskovic et al., 2008). For an experienced surgeon, certain surgeries that were formerly complex have become routine and are therefore less cognitively demanding. As such, there is much less reliance on executive functions. For the novice surgeon, that same surgery would still be complex and, thus, would require active engagement of working memory and inhibitory control.

Proposition 8: Because reliance on inhibitory control and working memory for routine tasks is minimal, listening to music with any combination of characteristics is beneficial for these types of tasks. Furthermore, music with combinations of characteristics that are normally detrimental for other tasks is beneficial for routine tasks.

POTENTIAL MODERATING FACTORS

In this section we discuss the variables that may enhance or mitigate the effects of music on employee performance. Here we focus on factors that are most relevant for defining the boundaries for our proposed music-performance relationships. Specifically, we focus on the things that are particular to the relationship between music and executive functions, as opposed to factors that influence the effects of music or executive functions generally.

Worker Attributes: Approach-Avoidance Temperaments

Individual differences in approach-avoidance temperament are purported to be important for successful self-regulation and job performance (Elliot, 2006; Elliot & Thrash, 2010). Although many dispositional variables might be relevant, differences in approach-avoidance temperaments are likely more important in the context of our article because they directly influence how individuals respond to emotional stimuli. Approach motivation reflects a personal predisposition to orient behavior toward positive or desirable outcomes, and avoidance motivation represents a personal predisposition to guide behavior away from negative or undesirable outcomes. These motivational tendencies correspond to a particular set of basic personality dimensions: positive affectivity, extraversion, and behavioral activation comprise approach temperaments, whereas negative affectivity, neuroticism, and behavioral inhibition comprise avoidance temperaments (Elliot & Thrash, 2002; Lanaj, Chang, & Johnson, 2012). These temperaments provide the catalyst for approach or avoidance behavior (Förster, Friedman, Özelsel, & Denzler, 2006) and are differentially reactive to the presence of positive or negative stimuli (Balconi, Falbo, & Conte, 2012).

The presence of emotional stimuli influences the behavioral strategies and action tendencies used to achieve goals (Forgas, 1995; Schwarz & Bless, 1991; Schwarz & Clore, 1983). Approach temperaments are sensitive to positive stimuli and are motivated into action in response; avoidance temperaments are sensitive to negative stimuli and, consequently, behave in ways to avoid undesirable outcomes (Elliot, 1999). Further, approach-avoidance temperaments may have characteristic differences in global and local processing modes (i.e., the tendency to focus on either general or specific features and characteristics of stimuli; De Dreu, Nijstad, & Baas, 2011; Förster, 2009). This corresponds to differences in attentional breadth: those with approach temperaments are more likely to engage in actions or favor situations that facilitate the broadening of attentional scope, whereas those with avoidance temperaments are more likely to engage in behaviors or seek out situations that narrow attention (Förster et al., 2006). Thus, individual differences in approach and avoidance temperaments influence responsiveness to emotional stimuli and general tendencies in processing information.

With regard to music, this suggests that the effects of musical key and complexity on executive functions may differ for those with approach or avoidance temperaments. Musical key and complexity are the primary reason for emotional reactions, and, thus, an approach-avoidance temperament is likely to be more relevant for these characteristics than purely arousal-based characteristics (i.e., tempo and volume). In essence, musical key and complexity generate conditions that are more favorable for expanding or narrowing attention through their effects on emotions. Approach temperaments would amplify the positive relationship of major key and low-complexity music with working memory because individuals with this temperament are more sensitive and responsive to positive stimuli. For these individuals, listening to music in a major key and/or low in complexity more readily broadens their attention because of their general predisposition for global-focused processing. By the same reasoning, approach temperaments would also increase the negative relationship of musical key and low complexity with inhibitory control because of increased breadth of attention and their global processing bias. Thus, the positive effects of major key and low-complexity music on working memory are stronger for individuals with approach temperaments, as are the negative effects of these characteristics on inhibitory control.

Avoidance temperaments would strengthen the positive relationship of minor key and high complexity with inhibitory control. Individuals with this temperament are more sensitive to negative emotional stimuli and have a general preference for local-focused processing. Likewise, avoidance temperaments would strengthen the negative relationship of minor key and high complexity with working memory because of decreased breadth of attention and local processing bias. Thus, listening to music in a minor key and/or highly complex more readily narrows attention for these individuals, which strengths the effects of these characteristics on inhibitory control and working memory.

> *Proposition 9: Individual differences in approach-avoidance temperament moderate the effects of musical key and complexity on executive functions. The benefits of major key and low complexity for executive functions are greater for those with approach temperaments and weaker for those with avoidance temperaments. Conversely, the benefits of minor key and high complexity for executive functions are stronger for those with avoidance temperaments and weaker for those with approach temperaments.*

Other Music Characteristics: Presence or Absence of Lyrics

One relevant factor that may influence the effect of musical characteristics on executive functions is whether the song has lyrics or not. Although the emotional and arousing effects of music are unlikely to differ based on the presence or absence of lyrics (e.g., Sousou, 1997), attentional availability is likely to differ. Performance on cognitive tasks is usually impaired when listening to vocal music as opposed to instrumental music, regardless of the presence of other characteristics (Crawford & Strapp, 1994; Salamé & Baddeley, 1989). We propose that the presence of lyrics weakens the effects of other characteristics on executive functioning. Because the presence of lyrics results in uniformly low levels of attention, other characteristics of music (i.e., musical key, complexity, tempo, volume) have less influence on inhibitory control and working memory and, by extension, job performance outcomes. When listening to music without lyrics, other characteristics of music (i.e., musical key, complexity, tempo, volume) are the primary drivers of attentional breadth. Hence, the effects of music characteristics on inhibitory control and working memory (and, ultimately, performance) are stronger as a consequence. Put another way, the presence of lyrics creates an attentional "bottleneck" that reduces the effects of other music characteristics on executive functioning.

> *Proposition 10: Lyrics moderate the relationship between music characteristics and inhibitory control and working memory such that the proposed relationships are weakened when individuals listen to music with lyrics.*

Contextual Factors: Workplace Distractions

The presence of environmental distractors within the workplace may also impact the effects of music characteristics on executive functions. Work environments that are designed to enhance employee communication and collaboration (e.g., open office space layouts) can actually increase distractions in the workplace (Oldham, Kulik, & Stepina, 1991). We propose that workplace distractions increase the presence of task-irrelevant cues (e.g., Beal et al., 2005; Jett & George, 2003), which impairs executive functions.

Music may act as a protective factor against workplace distractions by reducing awareness of one's environment. Because there are more distractions, anything that helps one to tune them out is beneficial, even more beneficial than it would be if there were few distractions. Listening to music that is in a minor key, highly complex, fast in tempo, or played at a louder volume facilitates inhibitory control, irrespective of the number of distractions in the surrounding environment. However, these characteristics are likely to be even more beneficial in highly distracting work environments because they narrow attention. The narrowing of attention due to these characteristics reduces awareness of irrelevant task cues that are prevalent in highly distracting work environments (e.g., office noise). As such, the positive relationship between these characteristics with inhibitory control is strengthened under such conditions. As a consequence, performance on tasks that require inhibitory control (i.e., vigilance tasks) will be stronger. When workplace distractions are low, key, complexity, tempo, and volume still demonstrate a positive relationship with inhibitory control; however, the relationship is not as strong because there are fewer task-irrelevant cues in such work environments. As such, the need to listen to music that is minor, complex, fast, or loud is not as critical to facilitate inhibitory control when environmental distractions are low.

> *Proposition 11a: Workplace distractions moderate the effects of characteristics of music on inhibitory control such that the positive effect of music characteristics (i.e., minor key, complexity, tempo, and volume) is stronger in distracting work environments.*

Yet workplace distractions may also impair working memory by tilting the balance of attended stimuli toward irrelevant cues. Attention can become too broad in highly distracting environments so that it becomes counterproductive for working memory capabilities (Blair & Ursache, 2011) in highly distracting work environments. As a consequence, characteristics that otherwise facilitate working memory when there are few distractions (i.e., major key, low complexity, slow tempo, soft volume) become counterproductive by broadening attention to the point that the balance of one's focus is on irrelevant stimuli. Thus, major key, low complexity, slow tempo, and soft volume are beneficial for working memory when workplace distractions are low, but these benefits for working memory dissipate as the level of distractions continues to increase.

> *Proposition 11b: Workplace distractions moderate the effects of characteristics of music on working memory such that the positive effect of music characteristics (i.e., major key, low complexity, slow tempo, and soft volume) is stronger when workplace distractions are low but then weakens as distractions increase.*

DISCUSSION

As organizations look for innovative ways to create a more productive workforce, they are turning more and more to unconventional approaches or solutions. We argue that a simple, inexpensive way to enhance productivity is through music. However, it is not simply the presence of music that matters but, rather, the type of music and the pairing of certain types of music with certain work-related outcomes. Our propositions provide a framework for organizations to understand tasks and outcomes that are likely to be enhanced or hindered by certain types of music. By understanding that different characteristics of music influence various self-regulatory processes (i.e., inhibitory control and working memory), organizations can more effectively utilize music to enhance task outcomes. Furthermore, by demonstrating that different characteristics affect proximal causes of self regulation that are sometimes complementary and sometimes discordant, our review highlights the need to be more mindful about the type of music we listen to and what we are doing while we listen to it. Our review also shows that characteristics that induce emotional responses usually associated with negative outcomes (e.g., sadness, fear, anxiety, anger) can have benefits for tasks that are routine, tasks associated with quality control, or even complex tasks. Conversely, characteristics that induce positive emotional responses can be detrimental to performance on particular tasks. Thus, this article shows that music is not universally bad or good for the workplace—its effects depend on its characteristics, their combination, and the work outcomes being emphasized.

Theoretical Implications

The purpose of this article was to develop a theoretical framework describing the potential consequences of listening to different types of music at work. This topic has sparked the interest of organizational scholars and musicologists alike, yet investigations of it have been isolated to their respective domains, with very little cross-fertilization between the two. This article shows that each has something that could benefit the other. For instance, musicologists have made great strides in understanding the affective, psychological, and neurological effects of different characteristics of music. Organizational scholars have undertaken decades of research and created various taxonomies regarding the different types of work tasks and the relevant factors needed for successful performance on these tasks (e.g., attitudes, emotions, motivation). Separately, neither has provided a coherent theoretical explanation for how and why music may influence job performance. By drawing on their respective strengths, this article ties these two fields together to provide a theoretical link between music and job performance.

Using self-regulation as a theoretical framework—with particular emphasis on executive functions—we have detailed the mechanisms through which music affects work-related outcomes. We integrated research from music psychology, cognitive psychology, cognitive neuroscience, and the organizational sciences to provide a framework in which music can affect various aspects of job performance via changes to executive functions. Further, we increased our theoretical contribution by focusing beyond that absence or presence of music to identify the various elements inherent in the music and propose specific arguments as to how these different characteristics can influence self-regulatory processes. We identified the affective and physiological mechanisms by which different characteristics of music influence executive functioning. Our review suggests that different music characteristics affect attentional breadth through changes in emotional valence and arousal; these changes in attentional breadth facilitate or hinder executive functions.

We further contribute to the organizational science literature by proposing that different combinations of characteristics lead to optimal levels of attention to facilitate the relevant executive functions needed to carry out different types of tasks (idea generation, complex tasks, vigilance/quality control, and routine tasks). We proposed that based on the cognitive requirements of each task type, certain combinations of characteristics will be more beneficial for performance on that task because of their combined effects on inhibitory control and working memory. Finally, we elaborated on the relevant boundary conditions under which music is more beneficial (e.g., work environment, instrumental versus vocal music) and for whom (e.g., approach-avoidance temperament). In establishing these linkages between music and self-regulatory processes, we provide a new framework to understand the effects of music on job performance.

Implications for Research and Future Directions

Our proposed theoretical model provides several implications for future research. Although most of our propositions are probably best tested with field experiments, much could be learned initially from observational studies. Observational studies could help researchers understand what music employees listen to, what sort of work do they do while listening to music, and how well do they do it. This would help to refine hypotheses, which could then be tested in field experiments. Eventually, experience sampling method studies could tell us about intraindividual change in performance as a function of music characteristics and how intraindividual relationships might vary across people or contexts. Although lab studies might sacrifice some fidelity in the measurement of performance, they would be useful for testing an entire causal string, given that it is hard to collect physiological measures in the workplace.

In addition to implications regarding testing our proposed model, this article highlights several other questions about music in the workplace and potential avenues for future research. One important direction for future research is further investigation of the theoretical assumptions of this model. For instance, we represent these combinations of characteristics as additive rather than multiplicative. However, it is conceivable that characteristics combine in an interactive manner. For instance, it might be that the effect of complexity on executive functions strengthens in the presence of dynamic variation, rather than dynamic variation being a component of complexity. Other evidence suggests that key and tempo may interact to influence performance on cognitive ability tasks (Jefferies et al., 2008; Thompson et al., 2001). This is an important empirical question that should be addressed in future research.

Another area for future research is the possibility of curvilinear effects of characteristics and executive functions. There is very little evidence to suggest that music characteristics in of themselves can become so extreme that they put people over an optimal point in a quadratic function. But, conceivably, there could be cases where this is true. "Thousand" by Moby is purported to be the fastest song ever recorded, with a tempo of 1,015 BPM (Buckley, 2003). It may be that, at such a tempo, attention becomes too narrow so that one can only focus on the music itself and, thus, performance on any task suffers, perhaps even routine tasks. Similarly, music by modern composers who embrace atonality (lack of a tonal center), such as Arnold Schoenberg and John Cage, is considered to be extremely complex. It could be that listening to music of this complexity or absence of a discernible key could generate such negative emotions that performance is universally impaired. Again, this shows that although there are clear linear effects of characteristics on executive functions, there could be curvilinear relationships at extreme levels of certain characteristics, which should be explored in future research.

We also recommend that future research identify how characteristics of music impact work outcomes other than the ones described in this article. For example, listening to music with positive lyrics has been linked to feelings of positive emotions and engagement in prosocial behavior (Mast & McAndrew, 2011). This suggests that music may play a role in influencing engagement in organizational citizenship behaviors. Arguments can also be made that music could influence job attitudes and various dimensions of occupational health and well-being (i.e., burnout). Although the effects of music on physical and psychological health are well documented in other domains (Yehuda, 2011), they are not well studied in the context of the workplace (Lesiuk, 2008). Likewise, researchers should examine the impact of music over and above contextual factors in the workplace (i.e., feedback, supervisor support) in influencing performance outcomes. Although there is some field research on music at work (e.g., Lesiuk, 2005, 2010; Oldham et al., 1995), these studies did not compare the effects of music against other well-known predictors of job performance. We do not presume that music is a "cure all" for organizations or that it will replace the function of well-established predictors for various outcomes. However, music may be complementary for these relationships. Supervisor feedback, as an example, is important for improving task performance by clarifying expectations, removing barriers, and so forth, but the presence of music may contribute beyond the benefits of feedback by facilitating the cognitive processes actually needed to execute the task.

Future research should also investigate the effects of music in workplace environments where music is a constant feature. Other environmental factors such as noise, temperature, odor, and lighting have been well studied in the work context (Baron, 1990; Leather, Beale, & Sullivan, 2003; Szalma & Hancock, 2011). There is, as pointed out recently by Payne, Korczynski, and Cluley (2017), little research on how background music affects employees in jobs where background music is a fixture of the work environment (e.g., retail, service). Yet there is plenty of research on how background music affects consumer behavior (Garlin & Owen, 2006; North, Hargreaves, & McKendrick, 1999). These types of jobs typically require high amounts of emotional labor (Grandey, 2000). Music may be more useful for occupations that require acute emotional labor, because it can change one's emotional state. For occupations that require chronic emotional labor, music may be less effective at facilitating emotional control because employees become habituated to its effects. This implies that, in such situations, what is good for the customer (and the business) is not necessarily good for the employee, and vice versa.

At this point some readers may be thinking, "But wait—what about preference and familiarity? Don't they matter?" Yes, they do. This article, however, focuses exclusively on *objective* characteristics of music, based on the general assumption that people generally listen to music that they like or that they are familiar with. Further, research shows that music characteristics provide incremental prediction over and above familiarity and liking (Cassidy & MacDonald, 2009; Rickard, 2004; Sweeney & Wyber, 2002). It may that familiarity and preference are moderators of the proposed relationships. Generally, listening to familiar or well-liked music induces positive affect and increases arousal (Huang & Shih, 2011). It may be that listening to one's preferred music or music one is familiar with may amplify the effects of characteristics that induce positive affect (i.e., major key and low complexity) and attenuate the effects of characteristics that induce negative affect (i.e., minor key and high complexity).

Although it may be tempting to assume that listening to one's favorite music is universally beneficial, research has found that listening to *disliked* (i.e., least preferred) music can actually help cognitive performance (Perham & Sykora, 2012). Research has shown that listening to one's favorite music can be distracting and can divert attention toward the music itself (Avila, Furnham, & McClelland, 2012; Huang & Shih, 2011). Finally, there is a body of research that suggests individuals who score high or low on certain Big Five personality traits (i.e., extraverts versus introverts) exhibit different levels of performance on cognitive tests while listening to music (Furnham & Bradley, 1997). Clearly, future research should explore how characteristics of the listener, such as personality, musical preference, and familiarity, may influence the relationships proposed in this article.

Finally, listening to music while working may have a potential "dark side." For instance, although we argue that music that elicits negative emotional states can facilitate certain kinds of task performance, there may be unintended consequences for other work outcomes. Meta-analytic evidence suggests that negative state affect is associated with engagement in counterproductive work behaviors (Shockley, Ispas, Rossi, & Levine, 2012). Likewise, research from social psychology has found that listening to music with negative lyrics is strongly associated with feelings of anger and aggression and actual engagement in antagonizing behavior (Greitemeyer, 2009). This suggests that listening to music with characteristics engendering negative emotions may encourage deviant behaviors at work, which may detract from the potential positive performance benefits outlined in our article.

Further, the actual act of listening to music may have negative consequences, depending on certain work characteristics. For instance, although we suggest that listening to music in a distracting work environment, such as in open office environments, facilitates individual performance, this may be counterproductive for interdependent work tasks. While one may want to use music as a way to reduce environmental distraction and improve concentration, it may, in fact, harm the functioning of a unit or team by reducing communication between team members. Coworkers may react negatively when other coworkers constantly wear headphones and may interpret such actions as a sign of disinterest in establishing personal relationships at work. Likewise, for jobs that require a high degree of customer interaction, listening to music may signal poor customer service orientation and reflect badly on the company as a whole. Thus, special attention must be paid to when and where employees listen to music and to the associated trade-offs. These are critical questions that should be explored in future research to help inform managers how they should develop and implement effective music listening policies.

Implications for Practice

Letting employees listen to music at work often presents a conundrum for organizational leaders and managers: to some, music is a way to improve employee mood and productivity, while to others, music is a distraction that disrupts organizational processes. Several articles have been published in outlets such as the *Wall Street Journal* and *Harvard Business Review* debating the advantages and disadvantages of music in the workplace. Yet, despite this interest, organizational scholars have been slow to join the conversation. As a result, we have little wisdom to offer regarding questions such as the following: Under what conditions is music beneficial and why? What are the characteristics of beneficial music and why? What are the characteristics of people who benefit from music in the workplace?

We believe our review provides the first steps in answering these questions for practitioners. For instance, although managers may be reluctant to allow their employees to listen to music at work, our review suggests that this concern is not always well placed. Listening to music should not impair all types of performance, and, in fact, certain types of music may improve certain workplace outcomes. Likewise, the type of music that employees listen to at work should depend on which outcomes the organization values most. For example, if the organization values creativity, it should encourage its employees to listen to slow music in a major key, played at a soft volume. We also identify potential characteristics of individuals (i.e., approach-avoidance temperaments) who might benefit from listening to certain kinds music at work. Finally, there are factors of the workplace itself that need to be considered when using music, such as the number of distractions in one's work environment.

The inclusion of music in the workplace may also offer additional benefits besides those driven primarily from listening to it. Research on group listening and singing activities suggests that such activities can facilitate interpersonal relationships (Knight, Spiro, & Cross, 2017). Workgroups, for instance, could institute a "song of the week" policy in which employees listen to a song recommended by a different team member every week. Work units could hold informal discussions about how it made the employees feel or what they thought about the music. Music is also commonly used as a learning device: most school children learn their ABCs or the elements of the periodic table through song. Creative managers could incorporate music into training exercises to increase trainee engagement and, potentially, recall of training material. These are some of the ways in which music can enliven the workplace.

CONCLUSION

Music is a universally valued phenomenon and a key feature of every known culture and civilization. People also devote a lot of time to music: the average American spends up to four hours a day listening to music (Rentfrow, 2012). It is more than likely that part of that time is also work time (Haake, 2011). Our article shows that organizations can use the power of music to positively impact the work lives of their employees and achieve organizationally valued outcomes. Based on the available research and the arguments we presented in this article, we believe that music and, more precisely, the characteristics of music should be included in the study of organizational behavior. We hope that this article serves a launching pad for such future research.

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