Cognitions and Effects of Music Consumption

Zachary Krastel

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By: Zachary Krastel

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Signed by the final examining committee:

_____ Chair
Dr. Alexandra Panaccio

_____ External Examiner
Dr. Mehdi Mourali

_____ External to Program
Dr. Karen Li

_____ Examiner
Dr. Danilo Dantas

_____ Examiner
Dr. Jui Ramaprasad

_____ Examiner
Dr. Bianca Grohmann

_____ Thesis Supervisor
Dr. Onur Bodur

Approved by

_____
Dr. Cédric Lesage, PhD Program Director

October 15, 2021

_____
Dr. Anne-Marie Croteau, Dean, John Molson School of Business

Abstract

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Zachary Krastel, Ph.D.

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Music plays an important role in our everyday lives, and constitutes a large consumer industry. However, research on music is fragmented across many disciplines, and lacks integration. In marketing, music is rarely the focus of study; it is predominantly examined in terms of its potential as an atmospheric element in retail settings, and is usually only applied as a moderating effect. This dissertation focuses on understanding music cognition by systematically deconstructing it, in order to better understand how music affects individuals and how it can be utilized to achieve specific goals in consumer contexts.

The first essay of this dissertation is a conceptual paper. It reviews the existing research on music and develops a comprehensive model of how music is processed by individuals. The model integrates music's core compositional aspects (lyrics, pitch, and rhythm) with the types of processing that can result when individuals encounter music (semantic, referential, and social). These processing types are then linked to the outcomes of music seen in existing research. Overall, the model is able to explain how music can influence emotion and create cognitive effects for individuals; specific adjustments to a song's core elements that can emphasize these effects are delineated. Research propositions are presented which aim to bring clarity and focus to future research using music.

The second essay focuses on a single relationship in this model: between rhythm and social connection. Anthropologists have hypothesized that the rhythm element of music may

have evolved over time in human societies as a vehicle for social bonding. Across five experiments, I examine this relationship further. I vary the level of rhythm in a song and show how engaging with rhythmic music with a member of an organization creates a "synchrony effect", where the two individuals feel closer to one another. Individuals' prosociality and feelings towards the organization improve after these tasks. I also show how it can lead individuals to change their brand preferences to align with the other participant. This effect occurs even in experiments where a pre-recorded video was used, which improves the feasibility of implementing this research in practice.

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Contribution of Authors

The first essay of this dissertation is co-authored with Dr. Onur Bodur. The idea of this project came about from my attempts to understand and explain music composition and its effects in discussions with him. Dr. Bodur was instrumental in these early discussions by asking questions that spurred further investigations, by providing feedback, and by encouraging the conceptual development of these thoughts into a larger work. He contributed to the preparation and editing of the manuscript.

The second essay of this dissertation is also co-authored with Dr. Bodur. He contributed to the conceptual development and design of the experiments, as well as preparation of the manuscript. He also provided financial support in data collection.

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Introduction

Imagine you are walking through a grocery store when music begins playing in the background. A variety of things may happen at this point. You may notice that it is a song you have heard before, or that it sounds familiar. Or, perhaps you don't consciously notice the music at all. Instead, you may find yourself feeling happier, for a reason you don't identify; maybe you complete your shopping trip faster than you normally would have, as you subconsciously increase your tempo to match the music. You may even find yourself interacting with store employees or other shoppers more willingly and pleasantly than you might have otherwise.

These thoughts and actions are not guaranteed to occur for every individual, in every circumstance. Many aspects of your life will impact whether music affects your mood or decisions in this type of scenario. This includes the culture you were raised in and the music you heard from an early age, your personality, and the extent to which you link music to specific memories, and your experience with the specific music genre or specific song that is playing. It also may be impacted by the task at hand: if you are rushed, you may not pay as much attention to the music playing, or it may add to your stress. Other things that could impact this dynamic include the volume of the music that is playing, whether it includes lyrics, and the harmonic complexity of the song, among a variety of other aspects.

There are many ways in which music can impact our lives, as described in the example above. Yet, while consumers are generally aware of music's influential abilities, when asked about the impact that music may have played in situations such as the one above, people generally deny that it affects their behaviours personally (Hynes and Manson 2016). In academic research, music is also often overlooked; it is generally treated as a single item, that is simply

either included in an environment, or not. The above example outlines just a few of the simultaneous processes that can occur when an individual encounters music, highlighting that there is much more that should be examined than the effect of simply including music in an environment, or not. In addition, music itself has a great variety of styles that are difficult to define and organize (Aucouturier and Pachet 2003), further complicating the question of how to implement music into an environment in the most effective and actionable manner possible.

Despite the confusion surrounding the potential implementation of music, the effects of music on individuals have been shown to be very strong, as evidenced by a large body of literature spanning multiple fields of study. Music has shown differential effects on both cognition and affect (Cameron et al. 2003), and has even been linked to neurochemical reward pathways otherwise reserved for basic biological functions, such as food and sex (Salimpoor et al. 2013). Yet, interrelations between these studies are lacking, as are attempts to reconcile these findings with how we know music affects us in our daily lives. Overall, it appears that there are many ways in which music can strongly affect individuals, but current insights from our own lives and from academic research are insufficient on their own in providing an explanation for how this occurs, or how it might change with different types of music.

The first essay of this dissertation, "A Review and Theoretical Model for Music Cognition," brings organization to this research topic by reviewing the existing literature on music and developing a model that can explain how music is processed by individuals. Specifically, three sets of research are identified and reviewed. First, research in anthropology and sociology has theorized on how music may have evolved, noting at least two distinctive evolutionary "pathways" that are driven by two underlying roles that music has played in relationships and the development of human societies. Research in neuroscience has similarly

found two separate processes linked to music in the brain, and there has been an effort to link these to the proposed evolutions of music mentioned above (Peretz 2006). Second, past research has investigated the emotions that can be evoked from music (e.g. Sachs et al. 2015, Salimpoor et al. 2015), and has developed propositions for how music develops meaning for individuals over their lifetime (e.g. Zhu and Meyers-Levy 2005). Finally, research conducted in psychology and consumer behaviour has discussed a wide variety of uses for music in everyday life, and has shown evidence of various effects that music can have on individuals; this includes when music used in a utilitarian fashion by individuals to manage their moods (e.g. Kawakami et al. 2013), or when encountered as an atmospheric element in one's environment (e.g. North et al. 2016), for example.

If brought together, these three sets of research have the potential to provide theoretical depth and a more thorough understanding of how music can affect individuals. The first essay does this by linking these research streams together in a conceptual model. First, music is deconstructed using evidence from musicology, neuroscience, and anthropology to explain how music is processed. It concludes that there are two *core elements* of music that have different evolutions, and are expected to have different effects on individuals. Next, the essay uses this deconstruction of music to explain how the core elements may develop meaning over time separately from each other, and how one's reactions to music and musical preferences should evolve over their life based on their encounters with these core elements of music. Finally, this understanding of music processing is used to explain how music will be expected to impact individuals in a variety of consumption environments. The second section of the essay presents a series of research propositions that suggest ways that this conceptual model can be extended, along with a selection of research questions that can be developed in the future using the model.

The model in the first essay outlines a variety of different processes that can be linked to music. The second essay of the dissertation, "Clapping to Connect: How a Music Synchrony Task Can Impact Organizations and Brands," focuses on a single process within this model. Specifically, it looks to understand why individuals have heightened awareness of other individuals and are more willing to follow cues given by the individual after the two individuals complete a joint musical task together. While the concept of this *synchrony effect* has been shown to be replicable and consistent in literature (Mogan et al. 2017), the process by which it occurs is not clearly understood. This second essay uses the deconstruction of music initially presented in the first essay as a foundation for the design of a series of experimental studies: results show that rhythm, specifically, is the core element of music that is responsible for these effects. Across five studies, it is also shown that completing tasks involving rhythmic music causes individuals to (1) become more willing to contribute to a charitable organization and (2) improve their perceptions of these organizations, after completing the task with a member of the organization; results of these synchrony tasks also lead individuals to (3) change their brand preferences and become more willing to try new products from brands that are aligned with the task partner. It is shown that these effects are the result of heightened feelings of social affiliation with the other individual in the task; thus, the joint music task is shown to be ultimately responsible for these outcomes, because of music's ability to improve interpersonal relationships.

In discussing these synchrony tasks, the second essay provides insight on how organizations can connect with consumers through a relatively novel means, and provides suggestions on how to implement these tasks in practice. More generally, the studies show the power that music – and specifically, rhythm – can have in facilitating social relationships. To this end, many of the results of this research are the result of the careful design and implementation

of the music stimuli in these studies. This demonstrates the usefulness of the model presented in the first essay, showing the value that comes from taking a more systematic approach to using and studying music in academic research.

Essay 1: A Review and Theoretical Model for Music Cognition

Abstract

The purpose of this conceptual essay is to review the existing research on music and develop a comprehensive model of how music is processed by individuals, based on music's core aspects (lyrics, pitch, and rhythm) and the types of processing that can result (semantic, referential, and social). The variables that form the basis of this model are chosen because past research in anthropology, psychology and neuroscience indicates that there are distinct origins and cognitions that result from each of these core aspects. The processing types are then linked to the outcomes of music seen in the marketing literature. The conceptual model presented in this essay is the first research to comprehensively address the structural components of music; its theoretical contributions include providing a process explanation for the impact of music, and in explaining how changing music's core aspects could result in differing emotions or cognitive effects. The essay concludes with a series of research propositions built upon the model presented, which focus on guiding future research in a way that takes a more systematic view of music. The main outcome of essay 1 is in identifying research directions in marketing that integrate music cognition.

Introduction

Current research in music spans many diverse fields, including anthropology, neuroscience, psychology, sociology, and consumer behaviour. However, the limited music research that has been conducted in each of these fields tends to fall into what has been called "research microtribes" (Alvesson and Sandberg 2011), where researchers focus on areas of study relevant to their own field and do not link their findings to a larger nomological net. The result of this has been a lack of overarching theory, which has limited our ability to fully understand music; thus, we are unable to unite insights gained in how music is neurologically processed in humans with the effects of music that we see in retail environments, for example. At the same time, there is a call within the field of consumer behaviour for researchers to explore and integrate findings from other disciplines into their work, in order to bring forward a new wave of insights (Zaltman 2000).

The current essay answers this call, presenting a multi-disciplinary work in music that brings together relevant aspects of music processing from various fields into a single theoretical model. Music's evolution over human history is united with its structural elements, and these are linked to ways in which music is neurologically processed. Finally, the resulting model is used to explain the different ways in which music can impact individuals. The foundation of the model is in considering music not as a single item, but as two simultaneously-occurring processes, linked to two core elements of music: pitch and rhythm. Through a series of research propositions, it is shown how this can potentially explain the variety of types or "genres" of music we see today; it can also explain why some music is better-suited for social situations, while other types would be better for individual emotion regulation, or to be played in the background while completing a cognitively-demanding task. Additionally, this essay highlights the potential for both attention

and culture to moderate music's effects, and the specific elements of the music that are most susceptible to these effects are identified.

There are key managerial implications of this model, as it can help to determine the types of music that are best-suited to supporting the manager's goals, whether they be to increase social interaction, increase arousal, or generate an emotional response. Given that there is limited work focusing on music's effects, this is a valuable first step in taking a measured approach to the implementation of music in academic studies. The model can be easily applied to future studies in order to generate stronger music-related effects; at the same time, it also provides process explanations for how and why they occur.

Essay organization

Since one of the purposes of this essay is to review and unite the findings of many fields, part 1 of the essay provides a detailed review of the literature in music, focusing on the (hypothesized) purposes and origins of music. Insights gained from this review are used to further refine the definition of what is considered "music", eventually resulting in the coalescing of music into two core elements: pitch and rhythm. This section focuses on defining and differentiating the key constructs of pitch, rhythm, as well as other relevant qualities of music.

Part 2 of the essay presents a conceptual model of music processing. The proposed model connects the core elements identified in the previous section with a series of music processing types, which are based on findings and theories from the literature. It then links each of these processing types with the outcomes that have been linked to music, including reward value, emotion, cognitive impacts, and interpersonal impacts.

Finally, part 3 of this essay presents a series of research propositions to guide future research on this topic, organized into three categories. The first proposes how the model can be applied: this includes use of the model to understand existing literature, and to choose music for various circumstances or goals; it also includes how music effects may differ based on culture, and how the model may be able to explain existing patterns of music across societies. The second category includes propositions on how to refine the model, focusing on potential relationships between constructs in the model that do not have empirical evidence in the current literature; it also discusses attention level as a potential moderator of the relationships in the model. Finally, the third category of research propositions discusses potential ways in which the model can be extended in future research, suggesting that focus be placed on understanding the domain-specificity of rhythm-related effects in music.

Part 1: Literature Review and Theoretical Foundation

Purposes and origins of music

Research spanning a wide range of fields has identified various purposes for music within human culture. The scope of this research is great; it includes linking the purposes of music to human evolution (Hagen and Bryant 2003), using the localization of music processing within the brain to explain music's functions (Peretz 2001), and relating music's functions to how we use music in everyday life (Hargreaves and North 1999). While disparate, it is important to note that these areas are not contradictory, nor are they necessarily independent; in fact, they are often complementary. This resulting array of "purposes" of music that appear in the literature will be summarized in this section.

Lyrics and language processing

A consistent theme among the literature is music's ability to convey a message. This can be divided into whether the message involves lyrics, which will be defined as semantic content that is attached to a melody, or whether the message is contextual, in how it is represented by the pitch and rhythmic elements of music.

First, we can consider that the lyrical content of a song can be processed for its semantic content. In other words, the text of music can be processed similarly to the text of speech. This on its own is relatively obvious. However, the literature in psychology has placed special focus on the idea that music as a whole is processed similarly to language. Evidence of this includes functional magnetic resonance imaging (fMRI) studies that show that when processing music, areas of the brain such as Broca's area become active (Maess et al. 2001) – this area is known to be responsible for text processing. Overall, there has been a conclusion that language and music are likely linked, because of shared neural patterns (Levitin and Tirovolas 2009), and therefore music is sometimes classified as a sort of "language", with the learning of music akin to the acquisition of a language.

Various studies and experiences bring support to this argument. Music's great complexity, at least in classical Western forms, requires a basis of knowledge in order to enjoy its full benefits, and those without this knowledge often feel lost when approaching a music listening environment; for example, consider attending a music concert in an unfamiliar genre for the first time (Gainer 1995). Similarly, performers require a long process of learning and familiarity to be able to create or perform music. Both of these suggest that knowledge must be acquired over time in order to effectively and fully process music, supporting the idea of a link with language acquisition. However, many concepts require this sort of learning process – for

example, the concept of learning and internalizing information regarding social norms also requires a building up of linkages and structures over time (Deutsch and Gerard 1955), yet we do not consider the learning of social norms as akin to language acquisition.

Further, there is empirical evidence to back up the idea that music is not processed similarly to speech (Bharucha et al. 2006). Although the overall structures appear similar, the specific brain areas for processing each do not exactly correlate (Peretz 2001). Even in cases where the area activated is the same, the spatial patterns within these areas for the processing of music and language are different (Abrams et al. 2011).

One likely explanation for past results showing similarities between music and language may be the confusion of including music in studies which contains lyrics, or in including familiar music stimuli with lyrics removed, which may have encouraged subjects to "fill in" the lyrics from memory. Research has identified that music with lyrics appears to be processed similarly to speech, in terms of the cognitive interference that it can have (Kang and Lackshmanan 2017), with music-with-lyrics having significantly higher interference with short-term memory than music without lyrics (Salamé and Baddeley 1989). This indicates that when lyrics are included, the added effect is likely due to the textual and semantic content of the lyrics, rather than anything unique to the sound-related aspects of music. If anything, including music with lyrics in scientific study may be leading to erroneous conclusions regarding the distractive potential of music. Overall, it is not of theoretical interest to include lyrics further in the current discussion, since it only acts to confuse the separate processing that occurs of the other elements of music, which have more evidence of being uniquely tied to music – sound without lyrics is still considered to be music. Therefore, while lyrics likely add layers of semantic meaning to music, they will not be considered further in the discussion in this essay or in the subsequent model.

Conveying a message and emotion

Second, apart from any text content of a song, the structure of the melodic and harmonic elements of the music can also evoke meaning for the listener. Songs are considered to have positive or negative valence based on the organization of simultaneously-occurring pitches, or "harmony": songs in a minor key are those whose pitch structure includes a minor third interval from the tonic foundation, and are generally considered "sad" songs, or otherwise of negative affect; conversely, those songs whose dominant pitch structure contains a major third interval from the tonic, and therefore is in a major key, are generally considered "happy", or pleasant songs[1] (Hevner 1935). An example of a song that is considered traditionally "happy" is included in Appendix A, Track 1.[2] This is not confined to the tonal center or key harmonies of a song, and we see examples of other music structures being associated with specific emotions. For example, as early as the Baroque era, a repeated descending bass line over the chromatic scale was seen to symbolize mourning and sadness; the composer Henry Purcell uses this to convey the grief that is felt as Dido mounts the funeral pyre in Act III of his opera, *Dido and Aeneas*, composed in the year 1680 (Machlis and Forney 2003). This is included in Appendix A, Track 2. Listeners during

[1] The C-major chord, comprising the notes of C, E, and G played together, evokes positive emotion; it can be contrasted from the C-minor chord, comprised of C, E-flat (E^b) and G, which is perceived as of negative affect for a Western listener. These two types of chords are the most effective and prevalent drivers of affect in Western music. The differentiator between these chords is their internal harmony, or the distances between the pitches: specifically, the major chord contains a major third from the tonic note of "C" – that is, the note of "E" is two full tones away from "C"; the minor chord contains a minor third, with "E^b" being only one and a half tones away from "C".

[2] This recording is from Haydn's Symphony No. 94 in G major, commonly known as the "Surprise" symphony. While listening, notice the pleasantness and calmness of this song, especially up until the 2:20 mark. Most Western listeners would characterize this as a "happy" song. This song was first performed in the year 1792, which puts it squarely within the "Classical" era of Western music history. Songs composed during this time period were generally *diatonic*, meaning that they were composed with the purpose of evoking clear emotions, which was done by only including relatively simple harmonic structures within the music; songs did not change key or tonal center very often, and the result was very stable music that could generally be described as clearly evoking a single emotion (Machlis and Forney 2003).

that time, but also today, would feel sadness not only from the narrative of the opera at that moment, and from the minor key (traditionally associated with sadness), but then in an additive function from associations they have with that descending musical structure, which they have experienced throughout their life as connected to mourning. It is important to note that associations with tonal center, melodic contour, and other pitch structures are likely culturally-specific, and there are differences in non-Western cultures with how pitch organizations are linked to emotions (Ball 2008). In other words, each culture has their own set of such associations that may or may not directly correlate with the associations found in Western music.

Regardless, in this way, music is used to transmit an "emotional message". There is evidence that we use this emotional content of music to complement our own moods, seeking out music that allows us to maintain our moods or otherwise facilitate changing them (Alpert et al. 2005). What we choose to use as music to regulate our mood is driven by associations we have from similar emotions in the past, as will be discussed below. A library of music and sounds we associate with each emotion is built up over time within our culture and passed down to each new generation. Evidence of this can be seen when mothers sing to infants in different styles to help them regulate their emotions (Trainor 2008), such as when a lullaby is sung to a baby as they are rocked to sleep. Even at this early age, we are taught which emotional states are associated with which music elements, and in this way, music is identified as a key method by which we can regulate our own emotions.

Group cohesion

Music is not solely used for *individual* emotion regulation. Music also operates via emotional contagion, where the purpose is to "converge emotionally" with others (Hatfield,

Cacioppo, and Rapson 1994). In this way, music can also be used to bring a group closer together. Anecdotally, we can see this when we go into a bar or restaurant and upbeat music is used to evoke excitement and conviviality in the patrons. Similarly, choir singing, in which individuals sing a melody together with a group of others but at regular harmonic intervals, is a common group activity in the religious music traditions of Western culture. The unison breathing required to complete this joint task is shown to require a consistent heart rate across singers, which positively affects their behaviour towards each other, uniting them as a group (Vickhoff et al. 2013).

In fact, one of the original purposes theorized for music within human societies is that it could be a way to bring a group together and improve their social bonds with each other. It is thought that music and dance are intertwined in this, and could have evolved together to credibly communicate coalition quality (Hagen and Bryant 2003). Supporting this is evidence of a strong motor component to the mental representation of musical rhythm (Lang et al. 1990, Peretz and Zatorre 2005) – when we listen to music, areas of the brain normally reserved for movement are activated. It follows, therefore, that music has often been used in history to accompany joint movement in groups that need to work together: this includes music for marching to, and work songs, among others. Although the music's role in these scenarios is to provide structure to support task regulation and coordinated movement, the fundamental principle at play is that the group must come together, and music is used to achieve this – therefore, this is still consistent with music's use as a method to bring people together. Altogether, the fact that music-making often necessitates a combining of multiple efforts across individuals, and the overall participatory nature of music both support the idea that music is a "group cohesive force" (Mithen 2005), working to bring individuals together and strengthen their bonds.

Sexual selection and complexity

Another theory for the purpose of music is that it may have evolved to impress potential sexual partners. This was posited by Darwin (1871): like other art forms, he thought that being able to achieve the level of skill required to perform music showed the "quality of one's brain, and therefore genes". Thus, a potential mate watching a skilled musician would evaluate their ability to create beautiful music as a signal that they would be a high-quality pair choice. Further, music's potential for complexity and creativity allows one to express boldness and individuality within a set framework, which can also be attractive. This theory has continued to be posited throughout the modern era (Miller 2000), since it can explain the variety and complexity of music that we see today.

This position is often challenged. For example, it has been pointed out that a sexual selection argument cannot easily account for the highly prevalent joint music creation scenarios we see across societies, and especially synchronized performances (Hagen and Bryant 2003). This social link to music is simply not consistent with the use of an exclusively sexual selection hypothesis for music's origins. However, as will be discussed next, it is of value to distinguish the origins of two separate elements of music – those of pitch, and those of rhythm. This distinction allows for a more logical link between sexual selection hypothesis and pitch elements, since the conflicting elements of social contexts and social processing of music have been conceptually removed and instead linked to the separate musical element of rhythm.

Core elements of music

The previous section presented four hypothesized purposes for music. For each, the composition or structure of the music can act as a process explanation for how music fulfills each

of these purposes. For example, when discussing how choir singing brings individuals together, the focus is on the temporal arrangement of the frequencies (notes); conversely, when discussing "happy" vs. "sad" music, the focus is on the frequency of the sound, and not the temporal aspects. In fact, for each of the above-mentioned purposes, one of the three *core elements* is most crucial in explaining the evolution of that purpose, and in facilitating the related outcomes.

The three core elements that can be identified in music are lyrics, pitch, and rhythm. As discussed above, the hypothesis that music is a sort of "language", and is therefore an accidental artefact of human's development of language, has strong counterarguments in the literature. Furthermore, lyrics are not necessary for sound to be considered music, nor for any of the above purposes to be fulfilled. For these reasons, *lyrics* will not be considered as a core element any further in this essay. The remaining two elements are discussed below. Altogether, music is defined here as the arrangement of discrete frequencies (or "pitches") across a temporal space.

There are many differences in how these elements are processed and applied within human societies. For example, while pitch elements appear to be learned over one's life, a sense of rhythm appears to be innate. Further, rhythm is very memorable: in one study, subjects who sang popular songs from memory came within 8% of the actual tempo of the music, despite having no prompts or reference points to match (Levitin and Cook 1996). As will be discussed in the following section, this is one of many reasons why pitch elements and rhythm elements should be considered separately in scientific study.

Pitch, harmony, and melody

Pitch elements of music refer to the tones (individual sounds) used in the music, and are a function of the frequency of the sound. For example, a piano has a frequency range of 27.5 hertz

(cycles of a sound wave, per second) to 4186 hertz; this is divided into 88 individual tones that can be played within this range. The tones within Western music, on which piano and other common instrument tuning is based, are tempered (or arranged) so that there is equal spacing between them; altogether, a piano presents with just over eight octaves (hierarchical groupings) of twelve tones each. While these tones have become quite familiar within a Western music tradition, it is important to note that other cultures have different frequency divisions, dividing an octave either into more or fewer than 12 tones.

A single sound frequency (tone) is not usually considered music on its own. The first method of adding complexity to sound to form music is to layer multiple pitches together at the same time. The term *harmony* is used to refer to this. Some aspects of harmony are consistent across cultures: this includes that tones an octave (12 tones) apart are perceived as being similar to each other – this is found to be the case in individuals across countries (USA, Germany, Japan), generations, and musical backgrounds, and in infants (Zentner and Kagan 1998); this is also found in animals such as birds and whales, even though other conclusions about similarities between human music and animal sounds cannot be drawn (McDermott 2008). This suggests that there is a universal fundamental preference for dividing frequency ranges into octaves. Apart from octaves, there also seems to be a preference across cultures to consider a fifth interval (the tone of "G", compared to C, for example) to be more consonant, or pleasing, than other intervals; this is consistent with Pythagoras's claim that a simple integer will have more consonance than a more complex one (Tramo et al. 2001). Again, this suggests a psychoacoustic or mathematical reasoning for the consistency across cultures. However, apart from these fundamental intervals, there is less similarity between preferred frequency groupings across cultures. Thus, apart from octaves, preference for certain harmonies is linked to each individual culture – this also indicates

that it is something that is not innate in all humans and must be learned by each individual. This topic will be discussed in more detail later in the essay.

The second method for adding complexity to pitches is to arrange them sequentially. The organization of pitches one after another is referred to as *melody*. Melodies can either go up or down, in reference to the frequency of the preceding pitch; as the melody continues, its contours (highest and lowest points) act as landmarks for the musical passage. The level of gap between the pitches – the interval between them, more specifically – will also provide complexity and character to the melody.

The final method for adding complexity to pitch is in terms of the larger structure of pitches to which all elements of the music refer. Within the Western cultural music tradition, the octave's division into twelve tones leads to twelve *tonal centers*, or "keys", corresponding to each note. For each key, notes that are closer in terms of consonance (such as an octave or fifth away, and descending in consonance from there) will lead to more pleasant sounds when combined. Both previously-mentioned aspects of pitch complexity – harmony and melody – are subject to the tonal center of the song. For example, melodies composed of notes that are consonantly closer to the key of the music ("diatonic"), will create more pleasant-sounding melodies. Complexity can be added by adding more layers of harmony through the addition of tones, and emotion can be evoked by composing harmonic intervals or melodic structures that alternate between consonance and dissonance, or by slowly moving to one or the other over a musical passage. Given that there are twelve tones available and that these can be layered into very complex groupings and combined with many types of melody contours, this interplay of consonance and dissonance can become quite complex.

Temporal aspects and rhythm

The second key aspect of music is that it exists across a temporal, or time-oriented, space. As discussed above, the arrangement of sequential frequencies creates melodies. Apart from what is mentioned above in terms of direction and interval gap of the frequencies, the timing of the spacing between notes is a defining feature of a melody, adding complexity and creating a unique character. Harmonic structures, such as chords played by an accompanying instrument (usually a piano or guitar, in the Western popular music tradition) can also be adjusted to fit with or complement the temporal space of the melody. However, the timing of pitch elements is only one temporal aspect of music.

Music almost always includes a regular *meter*, or "time signature", which acts as an anchor to which sequential pitches of music are connected. The basis of this concept refers to how sounds are grouped together in short cycles, called *bars* or *measures* – these are normally only a few seconds long, but the repetition of this pattern provides for the basic structure of a song. Bars or measures contain a set number of "beats", which you may think of as the points at which you would nod your head to the music, as a listener. The most common meter in Western music is a 4/4 meter, which means there are four "beats" for each measure of music. Therefore, multiples of 4 (quarter notes, eighth notes, etc.) are the most common ways of dividing a measure in popular music, although syncopated music which goes slightly outside these norms is common in styles such as jazz, for example. 3/4 meter (three beats per measure) is common for traditional dancing styles such as waltzes.

Regardless of the time signature, the downbeat (first beat) of a measure is the most important, and it is usually emphasized in some way, especially by instruments responsible for rhythmic aspects of the song. While the time signature is highlighted by the timing of the melody

and the accompanying harmonic elements, the most prevalent method to indicate meter is usually percussive instruments, such as drums. While drums form the core of the rhythmic elements of Western popular music, a bass line which is played at a regular rhythm according to the time signature can also be an important indicator of meter. Overall, the rhythmic aspects of the song tend to be most related to the drums and bass elements of a song, with melodic or harmonic elements fitting on top of this provided structure.

Evidence of discriminant validity between core music elements

There are many arguments for why pitch and rhythm elements should be analyzed separately in scientific study. This section lays out some of this reasoning, focusing on differences in each element's neurophysiology, differences in the hypothesized origins and purposes of each element, and differences in how they are linked to other cognitions.

Neurophysiology of music elements

The neuroscience literature generally concludes that there are two neural mechanisms for music, which are universal within humans (Peretz 2001). Specifically, in the brain, when pitch is being processed, there is increased activation in the right auditory cortex and the right superior temporal gyrus; when rhythm is processed, areas generally associated with movement and coordination are activated, including the motor cortical areas (Lang et al. 1990), cerebellum and basal ganglia (Janata and Grafton 2003, Peretz and Zatorre 2005). Included among the studies in which this is confirmed are clinical studies with patients who had impairments in areas linked to one music element, but who could still process the remaining element (Peretz et al. 1998).

This research indicates that these two elements can be processed independently from each other. Neuroscientists have therefore concluded that these are entirely separate brain modules, since they meet Fodor's criteria: they are domain-specific (linked to specific functions or elements without crossover), are localized within specific brain regions, and are innate within humans (Peretz 2006). Overall, there is clear neurophysiological evidence for separating pitch elements and rhythm elements, based on distinct mechanisms within the brain.

Discussion in the previous sections presented evidence from cross-cultural studies that pitch associations are not innate within all humans, and must be learned; this may seem to contradict the previous paragraphs, which suggest that pitch processing capacity is "built in" to humans. However, it is important to note that humans' general *capacity* to process pitch, as evidenced by domain-specific regions of the brain responsible for this, is not synonymous with any one individual's *actual ability* (which is learned over time) to meaningfully process pitch elements such as specific types of melody contours, harmonies, and tonal centers. While all humans *can* process pitch, the specific patterns of pitches that become preferred will depend on how an individual learns it – even if this learning occurs relatively automatically through listening to the music of their culture (instead of another's), for example.

Secondly, there is evidence that some universal elements of pitch processing *are* present in infants, i.e. before any cultural associations have been made. For example, developmental studies with children show that within the first year of life, they begin to associate long, high-pitched, and quiet tones with calmness (Trainor 2008). However, they can only begin to be able to detect changes in key and harmony in their native musical culture between the ages of 5 and 7 years (Trainor and Trehub 1994). Therefore, while some level of pitch processing may be innate across all humans, this is not enough to process even basic elements of music. Altogether, it can

be concluded that pitch associations must be learned throughout one's life in order to associate any meaning to them.

On the other hand, rhythm appears to be innate. Infants are capable of perceiving violations in complex meter, even though this more characterizes non-Western music than that of Western cultures; however, if this capability is not used, it declines at the end of the first year of life (Hannon and Trehub 2005). This provides more evidence for differentiating between the processing of pitch and rhythm, since there is a difference between the neural development of each: while a capacity to understand even complex rhythm is pre-programmed in humans, this is not true for pitch, which must be learned over time.

Origins and purposes of music elements

As discussed in the previous section, there are also differences between pitch and rhythm with regards to their hypothesized origins in human societies. Music is often placed alongside other cultural goods in explaining its origins as related to sexual selection and costly signalling; yet, this hypothesis cannot easily account for the widespread performance of music and dance in groups, especially synchronized performances (Hagen and Bryant 2003, Saad 2007).

If we consider that pitch and rhythm are separate, and therefore likely have separate origins or purposes within human societies, it is possible for both of these accounts to be true. Specifically, rhythm may have evolved alongside dance in a way that invites the listener to join in the music through synchronized movement or music-making (Witek 2017), while pitch evolved separately to support altogether different goals, which may include emotional or signalling purposes. Anthropologists have suggested as much, positing that rhythm likely preceded pitch in evolution (Mithen 2005).

Link to other cognitions

Finally, each of the two core music elements has meaningful differences in how they impact resulting cognitions. This is most evident regarding arousal level. Past studies show that adjusting the tempo (or speed) of a song can distract from other simultaneous tasks such as shopping (Milliman 1982), or driving (Brodsky 2002, North and Hargreaves 1999b), and that the process by which this occurs is a distracting effect where fast-paced music draws attention away from other elements in the environment (Fraser and Bradford 2013, Mayfield and Moss 1989, Zhu and Meyers-Levy 2005). Tempo appears to be the most important factor in determining the arousal level of the music (Hevner 1937). Since tempo is linked specifically to rhythm, we can hypothesize that the rhythmic elements of music may be more important when determining a song's potential to increase arousal. Conversely, the affect of a song is linked not to rhythm, but instead to pitch and its ability to transmit the valence of the emotion present in the song (Hevner 1935).

While in the above examples it is relatively clear which element is likely responsible for the effects, there are instances in which taking this dual-processing perspective can provide meaningful insight that otherwise would not be possible. For example, one study has found that when individuals sing in harmony together, such as in a choir, their heart rates converge, and they simultaneously improve their social bonds with each other (Vickhoff et al. 2013). It is the state of singing in harmony together which creates this bond: since harmony involves combining pitch elements, one might assume that this is pitch-related processing, and therefore that the valence or emotional aspect of the song causes the increase in social bonds. However, understanding that there is value in asking whether the other element of processing is instead responsible for the effects, we can uncover that it is likely the processing of rhythm that is

leading to these effects – specifically, being in time with others is a temporal aspect. Further evidence from this study (Vickhoff et al. 2013) indicates that if there is a convergence on arousal level (related to heart rate), it is likely due to rhythm, not pitch. Altogether, delineating between the core elements of music in this way provides a deeper level of explanation that can better explain the effects found.

Additional evidence of the difference between the two music elements can be seen in existing preference levels for complexity of each. The literature suggests that the most popular music within Western society tends to be that which has moderate complexity (North and Hargreaves 1996b), with an "inverted-U" pattern emerging. However, there are differences when we account separately for pitch and rhythm: melody and pitch elements appear to prominently and consistently show the inverted-U pattern regarding preference for complexity (Berlyne and Boudewijns 1971; Berlyne 1974; McMullen 1974), while songs with rhythm that is low in complexity and repetitive in nature tend to be preferred, as evidenced by an analysis of songs appearing on the Billboard top charts (Nunes et al. 2015). Process explanations can be provided for this by applying the theories on music's evolution presented earlier: if rhythm is meant to be a social activity, there is benefit to having relatively low-complexity rhythm in music, as this will facilitate group members joining in the activity. However, if a sexual selection hypothesis is linked to pitch elements, then we can expect a general preference for increasingly complex music, as an "evolutionary arms race" requires continuingly increasing complexity – although, this will be tempered somewhat by a requirement that society in general (i.e., potential mates) are able to process and understand the harmonic complexity. Overall, this can explain the simultaneous stable preference for *low*-complexity rhythm, alongside a developing preference for *moderate*-but-increasing-complexity pitch elements within music in recent history.

Altogether, there appears to be meaningful reasons why each core element should be considered separately, and this can have an impact on how we view music processing and its effects. The following sections will delve more deeply into this, discussing different ways in which music can be processed, and linking the core music elements to each of these processing types.

Processing types

Building on the above discussion delineating the core music elements as individual constructs, this section focuses on how these elements are involved in music processing. Delineating between pitch and rhythm is not enough to explain how music is processed in humans, which is altogether much more complex, as well as individualized in terms of life experiences with music. Furthermore, there are specific patterns of pitch, but especially rhythm, which may result in adjusting cognition *without* any associations or memory links. The purpose of this section is to bridge discussion of the core music elements with these different processing types, to explain how music develops meaning in humans.

Referential processing

As previously discussed, pitch, harmony, and melody are concepts which must be learned as an individual is slowly exposed to the music of their culture. However, as individuals learn about these music elements throughout their life, they are not only learning about common associations within their culture (i.e., that songs in a major key are happy), but are also associating certain combinations of pitch and rhythm with events in their personal life narrative. This leads to a layering of meaning to specific sounds: when a listener hears a piece of music,

there may be cultural frames to which the song is referred ("this song sounds happy", because it is in a major key), but also the potential for additional meaning to the song for the individual (e.g., perhaps because it is similar to a song the individual listened to at a pivotal point in their life, such as when they were graduating high school). Both of these processes are similar, in that they are learned associations that are built up over time within an individual that will impact the level of meaning or reward value that comes from listening to the music.

In the literature, this concept has been called "musical meaning" or "semantics" (Raffman 1993) or musical affect (Jackendoff and Lerdahl 2006), or "the listener's understanding" (Davies 1994). Altogether, these theorists have highlighted that music cannot simply be defined as gestaltist, where the value of it can be equally defined for every individual as a sum of its constituent pitch and rhythmic elements. Each combination of pitch and rhythm elements will likely mean something slightly different to each listener, depending on their life history and experiences with music.

Past research has identified two types of similar processing on this topic: music can evoke either a purely hedonic meaning, or one which is more "context-dependent" in nature, regarding when an individual has linked sounds to specific emotions or memories (Meyer 1960, Zhu and Meyers-Levy 2005). This provides a basis for the delineation presented here. In this essay, a culture's norms regarding the link between certain sounds and emotions would be considered analogous to the hedonic meaning within music, whereas the context-dependent meaning linked to each individual's memory remains a separate, albeit similar process.

Together, these are both considered as types of *referential processing*, which is defined as when an individual interprets incoming sounds in reference to a stored "memory bank" of familiar sounds developed over their life. It is argued that this is the only process by which

incoming pitch and rhythm combinations are consciously interpreted as having meaning, and the primary way in which emotion resulting from music is evoked in the listener.

It should be noted there is value in dividing music into its core elements, even when discussing referential processing and the emotion involved in music, since it is possible that there are differences in how each element contributes to this type of processing. This discussion will be revisited later in the essay. In this section, each of the two ways in which referential processing can occur will be discussed individually.

1. Culturally-learned referential processing

The strongest evidence for the theory that pitch organizations such as tonal center, harmony, and pitch preferences are learned comes from developmental studies. Infants under one year of age are unable to process music according to particular scales (Trainor 2008), and children can only detect changes in key and harmony once they reach approximately age 5 (Trainor and Trehub 1994). This suggests an overall trend where each generation contributes to, and then passes down, their culture's music preferences and associations (McDermott et al. 2016).

This concept has been called "musical grammar" (Jackendoff and Lerdahl 2006), since learning it requires linking sets of norms and rules regarding sound. Like the process of learning language-related grammar, incoming sounds can only achieve meaning in reference to these rules. Examples include the previously-discussed link between major or minor key and positive or negative affect in Western music. It also includes the concept of tonal space, or "key", as described previously: although tonal centers will differ between cultures, the tonal center of one's culture nonetheless needs to be understood in order to enjoy its music (Maess et al. 2001).

On the other hand, there is less evidence for the concept that the rhythm element alone is culturally-inherited, or learned, and therefore it is less likely that rhythm alone is referentially processed. However, it appears to be key in contributing meaning to pitch elements. The expressiveness of the music is mostly carried through rhythm and tempo, rather than through pitch elements alone (Hevner 1937); for example, "energetic" music has been determined as being faster, containing more short percussive sounds, and involving more repetition than calmer music (Gaston 1968). In other words, apart from it being of negative affect, melody cannot as easily distinguish between anger and mournfulness, for example. Rhythm therefore helps to differentiate the arousal level of the music, which indicates a more specific emotion. Similarly, subtle variations of the timing and amplitude of expression in music has large effects on judgements, with timing having slightly more effect (Bhatara et al. 2011). In other words, understanding cultural norms regarding pitch elements of music likely contributes to gaining an emotional response to music through referential processing; while rhythm also appears to have its own unique contributions with regards to these norms, its value appears to be in helping interpret pitch-related elements, rather than being processed referentially on its own.

2. Memory-linked referential processing

The second way in which pitch and rhythm combinations can have meaning is through their link to meaningful events. Music is experienced in a variety of situations across one's daily life: this includes settings in which its purpose is as a contributor to background ambience, such as during social gatherings, in stores and restaurants, or while doing chores; it also includes scenarios in which music is a focus of the activity, such as when it is sung at church or danced to in a nightclub (North and Hargreaves 1996a). This creates the possibility for a specific song, a

style of music, or a specific pitch or rhythm combination to be associated with these events or contexts in a "network of associations" (Meyer 1960), and for related memories to be evoked the next time that sound or song is heard again. An example of this could be the emotions and memories associated with Christmas that many will experience when they hear sleigh bells, for example, or the flood of emotion that can be experienced when a bride or groom hears Mendelssohn's famous "Wedding March".

These associations have the potential to be reinforced over time, not only because we use music in these settings and scenarios as part of our social traditions and norms. Individuals also use music that is linked to specific emotions to regulate their moods (Alpert et al. 2005, Larsen et al. 2010, Hargreaves and North 1999). For example, individuals who are sad often listen to sad music, using it in a way that is similar to that of commiserating with a close friend (Kawakami et al. 2013). This use of music reinforces any memory-linked meaning attached to it, strengthening the association over time.

There is likely a strong link between these two types of referential meaning. For example, music that is used in a dance club would likely be characterized as "energetic"; according to the above discussion, individuals may be experiencing emotion in this context because of the link between energetic music and dancing within their learned cultural associations, but they may also be experiencing emotional responses to the music because it evokes memories from dancing at clubs in the past. This intertwining of types of referential processing shows the challenge of trying to tease apart how emotion is evoked from music. However, it does not detract from the overall concept: that there is a deeper level of processing that occurs when individuals come across pitch combinations that are already familiar to them, and that this can come about through specific memory links, or learned cultural preferences and associations, or both.

Altogether, while we can define music as a combination of pitch and rhythm elements, it only gains specific emotional meaning by comparing the incoming organization of the music to what we are familiar with within our culture, and what we have experienced in our life.

Referential processing as a learning process

How referential processing appears to operate is through the neurochemical dopamine, and the related model of learning and expectation that is associated with it. Through this model, individuals compare incoming sounds to the musical structures they expect, given the context of the music (i.e., if they are at a funeral, they will expect sad-sounding music); individuals' expectations of the music as a rewarding or pleasurable experience will lead to a dopamine release in anticipation of the music listening (Salimpoor et al. 2011). However, if an incoming sound is relatively novel, while still conforming at least partially to the expected musical structure, a second dopamine release can happen as the music passage actually occurs – these have been called "peak musical experiences", sometimes known as "chills", that occur in response to optimally-distinct music (Blood and Zatorre 2001). The areas of the brain that are activated are those responsible for reward processing (Menon and Levitin 2005), along with those usually reserved for rewarding the fulfillment of activities related to survival (Salimpoor et al. 2011), showing the strength of the effects that music can have.

This research has found that explicit familiarity of the music is not necessary for this type of dopamine activity to occur (Salimpoor et al. 2013), with these researchers concluding that appreciation of music is likely related to "highly individualized accumulation of auditory cortical stores based on previous listening experiences", along with the dopaminergic reactions to these stores (p.218). Specifically, it is identified that internalized templates of various genres and styles

of music are created, and then referred to when one is exposed to music, and that this will vary based on different cultures, age cohorts, social groups, and potentially other individual factors (Salimpoor et al. 2015). In other words, they have shown neurochemical and neurophysiological evidence of referential processing as the process by which music is rewarding.

A common question in music research is whether musical training impacts any of the processes discussed here. The hypothesis would be that one who engages in deliberate study of music may be better able anticipate musical structures, and therefore would experience fewer (or potentially more) dopamine spikes. While musical training has been shown to moderate the development of this internal "library" of musical rules or syntax (Jentschke and Koelsch 2009), the overall conclusion is that training (along with past exposures and social and cultural influences) only impacts the development of a more extensive library, not the process by which music becomes rewarding at any given moment (Salimpoor et al. 2015).

The concept of referential processing of music has taken us to a second "level" of music processing. While music can be defined by its core elements of pitch and rhythm, in order for music to be rewarding, it must be processed holistically and in reference to meaningful libraries of sounds that the individual is already familiar with. According to this discussion, music is not simply a sum of its parts in gestalt form, and the combination of pitch and rhythm that is rewarding for one individual may not be rewarding for another.

While these arguments are expected to be generally true, there are also instances in which music *can* be rewarding for individuals regardless of how it conforms to their internal library of familiar music. Two such instances will be discussed below, in terms of some fundamental aspects of how humans process sound, as well as music's ability to be processed socially.

Sound-evoked subconscious processing

There are a variety of reactions that sound can evoke in humans. This includes, for example, that low-pitched, loud sounds can evoke fear – or, conversely, that high-pitched and quiet sounds tend to evoke feelings of calmness (Trainor 2008). These likely would have conferred an evolutionary advantage to avoid predators and to be calmed in their absence. Such reactions are examples of emotional reactions occurring in an individual regardless of the musical content. This therefore presents a counterargument to the above position, that music must be processed referentially in order to create an emotional response.

The literature contains a variety of effects which could be characterized similarly. For example, the tempo of music can increase arousal in listeners (Milliman 1982), with distractive effects on simultaneous cognitions such as driving (Brodsky 2002, North and Hargreaves 1999b), processing advertisements (Fraser and Bradford 2013, Zhu and Meyers-Levy 2005), performing complex tasks (Day et al. 2009) and trading stocks (Mayfield and Moss 1989). The complexity of the music could also interact with tempo to create similar effects (Day et al. 2009), and the volume of the music has also been shown to increase cognitive load (North et al. 1997, 1999).

However, all of the above effects would occur regardless of the musical content, and we could expect similar effects of volume, extreme frequencies, tempo, and complexity with non-musical sounds as well, such as when a loud crash brings you to alertness. This does not mean that understanding the role of these aspects as they may be applied within music is not important. Often these effects are utilized by composers within music with the purpose of evoking such visceral responses and contributing to a deepened emotional response. For example, the second movement of Hayden's Symphony no. 94 (the aptly-titled "Surprise Symphony") starts with a

plaintive, calm orchestral passage, punctuated by a sudden, loud chord intended to jolt the listener to attention (Machlis and Forney 2003). A recording of this can be found in Appendix A, Track 1 – the "surprise" occurs at approximately the 34-second mark of the recording. Here, loud volume and pitch extremes (via a wide chord, utilizing the whole orchestra) are used to accentuate the designed emotional response. However, these items are applied *to* a musical passage, rather than being considered music on their own. Compare this to being interrupted by a loud car horn: it is likely you will experience a visceral response that is similar to when listening to Hayden's symphony, but you would not call the volume nor the car horn music on its own. In other words, not all sound-related effects are necessarily related to music, even if they can be applied to music.

This is important to recognize, because in order to understand music's value, we need to be able to differentiate what is specific to music processing, versus what is not music-specific but can increase or attenuate its effects. This is similar to the previous argument regarding lyrics: while lyrics can add additional meaning to music, this would be an additive effect, and music can exist without lyrics. Thus, there is value in separating the impacts of music from that of lyrics. Similarly, here, tempo is not music-specific: adjusting tempo can have impacts in other domains as well, as will be discussed below; on the other hand, pitch *is* music-specific, and so we need to understand the process by which pitch creates meaning in listeners before applying layers of additional potential processing, such as what comes from tempo, complexity, or volume.

There is much to be investigated to better understand how the non-musical aspects of sound could moderate music processing. For example, how could complexity moderate the referential processing of music? However, since the purpose of this essay is to outline how *music* is processed, rather than sound, the focus of the discussion and the model presented here will be

on music (which may contain elements such as changes in volume, for example). This also provides a key boundary to defining music: while music can be moderated by these aspects, the aspects on their own do not constitute core elements or features of music.

Universal processing of pitch

Although it is concluded in a previous section of this essay that pitch-related processing of music is learned over time, the literature also discusses how the processing of certain pitch intervals – including octaves and fifths – is universal, along with the hierarchical organization of pitch in which the top note of any given chord is generally considered the most prominent (McDermott 2008). These universals do not need to be learned over time, and exist in all cultures.

While these intervals may be present in music, their meaning and value may be arbitrary in reference to music overall. Although octaves are generally considered consonant (and thus pleasant), the concept of consonance itself and how it is evoked through music is otherwise different across cultures (Ball 2008). Similar to the above discussion regarding tempo and complexity, we cannot rule out that there may be frequency-related processing of sound that can have effects for humans outside of music; however, this does not mean that on their own they are considered music. It may simply be that the psychoacoustics of sound cause preference for these intervals. The fact that a similar preference for octaves and fifths is also present in birds and whales (Fitch 2006) seems to confirm this acoustic argument.

Furthermore, there is no evidence to suggest that prevalence of these intervals within music could lead to an alternative processing path, through which an individual can gain reward value from music *without* processing the music referentially. Future research is needed to

confirm this, or to investigate the link between these intervals and referential processing. For now, the position in this essay is that any universal processing of pitch elements such as octaves and fifths likely says more about the acoustics of sound, rather than indicating that these are unique types of music processing that would lead to a meaningful difference in how music is rewarding. While processing of this element on its own is possible, any route to a rewarding experience would likely not be analogous to the type of reward experienced through music. Therefore, it is not considered as a "bypass" route by which pitch can be processed without reference to the existing library of musical structures the individual has built up over time.

Rhythm-related processing

The above discussion concludes that there are ways in which sound can create effects within humans that is unrelated to music. Although it has already been argued in this essay that volume is not considered a music-specific element, tempo and complexity were included in previous discussions of this essay when defining rhythm, and therefore they are least relevant to the effects of this core music element. Yet, we see effects of tempo and complexity in their ability to adjust cognition throughout other, non-musical aspects of our life as well.

In this essay, the position taken is that the only method for pitch elements to create meaning for humans is exclusively through music. For example, hearing a pleasant-sounding chord is necessarily a music-processing effect, since we cannot show a way in which this chord can bring reward to an individual other than through referential processing (based on the familiarity that the individual has in experiencing that chord or similar-sounding chords in the past). However, rhythmic elements can affect humans in non-musical ways: a consistent meter (i.e. a series of even repetitions) is a feature of music, but it is also a feature of walking or

marching, for example. This means that it is possible for music to have impacts on individuals even if it has no meaning to them, referentially.

Specifically, it appears that the process by which music has these non-referential effects is through the construct of arousal. The tempo (speed) of music has been shown to be the main structural music component that drives arousal (Garlin and Own 2006), although complexity (Day et al. 2009) or volume (North and Hargreaves 1999b) may interact with tempo to create these effects. When arousal is heightened or lowered due to music, this can have an impact on the mood of the listener (Kellaris and Kent 1994). Thus, there is the potential for arousal-related effects of music to occur regardless of any simultaneous referential processing (or lack thereof).

Returning to the example given at the start of the essay, an individual in a store environment in which music is playing in the background may not be paying any attention to the music. They are not processing the music in any conscious or subconscious depth in terms of its structure, and they are not, therefore, gaining any emotional meaning from the song. However, it is possible in this situation that the tempo, complexity, or volume of the music is still being processed by them, and that one or more of these elements are increasing their arousal level; if so, this can increase the speed at which they shop, for example (Yalch and Spangenberg 2000). If this is the case, one argument is that perhaps the same effects could be evoked with non-musical, regular-metered sound. Therefore, it is possible for there to be impacts of music that occur entirely separate from the referential processing of the music.

In conclusion, music can be processed referentially, in terms of how familiar it is to existing culturally-learned schemas or memory links; however, it also has the potential to impact an individual even if it does not directly align with the individual's internal library of familiar music. In the latter case, this is shown to occur exclusively through rhythmic aspects of music,

such as tempo or complexity; there is no hypothesized route in which the pitch elements can be processed by individuals except through a referential lens. Altogether, this suggests that pitch-related processing is specific to music, while individuals processing rhythm can experience effects even if the sound is not specifically processed as "music" by the individual. This line of discussion will be continued later in the essay.

Social processing

The preceding sections conclude that music is generally processed referentially, but that rhythmic elements of music are not domain-specific, and therefore have the ability to also impact arousal, regardless of the level of referential processing of the music that occurs. However, the literature indicates one other route by which music may have effects that bypass referential processing. Specifically, there is evidence that listening to music in a social setting, or engaging in music in some way with others, can lead to positive social outcomes that are independent from the types of reward that comes from referential processing of music.

Research on this topic has generally involved participants engaging in a joint task with one or more individuals, such as clapping, swaying, or marching to music, and then measuring changes in the interpersonal relationship between those involved. Results from these studies indicate four main increases resulting from engaging in these synchronous music tasks: on prosocial behaviour, social bonding, social cognition, and positive affect (Mogan et al. 2017). These effects may not be limited to social situations: studies have shown neurochemical responses of the endogenous opioid system (related to social bonding) occurring even when listening to music alone (Tarr et al. 2014). Overall, this research indicates a strong link between music and social processing.

Again, in delineating between the core music elements, rhythm is more likely linked to these outcomes, rather than pitch. The hypothesized link in anthropological discussions between rhythm and social situations provides evidence that strengthening intra-coalition rhythm promoted group-level integration (Hagen and Bryant 2003). This leads to the hypothesis that experiencing rhythm causes individuals to think about others around them, as this was the reason for rhythm's evolution. This also provides a process explanation for the above effects: if one of music's core purposes is to increase social bonds within groups, we can expect heightened levels of social bonding and social cognition, and increased cooperation and prosocial behaviour as a result. Specific results from these synchrony studies support this argument, by showing that the joint tasks weaken psychological boundaries between the self and the group (Wiltermuth and Heath 2009), with individuals increasing their level of self-other overlap (Lang et al. 2017). Thus, it is not just that the individuals are more friendly towards others as a result of these tasks, which could indicate benefits outside of an intra-group scenario: they also start to identify with each other more closely, which supports the social bonding hypothesis.

The role of pitch in these effects can be questioned. The key process by which entrainment (keeping in time with others to music) effects appear to occur is by taking advantage of empty spaces within music's rhythmic framework; when participants "fill in" these spaces with their own rhythm, they feel that they have contributed to, or are participating in, the group activity (Witek 2017). This could occur through clapping, drumming, or through dancing, which is intricately tied in its evolution to rhythm (Phillips-Silver et al. 2010). Various studies have shown that prosocial- or identification-related effects can be evoked through joint rhythmic activities without music (e.g. Hove and Risen 2009), which would seem to indicate that any increases in social cognition resulting from music are incidental, as the underlying effect is

through rhythm, not rhythm-plus-pitch. Yet, other studies have shown that using music adds something to the effect, since using music (rhythm *and* pitch, together) as the focus of a rhythmic activity leads to significantly stronger effects than if a beat without pitch elements is used (Stupacher et al. 2017).

Altogether, while individuals can experience social effects from music, it is likely that the effect is coming from the rhythmic element of music. Even if pitch elements help by "providing an external framework" to facilitate these processes (Tarr et al. 2014), there is no evidence to suggest that the social effects that occur are dependent on any sort of referential processing. At the same time, there are meaningful outcomes of this type of music consumption that are unique to it, including the prosocial and interpersonal outcomes mentioned above. Although there is neurophysiological evidence suggesting social processing of music may be possible alone, there is no evidence that the effect is strong enough to result in changes in outcomes due to individual music listening with referential processing alone. Therefore, an entirely independent type of processing can be delineated, which will be termed here *social processing*: this is separate from referential processing and leads to a unique series of outcomes.

Other influences on music processing

Visual information in a music performance, such as musicians' movements on stage, can be used to augment or lessen the emotional intensity of the performance (Vines et al. 2006). Indeed, in concert settings, it is reported that this can even be the primary way in which expressive intentions from the musicians are perceived by observers (Vines et al. 2005). Additionally, the literature within marketing and psychology highlights various ways in which social situations regarding groups of music listeners can act to impact music preferences and

consumption. Music is often used to define the shared identity of "reference groups" of peers that have similar preferences and opinions, and individuals can judge how similar they may be to another individual based on how their music preferences align (Rentfrow and Gosling 2006). More importantly, social dynamics can drive the development of music preferences: social norms develop as to the expected styles of music within social circles (North and Hargreaves 1999a), and individuals are often attuned to others when forming and refining their music preferences (Selfhout et al. 2009). Individuals closely monitor cues that indicate the popularity of music and will adjust their preferences accordingly (Salganik et al. 2006), even if they do not actually prefer the music; not adjusting one's preferences to fit or contrast with the social environment can lead to neural responses consistent with fear and anxiety (Berns et al. 2010). Conversely, music preferences that fit with the social situation are expected to yield strong positive emotional responses.

In other words, there is the potential that emotion and reward can be gained from music consumption in ways that cannot be explained by deconstructing the core elements of the music itself. Likely, emotional cues are being drawn from the performers, or from others in the individual's listening environment, and this can lead to reward value regardless of the music's core elements or composition.

This would seem to indicate that a model which does not account for these external influences is incomplete, as it cannot fully explain the different ways in which music can be rewarding to individuals. However, the scope of the current discussion is to analyze ways in which music *on its own* can be rewarding, rather than to examine an exhaustive list of potential moderating effects. Social situations, as well as other aspects such as internal mood, for example, could be directly related to the social or referential processing of music; however, for the

purposes of the current discussion and parsimony, they will not be included further in this discussion, nor in the subsequent model. Instead, the focus of this essay is on how the composition of music can be delineated in such a way to explain reward value that results from it, regardless of how outside forces such as social or performative aspects of music listening environments may subsequently impact these initial cognitions. It is argued that a complete discussion of the influences on music consumption would require first completing the purpose of this essay, which is to deconstruct music cognition on its own; the theorist could *then* apply any potential outside influences. Therefore, future research can use the current work as a foundation on which to complete this discussion, to further examine any potential moderating effects of music consumption.

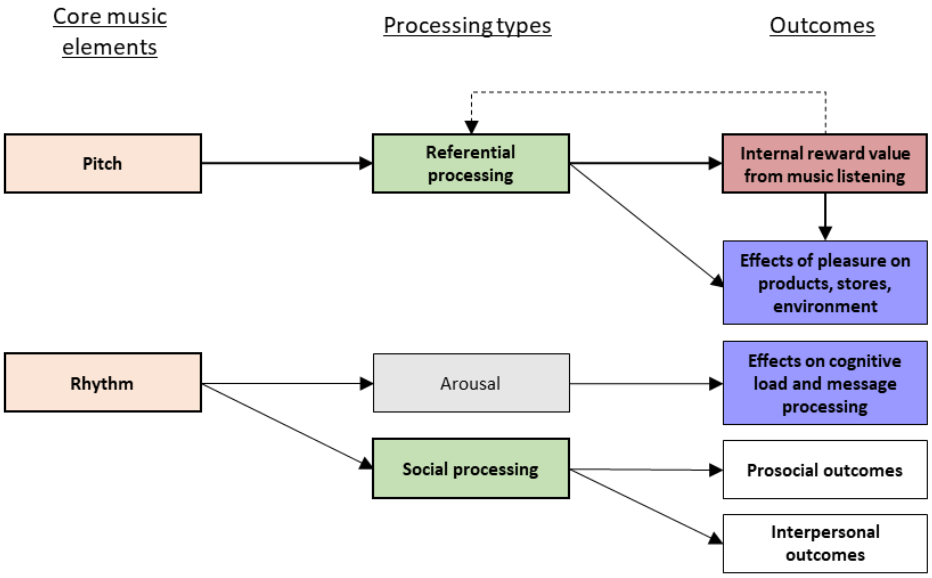
Part 2: Model of Music Processing

The previous sections reviewed the hypothesized purposes of music, the core elements of music, and the ways in which music is processed by individuals. While links between these items were often presented alongside the discussion in the previous sections, the purpose of this section is to explicitly link these elements and constructs in a theoretical model. The goal is to theorize, overall, on how music is processed in humans, and then to link these processing types to the various music-related outcomes that are found within the consumption literature.

A parsimonious model of music processing based on these elements is presented in Figure 1.1. The model was developed by first concluding that there are likely two "core" music elements. This determination comes not only from the differentiated processes that can be linked to each, but also from the neurophysiological evidence indicating a distinction between how the

two items are processed in the brain, and the distinctive hypothesized evolutions of each in human history. These two elements can be seen on the left side of the figure.

Figure 1.1 Model of music processing



Second, the previously discussed literature presented three ways in which music can be processed – these are presented in the center of the figure. First, music can be processed referentially: this occurs when an individual hears music that is at least somewhat familiar to them, either because they heard similar sounds during another time in their life, or because it fits within general rules regarding music within their culture. As a result, they can experience emotions and memories linked to the music (Zhu and Meyers-Levy 2005). It is not argued that this is necessarily a conscious processing: consumers generally deny that music would affect their behaviour in a retail environment, for example, even when presented evidence indicating otherwise (Hynes and Manson 2016). Instead, individuals likely process music automatically. This is supported by evidence that even infants process music this way (Trainor 2008), as well as

examples in empirical settings in which music has been put in background or atmospheric scenarios and individuals have been unaware of how it has impacted their cognitions (North et al. 2016, Yalch and Spangenberg 1990). Research has also concluded that mood can be impacted by music without simultaneous cognitions occurring within the individual (Alpert and Alpert 1990), which also suggests that this referential processing occurs subconsciously.

While it is theorized that pitch elements must be processed referentially in order to have any effect on humans, rhythm has the potential to be processed through two processing types. The first is arousal, which has been directly linked to the rhythmic element of music, rather than pitch elements (Hevner 1937). Rhythm's link to autonomic human functions such as heart rate (Vickhoff et al. 2013) supports this link between meter and arousal. Again, the evidence on music's use and effects to impact arousal indicate a subconscious process.

The second processing type linked to rhythm exclusively is social processing, in which an individual can process the music in a way that causes them to relate more to those around them who are also engaging in the music consumption at the same time. This is evidenced by studies showing that individuals increase their social cognition in these joint music scenarios (Cacioppo et al. 2014). Like the two previous processing types, social processing is also hypothesized to occur subconsciously. This draws a distinction between this type of music listening and intentional or "active" music listening within social situations, which may include an individual being consciously aware of how the music is influencing the social dynamics. It is argued here that social processing can occur outside of a conscious effort to be social with music, such as when an individual feels closer to those around them without being aware of music's role in the increased interpersonal connection. This is what is referred to in the model, rather than a deliberate use of music to fulfill a social function, which is outside the scope of this model.

Outcomes related to music processing

Finally, there are various outcomes that can be linked to the processing of music. First, music can be rewarding for the individual. The main process through which this likely occurs is through referential processing: when an individual (subconsciously) compares the incoming sound to that which they are familiar, if the sound is optimally distinct while fitting in existing cultural schemas, neurological studies show dopaminergic responses in the brain consistent with pleasure (Salimpoor et al. 2011). Other studies support this concept, also showing that areas of the brain related to rewarding stimuli become activated when processing music (Menon and Levitin 2005, Sachs et al. 2016).

There is a deliberate attempt in the current essay to separate the concept of reward from that of valence, since music can be rewarding even if it is not positively-valenced. For example, individuals have been shown to listen to sad music when they are mourning a loss, and consider this to be rewarding in the same way that one might commiserate about a sad event with an empathetic friend (Kawakami et al. 2013). Regardless of the valence, music that has been rewarding is expected to be added back into the internal library of sounds that is the basis of referential processing, forming a "feedback loop" – this is indicated by the dotted line connecting these constructs in the model in Figure 1.1. In the future, similar sounds that are experienced can be characterized based on the reward level experienced in the initial consumption event, alongside with other sounds the individual has experienced over their life (Salimpoor et al. 2013). Apart from referential processing, there is also a potential for arousal evoked from rhythm to itself be rewarding for the individual; however, this link is only theorized upon, and there is limited existing discussion to support it. Therefore, this link is not included in the model in Figure 1.1

The second category of outcomes indicated in the figure (in blue boxes) refer to a variety of effects found in the literature that show music distracting from other simultaneous cognitions or actions. There are two ways in which these outcomes can be evoked. Some of these appear be the result of the arousal process: for example, music has been shown to affect the pace of store traffic and sales volume (Milliman 1982, Smith and Curnow 1966), to make individuals more comfortable in a high-density environment by lowering arousal (Eroglu et al. 2005), and to affect their ability to cognitively process messages (Day et al. 2009, Hahn and Hwang 1999, Mayfield and Moss 1989).

These outcomes can all be linked to rhythmic aspects of music, such as tempo, expressiveness resulting from tempo, or complexity as impacting arousal, rather than relying on individuals' referential processing of the music. However, referential processing itself can also lead to similar managerial outcomes, through a separate link in the model: these include the impact that enjoyable music can have on pleasure while waiting in a retail environment (Hui et al. 1997), and on the willingness to affiliate with others in a retail environment (Dubé et al. 1995).

Other studies have shown evidence of affect transfer from music that is processed, either to product evaluations (Bruner 1990), the store itself (Garlin and Owen 2006), or the general shopping environment (Morin et al. 2007, Oakes and North 2008); this group of studies also suggests it is possible for a link between the reward that comes from music and some of the effects of music found in the literature, necessitating a third path by which these effects can occur. This path, between "reward" and these outcomes is included in Figure 1.1. Note that since both categories of processes regarding these effects are outside of the internal emotional processes of the listener, there is no hypothesized "feedback loop".

The third category of outcomes (white boxes in Figure 1.1) from music are those related to social processing. Studies have shown that individuals who coordinate movement with others to music are more spontaneously cooperative (Cirelli et al. 2014), and more prosocial towards others in the immediate environment (Mogan et al. 2017). There are also many studies showing that individuals can feel closer to others when they complete these joint music tasks: their levels of self-other overlap (Lang et al. 2017) and ratings of connectedness and likeability towards the task partner (Stupacher et al. 2017) are positively impacted. This is confirmed with fMRI studies showing brain areas related to self-other expansion becoming activated during these activities (Cacioppo et al. 2014), as well as the activation of endorphins, which is related to social bonding (Tarr et al. 2014). Altogether, this type of processing does not appear to be dependent on arousal or referential processing; thus, the outcomes that result are theorized to be entirely independent of these other types of processing, resulting only from the social processing of music.

Positive affect has been shown to be a consistent result of studies investigating social processing of music (Mogan et al. 2017), and so it can be questioned whether social processing is influenced, fully or partly, by affect. In reference to the model, the question would be whether internal reward value, referential processing, or both, interact in some way to impact social processing and its related outcomes. However, studies show that social processing relating to synchrony can still occur even without positive emotions (Wiltermuth and Heath 2009). Further, studies with infants still show positive social effects as a result of engaging in music synchrony tasks (Cirelli et al. 2014), despite the fact that they have a limited ability to process music referentially until around the age of 5 (Trainor and Trehub 1994). These results suggest that neither internal reward, nor referential processing can explain social processing outcomes, and so these should be considered independent in the model.

Order of processing

The model in Figure 1.1 is presented in linear fashion to show the potential for the constructs to have a causal relationship. For example, hearing an upbeat song in a major key (i.e., a combination of pitch and rhythm elements) will likely lead to an individual perceiving the music as happy (referential processing), which may be enjoyable for that individual (internal reward value). This process has a specific order: an individual would not, for example, hear the major-sounding song and be rewarded, and *then* perceive it as happy. This suggests an ordered relationship as one moves from left to right through the model.

Additionally, by changing one or more of the core music elements, it is hypothesized that subsequent processing types will be affected, which can then impact the outcomes and effects of the music. As an example, increasing the number of discrete pitch elements within a song has been shown to hinder subsequent task performance (North and Hargreaves 1999b); taking this model into account, we can theorize that this is because the individual must process additional referential (i.e. memory) links that come with each additional pitch element.

However, there is no hypothesized order with regards to how the individual elements within a "column" of the model are processed. To continue the example above, the upbeat nature of the song may increase arousal level in the individual, in addition to the referential processing that is simultaneously occurring. There is no empirical or theoretical indication in the literature that one of these processes will occur before the other within the individual. Similarly, there is no existing discussion on whether pitch or rhythm elements are processed first. Future research using specific high-resolution temporal methods such as fMRI could investigate this, and the model could then be adapted accordingly.

Boundaries and limitations of the model

The purpose of the model is to be comprehensive, but parsimonious. Therefore, some relationships within the model that are not key to understanding how music is processed have been excluded.

First, the model does not contain potential links that have no empirical evidence, or limited theoretical discussion. For example, a bypass link is possible, by which pitch processing can be rewarding on its own without being processed referentially. As previously discussed, some fundamental aspects of pitch, such as a common prevalence of octaves and fifths across cultures (McDermott 2008) may indicate that some elements of pitch processing do not need to be learned in order to be rewarding. While this is possible, it is also entirely possible that even though auditory processing of humans (and perhaps animals; Fitch 2006) may predispose us to include these intervals in the music of our cultures, they may still be directly linked to emotions and reward value, such as calmness, completeness, and pleasantness. In other words, just because the intervals are prevalent across cultures does not mean that they can be rewarding without context. There is no empirical evidence for either claim, and there is limited discussion of the topic altogether in the literature. Therefore, this purely theoretical link is excluded from the model.

The model also does not delve into specifics regarding organization of the core elements. For pitch, this would involve specifying differences in potential processing pathways between melody, harmony, and discrete (individual) pitches. The position taken in this essay is that no meaningful differences regarding processing types should be seen between these elements anyways, as they all need to be processed referentially. For rhythm, it is possible to specify differences between effects of meter, tempo, and the frequency of the rhythm (e.g. four or eight

notes per bar, etc.), among other potential distinctions. For example, the model does not attempt to explain whether a less-common, 5/4 time signature will impair referential processing, or in some way impact arousal. Similarly, it does not directly specify a link between tempo and arousal, although tempo is the specific element that seems most likely to impact arousal (Hevner 1937), compared to other rhythm-related aspects. Likely, the link to arousal is stronger for tempo, while the link to referential processing may be stronger for meter. Regardless, it is beyond the scope of this essay to hypothesize or quantify the strength of the relationships between these sub-elements and the subsequent processes and outcomes.

Instead, the purpose of this essay is to provide a more general framework. For example, if one were to begin investigating rhythmic elements, this model would highlight that there is value in examining the potential for impacts on three processing types and a variety of potential outcomes resulting from them, rather than limiting focus on a single outcome construct. On the other hand, if one was investigating the role of melodic elements in music, there does not seem to be value in investigating the role of the social processing construct, for example.

This general principle continues for other constructs in the model, such as referential processing: while two distinct types are mentioned in this essay, this is not represented in the model presented in Figure 1.1. Again, it is not hypothesized that there would be any significant differences with regards to how any other constructs or core music elements would link to referential processing if each type were considered separately. Such investigations and delineations are outside the scope of this model.

Finally, on a related note, the potential for various moderating effects is not included in the graphical model. First, familiarity of music has the potential to significantly impact how music is processed, and has been shown to impact other simultaneous cognitions, such as

shopping speed (Yalch and Spangenberg 2000). As an individual encounters music that is familiar to them, they are likely to respond to memory links to the song, as well is its familiarity in terms of pitch and rhythmic structure. This is accounted for via the inclusion of referential processing in the model. What is not accounted for is the potential for familiarity with a music element over time to impact other relationships in the model: for example, it is possible that becoming increasingly familiar with complex rhythms can impact the likelihood of these rhythms of evoking emotion through arousal, or increase the likelihood of them being rewarding for the individual through referential processing. This is indicated in studies showing that musical training – and therefore increased familiarity with music – can impact the development of one's internal library of "musical syntax" (Jentschke and Koelsch 2009), which would be considered here as having a larger or more comprehensive internal library to refer to during referential processing. However, while familiarity with an individual music element, song, or with music in general can likely impact the strength of the individual relationships in the model, it is not seen as having the potential to meaningfully change the pattern of relationships, nor their existence.

Other constructs related to this model include volume and complexity, as they may interact with the rhythmic element of music to impact arousal, for example. These are also not included in the model. However, a brief discussion of these occurs later in the essay, to highlight the potential value in further research on these as two potential moderating effects.

Part 3: Research Directions and Discussion

The purpose of the model presented in Figure 1.1 is to organize the existing literature on music. The benefit of the model is in this separation of the core elements and processes of music,

rather than considering music as a single element. Existing literature on music's effects within marketing does not draw such distinctions. Literature in other fields makes clear that there are differences in the processing of pitch and rhythm, so it follows that research in marketing should also consider the possibility of these elements having different effects on consumers, and should consider that there may be multiple "routes" by which music can be processed, leading to different types of effects. By providing this model, this essay suggests an initial method by which studies examining music can be contrasted, while also providing a roadmap to how future examinations of music should be conducted.

This brings forward another benefit of the model: conclusions can be drawn about the fundamental aspects of music processing, what is missing from our current understanding, and how it should be investigated in the future. The purpose of this section of the essay is to begin this discussion and present a series of research directions that can be a first step to more methodical research on music.

The first section of this discussion focuses on applying the model to existing research. This includes first recommending how past research can be better understood and united through the use of the model. To do this, the literature of effects of music is arranged according to the core music elements and processes that are related to each effect; based on this, a series of research propositions discuss how practitioners can use the model to determine the types of music best-suited to facilitate the goals they have. Second, research is proposed to further examine the potential for there to be specific cross-cultural differences in music's impacts. This section also presents a research proposition regarding the potential to explain the patterns of musical styles seen in society today, through the lens of the model.

The second section discusses ways to refine the model. As mentioned, the model as presented in this essay is parsimonious, and is built upon links in existing research. However, there is a lack of research linking specific constructs, especially regarding the effects of music and processing types. There is also a lack of specific measures to capture these processes in individuals. This is outlined, along with a research direction linked to the potential for a moderating effect due to the level of attention paid to music.

The final section suggests ways to extend the model in the future, emphasizing that questions of music effects related to rhythm should be questioned as part of this discussion. Overall, the research proposed in these sections provides suggestions on how to refine and utilize the model to provide practical implications for the implementation of music in marketing scenarios.

Implications of the model

1. Understanding antecedents and consequences of music in marketing

The literature shows a large range of effects that music can have on individuals, from generating emotion that can be transferred to a product (Gorn 1982), to impacting driving performance (North and Hargreaves 1999b). However, given the literature and model presented in this essay, it does not conceptually make sense to consider these as similar. Specifically, the former can be linked to referential processing and a subsequent spillover of emotion, whereas the latter can be linked to arousal. In the model presented in Figure 1.1, these are entirely separate processes, linked to different core music elements. Effects involving pleasure, emotion, and memory are linked to pitch elements, while effects involving cognitive load and message

processing (through changes in arousal), as well as prosocial and interpersonal effects, are related to rhythm elements of music.

There is value in understanding that rhythm and pitch processes are separate. Without this delineation, an explanation for the process of the effect will be missing, and it will be difficult to draw conclusions on how music should be adjusted to elicit the same effect in the future.[3]

A detailed analysis of each article in the literature according to how the theory presented here would apply is beyond the scope of this essay.[4] However, the overall results of each article in which music is a focus can be mapped onto the model in Figure 1.1. This allows us to group common effects together and link them to relevant processes and the individual music elements that are responsible for them. This can be seen in Figure 1.2.

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[3] For example, one study showed that playing country music in the background in a hardware store encouraged purchases, and concluded that this was due to congruency in terms of the utilitarian nature of both (North et al. 2016). Based on the model presented in the current essay, their conclusion is related to referential processing, specifically in terms of related cognitions or schemas that individuals have linked to the country style of music. However, an alternative explanation can be that the regular and more prominent rhythm presented in country music (compared to their control condition of classical music) was what instead facilitated purchases, similar to how other studies have shown that rhythmically-prominent music increases focus on the task (Day et al. 2009, Mayfield and Moss 1989), or how increased arousal resulting from music can shorten shopping times (Yalch and Spangenberg 2000). Therefore, it is not clear whether the effects shown in that study require schema-relevant pitch elements to evoke referential processing, or regular rhythm elements to instead increase arousal. These two processes would lead to quite different conclusions – not only about the type of music that should be used, but also the level of processing needed: generating memory links as a result of music (referential processing) is expected to require a more conscious level of processing than that required to induce rhythm-related effects (arousal). This will be discussed further in the following section.

[4] A detailed evaluation of each article is beyond the scope of this essay, as it would likely require the redesign and re-running of of studies in order to control for one element while testing the other. For example, studies often compare "familiar" music with "unfamiliar", using Top-40 (popular) music as the familiar music, and other genres of music (e.g. classical music) as the control condition (see the stimuli choice of Yalch and Spangenberg 2000). This not only assumes a correlation between familiarity and genre that may not exist, but also confounds the core music elements, since it is likely that top-40 music has more prominent rhythmic elements than classical music. Based on the model presented here, it can be hypothesized that the use of popular music could involve referential processing, but it could also involve changes in arousal due to a more prominent rhythm. However, testing this hypothesis would require adding measures to the study, or including alternative types of music as control variables. This would generally be true for other studies in the literature as well.

Figure 1.2. Linking effects to the model of music processing

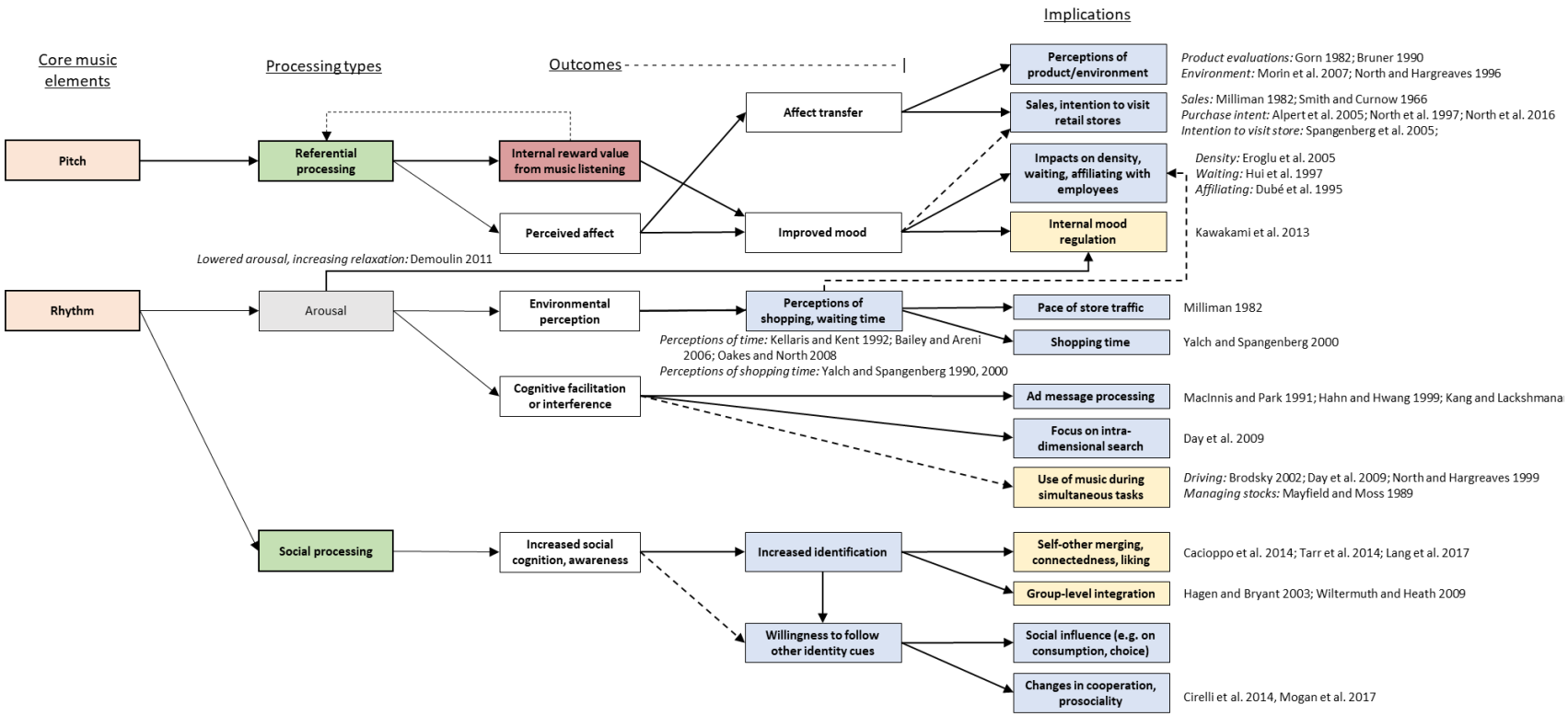


Figure 1.2 shows that there are a variety of managerial (blue boxes) and interpersonal (yellow boxes) effects in the literature that can be linked to music. With only a few exceptions, these still fall into three categories, each linked to one of the three hypothesized processes of music: (1) reward value and affect, linked to the referential processing of pitch elements of music; (2) arousal, linked to the processing of rhythmic elements of music; and (3) interpersonal effects resulting from the social processing of music, which are also linked to rhythmic elements. Appendix B provides details for each of these links, delineating a series of hypotheses to explain how each effect from the literature occurs, relative to the model. Specific paths through the model are presented, starting with a core music element and continuing with related processes resulting from the processing of that element. Each hypothesis in this section is testable, using constructs from existing research but adapting the music stimuli according to the theory discussed here.

Overall, Figure 1.2 and the propositions presented in Appendix B detail what occurs when music is processed by consumers, proposing a list of potential implications for managers. By linking these implications to core music elements, managers can more accurately predict outcomes that will occur by implementing different types of music. Some individual relationships within this model require further study to understand how music has the impacts found in past research; refinements such as this will be detailed further in a later section of the discussion.

2. Selection of music stimuli to achieve intended implications

The previous section presented cause-and-effect relationships between the core music elements, processing types, and outcomes, predicting types of outcomes that will occur as a result of implementing music in a given context. Conversely, the model can also be used to determine which type of music would be best-suited for a given environment, by understanding

how the core elements of music influence different outcomes. Based on the theory presented so far, specific hypotheses can be developed for each type of processing, which take into account the core music elements that are linked to each:

Research direction 2: When determining which type of music will be most effective in a given environment, music's core elements should be taken into account:

(a) Music with more complex and nuanced pitch elements will be better at evoking emotion, impacting pleasure, and resulting in internal reward for the listener

(b) Music with more complex and prominent rhythm will increase cognitive load and encourage intra-task focus, impacting individuals' processing of external stimuli

(c) Music with more prominent rhythm will be better at encouraging social connection, resulting in stronger prosocial and interpersonal outcomes

An example of the application of this model can be seen in the second essay of this dissertation. In the design of a series of empirical studies, the model presented here is taken into account to help choose stimuli that will be best-suited to evoking the social processing of music. Specifically, in study 1, two versions of a song – one with a prominent rhythmic background, and one which consists of the same recording but without the rhythmic overlays – are compared in their ability to impact social connection through the music's use during a joint clapping task. This therefore acts as a test of proposition 2(c). The results show that the more rhythmic version of the song resulted in stronger social connection with the task partner when compared to the less-rhythmic version, thus confirming this hypothesis. Overall, this shows the value in accounting for the core elements of music in study design and stimuli choice.

The relationships and constructs that have been discussed so far have been derived based on existing empirical evidence within the literature. However, it is possible that music may have effects and benefits apart from that which has been previously examined. For example, music is often used in a variety of daily tasks, with "appropriate" music chosen for each task, such as when upbeat music with a regular beat is listened to while exercising (Levitin 2007). However, *after* completing the exercising task, individuals prefer calmer music, likely because it can effectively regulate their level of arousal back to a comfortable baseline (North and Hargreaves 2000). Mapping all possible activities during which music can be played onto this model is beyond the scope of this essay. Instead, when determining what music to use for a specific purpose, one can identify what the intended outcome of the music is, and use the model to determine the music that will best facilitate that activity. In the case of exercise, both the para- and post-exercise music choices in the example above are related to the individual's desire to control their level of arousal; applying the model here, this suggests that the rhythmic element of the music will be most crucial, and that pitch elements, referential processing, and affect will all be less important when determining the most appropriate music to be used surrounding the exercise activity. If one was determining what music to play in a commercial gym, using the model in this way can lead to an actionable recommendation for what to play in high-activity vs. cool-down spaces, for example.

3. Understanding existing music consumption patterns in society

The previous directions focused on a series of individual relationships between music elements, and a wide range of effects that they create. Altogether, this highlights the variety of tasks that music can be used for in a way that benefits individuals or groups. Continuing in this

broad perspective, we can also expect that over long periods of time, music which best facilitates an effect or category of effects will be encouraged to develop, and that this music will be that which prioritizes the core music elements that are most important to its underlying purpose. At the same time, other types of music which utilize other elements should develop separately to support other purposes.[5] In other words, we can expect that the development of different styles of music should correspond with the underlying purposes they can best apply to. The model presented here can help to explain this pattern of development over time in terms of the core music elements that are present in that type of music. It is proposed here that this model can not only explain past musical developments, but also that it can predict how music may develop in the future. This section will explain this theory in more detail.

At a basic level, the model presented in this essay is built on the premise that music has two core evolutionary paths (relating to the development of pitch and rhythm) that have combined to form what we call music. The development of musical styles is theorized to have occurred slowly over time, characterized by the interplay between these two processes of pitch and rhythm development. The literature also shows evidence of two purposes for music within humans' social world: it can be used as a costly social signal, by which knowledge of it can indicate evolutionary fitness, or it can be used as a facilitator of social interactions, such as through encouraging joint movement or dance. These two different purposes can be linked to specific paths in the model: costly signaling requires knowledge of complex patterns of music, utilizing extensive referential processing in order to appreciate the complexity of the gained

[5] It is acknowledged that at a given point in history, whether the popular music of the day emphasized pitch or rhythm elements may be at least partially explained based on other outside forces that have not yet been mentioned here, such as societal structure and the desires of those in power. This is also accounted for later in this section.

knowledge or skill; social interactions utilize social processing of rhythm to increase prosociality and improve interpersonal relationships.

There is evidence of these two purposes of music (signaling and interactive) in the existing pattern of musical styles seen in society today. Specifically, a delineation has been drawn between the concepts of "art music" and "functional music": whereas the former is defined as music which is unique, complex, and less concerned with accessibility, the latter is music which is easily understood by members of a society and can more easily be participatory (Nettl 1973). Applied to the music of today, we could see modern classical music, with its complex pitch elements and requirements for extensive instrumentation, as representative of "art music". Individuals must become familiar with the intricate forms, styles, and pitch structures present in classical music in order to understand it; from a social perspective, individuals are aware of the knowledge required to understand this music, and view individuals who have gained this knowledge as part of a social "world" that is relatively exclusive (Gainer 1995). This is in direct contrast to "functional music", which in current society would be best represented by the most popular music styles, such as pop, rock, country, and rap music: with their simple forms and structure, limited pitch elements (such as few, if any, key changes, and limited instrumentation), and prominent but simple rhythm, this music is much more easily understood by the general population. It is therefore not as useful as a social signal of exclusivity.

Returning to the model, we can see that these two types of music can be directly linked to the two pathways discussed so far: *art music* requires development of an internal library of sounds, rules, and structures of music, and thus requires extensive referential processing. *Functional music*, on the other hand, involves more prominent rhythm elements, facilitating

more extensive social processing of the music. We can further link these back to the two origins of music, as a tool for sexual selection (pitch) and for encouraging social dynamics (rhythm).

However, it is not comprehensive to consider that the development of music with complex pitch elements evolved exclusively for purposes of social signaling. As discussed previously in this essay, the processing of pitch elements is intricately tied with emotion, and strong emotional responses occur in individuals listening to music (Sachs et al. 2015). This literature generally does not involve manipulating social dynamics, and the design of existing empirical studies in this area suggests that music is rewarding without social presence (such as fMRI studies that involve individuals listening to music, alone, in an fMRI scanner; e.g. Salimpoor et al. 2013).

Therefore, it follows that there may be multiple explanations for the development of pitch complexity in modern music: one involving social signalling, and another involving individual emotion regulation. These would likely have separate evolutionary paths, especially in terms of the value of complexity: music's use for social signaling would prioritize continued increases in pitch complexity in music developments over time, whereas there is no such value in increasing pitch complexity in order to facilitate emotional value derived from music, apart from simple extensions that allow for more variety and therefore cover a wider range of potential emotions.

In fact, existing evidence on individual music preferences (i.e., not in a social signalling context) suggests that, overall, a level of "optimal complexity" exists in aesthetic goods, including music (Berlyne and Boudewijns 1971); if music is too new or complex (relative to what is familiar to the listener), it will be less-preferred for individual consumption (Ward et al. 2014). This is in agreement with literature showing that at least some repetition of harmonic structures in music is preferred by consumers (Nunes et al. 2015).

Altogether, there are likely multiple factors at play in explaining the wide variety of music seen in society. One dynamic includes intellectual developments in humans and a resulting preference for increased pitch complexity (Habibi and Damasio 2014), which would involve more extensive referential processing of music. However, this is likely only part of the story. The use of music for emotional regulation also suggests a focus on referential processing, but with a focus on *moderate* pitch complexity. At the same time, the use of music for social purposes suggests a preference for moderate (Witek et al. 2014) or low rhythmic complexity and greater repetition in structures (Nunes et al. 2015).

In other words, while the purposes and uses of music within society may be key in determining the development of musical genres and styles, these do not exist on a continuum that only includes defining it based on usefulness for one or two purposes. Therefore, it is suggested that future research consider multiple potential explanations for the development of music. As evidenced by the above discussion, it is helpful to define each purpose based on the two core elements defined in the model, as it allows for a clear framework for the discussion. For now, a series of research directions are defined below that summarize the views presented here, although it is noted that these could be expanded to include other possible reasons for music development. This discussion is seen as a first approach to explaining existing music style preferences, as well as predicting the development of musical styles over time.

Research direction 3: The development of music styles in society can be explained by the interplay between four simultaneous purposes of music, and these can be explained in terms of the core aspects defined in the model:

(a) The use of music for social signalling will encourage the development of music with high complexity of pitch elements
(b) The use of music for individual emotion regulation will encourage the development of music with moderate complexity of pitch elements
(c) The use of music for individual arousal purposes will encourage the development of music with moderate complexity of rhythmic elements
(d) The use of music for social connection will encourage the development of music low complexity of rhythmic elements

It is hypothesized that existing styles of music can be defined based on the extent to which they prioritize one or more of the above motives within that genre or style. For example, classical music can be used for social signalling, but also emotion regulation, and so it is expected that it will be characterized by a combination of (a) and (b) above; alternatively, dance music can be expected to be more focused on (d), although could also include aspects of (c) and perhaps (b). An integrative approach to the development of musical styles is likely. In other words, a musical style may be able to fulfill multiple motives for individuals at once, or different motives for different individuals, and this should be taken into account. The purpose of the discussion here is to categorize and create a typology, by which "extreme types" of music are delineated; this is useful for the purposes of theory development (Doty and Glick 1994). It is not hypothesized that any of the extreme types presented in the research direction above would occur – for example, it is not predicted that music could exist for exclusively social motives with no involvement of emotion or arousal.

4. Cross-cultural differences in music effects

The literature has concluded that there is divergence in the innateness, and therefore universality, of the two core music elements across cultures. Rhythm is innate within humans: individuals are born with an ability to process rhythm, as evidenced by the ability of infants to be affected by coordinated rhythm (Cirelli et al. 2014). On the other hand, pitch organization appears to be learned, with infants not showing any ability to process pitch before the age of 1, and only showing abilities to understand their culture's tonal structures starting around age 5 (Trainor and Trehub 1994). Literature has therefore concluded that while rhythm is consistent across cultures, pitch organization is culturally-learned (Ball 2008, Janata et al. 2002), with distinct schemas or preferences for unique organizations of pitch, tonal centers, and harmonies developing within a culture over time (McDermott et al. 2016).

Therefore, it is expected that individuals from different cultures will respond differently to pitch elements of music, while this pattern will not exist for rhythm. Returning to the model, it can therefore be expected that any results regarding referential processing, and therefore also reward value and emotion, may experience a moderating effect due to culture. The same cannot be said for arousal and social processing of music and their related outcomes, since these are related to rhythm, which is universal across cultures.

Research direction 4: Examine the potential for cultural differences regarding pitch-related effects, but not rhythm-related effects. It is expected that:

(a) Referential processing of music will occur at a lower rate for individuals encountering music from a culture with which they are not familiar

(b) Arousal processing resulting from music will occur at a similar rate for individuals, regardless of their familiarity with the culture from which the music originates

(c) Social processing resulting from music will occur at a similar rate for individuals, regardless of their familiarity with the culture from which the music originates

This has the potential to impact decisions regarding music's use. Managers should be aware that music experienced by an individual that is not from the culture the music originates may experience impacts on arousal and social processing similarly to an individual from the same culture as the music; however, the individual may not draw reward value or have emotion that can be transferred to a service environment. For example, it is still expected an individual experiencing culturally-inconsistent music will show differences in their perception of crowdedness of the space (Eroglu et al. 2005), or in their ability to recall a message (Hahn and Hwang 1999), since these are music effects linked to arousal, and therefore rhythm. On the other hand, the individual is unlikely to experience issues or benefits from congruency with other aspects of the servicescape (Demoulin 2011); they are unlikely to experience pleasure from the music, which could affect store evaluations (Dubé and Morin 2001) or their willingness to wait (Hui et al. 1997); and they are unlikely to experience the additional memory traces that can have an effect on perceived time (Bailey and Areni 2006). This is because these effects require referential processing of the music, which is less likely to occur due to the cultural specificity of the pitch element of the music. Therefore, managers should be aware of what their goals are for including music in a servicescape: if these are related to pleasure, reward, or emotion, they should be aware that the music may not be effective at accomplishing this for all individuals.

Refining the model

The model presented here requires more study to confirm the nature of the relationships that it outlines. This includes understanding the potential for interactions between processing types, a well as determining whether the relationships will change depending on situational or other moderating aspects. Research directions that can act as a starting point for these investigations are presented in this section.

Interrelations between processing types

The first series of propositions in this essay provided explanation for existing findings in the literature, linking these previously-reported effects to specific core music elements and processes. These hypotheses generally follow a consistent pattern, with effects of music being linked exclusively to one of referential processing, arousal, or social processing; few effects of music are hypothesized to come from multiple types of processing. Additionally, there is value in presenting the model in this way, analogous to a typology, in which there are cleanly-defined "types" of music processing that do not intersect with each other in their occurrence or related effects (Doty and Glick 1994). However, it is possible that this is not always the case, and that either the processing types interact with and inform one another, or that multiple processes may be involved in creating a single effect. These arguments will be presented here.

First, it is possible that there are relationships between the constructs at the "processing" stage of the model. For example, it may be possible for music that is successfully used for social processing to be "added" to the referential library of sounds that one is familiar with, so that when an individual encounters this music in the future, a positive emotional response occurs due to the pairing of that memory with that specific music. Similarly, music that is successful at

inducing heightened arousal in the individual could also be added to one's internal sound library. In both of these cases, a feedback loop would be occurring, similar to the one proposed between internal reward and referential processing of music; however, this time it would be bridging between other types of processing and (future) referential processing of music, mediated through the internal reward outcome. It is suggested that this link could explain strong emotional responses that occur to music that are closely linked to social events in one's life, for example.

Research direction 5A: Examine the extent to which arousal resulting from music and social processing of music can lead to internal reward value from music listening

Second, a related possibility is that some effects resulting from music are due to multiple processing types acting in concert with each other, rather than each effect being mapped onto a single type of processing. There are indications in the literature that this is the case, and the fact that these occur suggests that these relationships require more study, as they do not cleanly align to the theory presented so far.

For example, research that examined impacts on willingness to wait within a retail environment report that music improves mood, while also affecting perceptions of time (Hui et al. 1997, Dubé et al. 1995). This suggests that both arousal and/or referential processing effects could be affecting consumers at the same time. As will be discussed below, other evidence suggests that composing music entirely with the purpose of creating social effects (i.e., that which includes only rhythmic elements with the absence of any pitch elements) does not lead to the expected outcomes either, suggesting that at least some limited processing of pitch likely occurs for all music processing, even if the expected outcome is due to arousal or social

processing of music.[6] Evidence that these music processing types can occur at the same time – and that they may even support each other – encourages future study that examines the interplay between them in influencing related outcomes and implications.

Research direction 5B-1: Examine the potential for multiple processes resulting from music listening to occur at the same time to influence related effects

If it is the case that multiple processes can occur at the same time when an individual listens to music, then there are two possible changes to the model. The first is presented above: the processes occur simultaneously, but independent of each other, to influence the effect. In the waiting study discussed above, this interpretation would mean that individuals are processing pitch elements (leading to reward value and improved mood, through referential processing) and also processing rhythm elements at the same time (leading to impacts on perceptions of time, through arousal). Alternatively, it may be that the processing types interact with each other, such

[6] Evidence of this comes from Essay 2 of this dissertation. In the experiments in that essay, participants completed a music task (clapping) with another person, and then were asked to rate this task partner. According to the model in Figure 1.1, participants should be engaging in social processing of the music in this case, due not only to the social nature of the experiment, but also due to the rhythm-heavy music that was used (note that the first study in this essay showed that a song version with more present rhythm elements led to higher ratings of the task partner than a less-rhythmic song version, consistent with this theory and the model in Figure 1.1). However, in Study 5, this task was compared with a condition in which participants completed the music task by clapping in time with the task partner, but without the music accompaniment. In other words, if rhythm alone was responsible for heightened social processing, we would expect this condition to perform better than the condition which includes rhythm elements, but also pitch elements, since the pitch elements could be distracting from the underlying rhythm-social process; regardless, the theory would suggest no link between pitch processing and social outcomes such as increased identification or liking of the task partner. Yet, results of this study show that the rhythm-only clapping condition resulted in significantly *lower* ratings for the task partner than the condition in which rhythmic music (with both rhythm and pitch elements included) was used. This is consistent with other literature showing that music performs better than other rhythmic tasks that do not include pitch elements (Stupacher et al. 2017). Overall, this suggests that while the main process may be occurring through rhythm, it is not alone sufficient in creating these effects. Pitch elements appear to be required, at least at some level, in order for the effects of rhythm to occur.

that both are necessary in order for either outcome effect to show its result, or that individuals experience a "boost" to the original effect if both types of processing occur.

Research direction 5B-2: Examine the extent to which music processes (referential, arousal, social) interact with one another to influence related effects

Finally, the specific relationship between arousal and social processing deserves further study. Both processing elements are reliant on the rhythmic element of music and not the pitch element, in contrast to referential processing which has a unique contributor (pitch elements). Therefore, it should be examined whether a single change in the rhythm of a song could simultaneously lead to changes in both arousal and social processing at the same time, or whether there is any interplay between these processes.

Research direction 5C: Examine whether a single change in a rhythm element of music may have effects on both arousal and social processing at the same time

Interrelations between other portions of the model

It is also worth questioning some of the remaining potential links between constructs across different "stages" of the model. The model has been developed based on evidence from the literature on music, which is not comprehensive, and so it is difficult to develop hypotheses about some of these links. However, two such examples are presented below as research directions on this theme.

First, it is not clear from existing research whether rhythm is processed referentially at a meaningful level. The existing model hypothesizes that pitch is processed exclusively through the construct of referential processing. Among other things mentioned in this essay, the development of a library of sounds (pitch organizations) and their linking to specific emotions and concepts is how pitch likely evolved, and how it becomes meaningful for individuals as they grow up within a culture. Rhythm does not require "linkages" to other concepts to have an impact: individuals respond in terms of arousal level (e.g. their heart rate changes; Vickhoff et al. 2013) and they react differently to others around them in response to rhythm, even if they do not gain meaning from it. However, this does not mean that rhythm *cannot* have referential meaning.

As an example, consider the repetitive three-note rhythm at the start of the popular *Queen* song "We Will Rock You" (see Appendix A, Track 3). For a significant portion of the beginning of the song, the only sound heard is the rhythm, and no pitch elements (which would be provided by instruments or vocals) are present. Yet, the song is recognizable to many from the starting seconds of the recording, and it is often played at sporting events in Western cultural tradition as a participatory activity for the audience. Listeners know to join in as soon as the song starts playing, which seems to indicate that the rhythm alone has some sort of referential association for them.

As another example, consider the more culturally-specific "clave" rhythm. This rhythmic pattern has its origins in Afro-Cuban music tradition, which originated in the Southern US and the Caribbean. The five-note pattern (with the organization: "long-long-long, short-short") is a staple of many songs in this style of music, and fans and musicians of this music internalize the pattern. Likely it evokes memories and meanings for these individuals, absent of any specific accompanying pitch elements. As an example, consider the song "Iko" by the New Orleans-

based artist *Dr. John* (included in Appendix A, Track 4). The rhythmic pattern begins immediately at the start of the recording, and thus cements the listener within a cultural space immediately at the start of the song. Despite the fact that the pitch-related elements are constant for the beginning of the song, an experienced listener would still recognize this as a song within the New Orleans music style. Harmonic and melodic elements that come later provide the interest and nuance that makes for a more specific song within the existing cultural tradition.

This case seems to indicate a path for rhythm to be processed referentially. However, it should be noted that the examples above are songs that include both pitch and rhythm elements. In other words, it is not clear whether either of these examples would have been able to have any referential meaning in the first place without pitch elements. Taken in another direction, if different pitch elements were included with the original rhythm, the referential meaning of the rhythm might change. An example of this is the *George Michael* song "Faith" (included in Appendix A, Track 5). Starting at 0:36 in the recording, this song exhibits the same 3:2 clave rhythm from the *Dr. John* song – yet, it would not be described as a "New Orleans-sounding" song by most listeners. Another example is the *U2* song "Desire" (included in Appendix A, Track 6), which contains the same 3:2 clave rhythm and is also in a different style. In both of these songs, the rhythmic elements are likely immediately familiar to listeners; yet, any referential associations linked only to the rhythm in these cases either: (1) are overridden by the referential processing that comes with pitch; or (2) are non-existent. If the latter case is true and it is concluded that rhythm cannot be processed referentially, it is then necessary to reconsider why the previous two examples ("We Will Rock You" and "Iko Iko") are immediately familiar even though rhythm is the only salient feature. Overall, this remains an open question on which future research can theorize.

Research direction 6: Examine whether rhythm elements of music can be processed referentially without the interference of or requirement for an original link to pitch elements of music

The second link between constructs of the model that is proposed to be examined is whether referential processing of music impacts cognitive load or message processing. Existing research suggests that "memory traces" resulting from enjoyable music consumption experiences can impact the perception of time that has passed during the music listening (Bailey and Areni 2006), but it is not clear whether this process (which seems related to referential processing) would increase cognitive load during another task, or whether the referential aspects of the music would simply be ignored. Existing studies show that music can either help (Day et al. 2009, Mayfield and Moss 1989) or hinder (Brodsky 2002) performance on simultaneous cognitively-demanding tasks, but this was examined using unfamiliar music – thus, any impacts found in those studies can be attributed to heightened arousal, which is already hypothesized to impact cognitive processing. An empirical study using carefully-designed music stimuli, with conditions for familiar and unfamiliar music, could be implemented to tease apart any additional contribution of referential processing to the arousal-based effects found in the literature. This could also contribute to our understanding of how music processing types may occur simultaneously to influence effects, as discussed above in research direction 5B.

Research direction 7: Examine the extent to which referential processing of music may impact the simultaneous performance of other cognitive tasks

5. Passive vs. active music listening

The discussion so far has overlooked that the effects of music will be significantly different depending on the level of awareness the individual has regarding music that is playing - whether it is being listened to intentionally, or whether it exists in the individual's environment but is not intentionally focused on. These are defined here as "active" and "passive" music listening, respectively. For example, the discussion regarding the development of music styles over time hypothesized a series of four purposes of music; these exclusively reference active music listening purposes. On the other hand, the above discussion of cognitive load may confound both active and passive listening scenarios: an individual may choose to listen to music while working, or they may encounter it without choice as it is playing in the background of their work environment, and the impacts that the music has on that individual may differ depending on whether the music is being listened to actively or passively.

The model presented in this essay does not distinguish between these levels of music listening awareness. This is because the paths by which the core music elements have impacts on the processing types are not hypothesized to change based on this. For example, regardless of whether an individual is actively or passively listening to music, pitch elements could only be processed referentially. In other words, the pattern of possible relationships will not change. However, whether any of the processing types occur at all, or the magnitude of their effects when they do occur *is* expected to be a function of whether the music listening is active or passive, at least for some of the hypothesized relationships.

Overall, a pattern of results can be predicted based on the moderating effect of the level of awareness of the music. It is expected that arousal and social processing of music do not require conscious awareness of the music that is being played – if anything, focus on the music

could actually distract from social and arousal-based effects. Conversely, it is hypothesized that music can be processed referentially at a deeper level during active (rather than passive) listening, and that active listening will lead to heightened reward value and a strengthening of effects on pleasure and affect transfer to products, stores, and environments.

Research direction 8: Investigate how level of focus on the music that is being played will impact the strength of relationships in the model. It is expected that:

(a) Increased focus on music being played will increase the level of both memory-linked and culturally-learned referential processing, resulting in increased internal reward value and increased effects of pleasure on products, stores, and the environment related to the music listening situation

(b) Increased focus on music being played will decrease the level of arousal resulting from the music, decreasing the effects of arousal on cognitive load and message processing

(c) Increased focus on music being played will decrease the level of social processing of the music, decreasing the effects of music processing on prosocial and interpersonal outcomes

Extending the model

Finally, the domain-specificity of the effects in the model should be a focus of future research. The processing of pitch elements appears to be specific to music (Peretz 2006), and so the resulting referential processing of music can also be expected to be domain-specific. In other words, the way in which we store a library of sounds that we are familiar with, and the way in

which they create strong emotions within us, is likely unique to music. This can explain results showing strong emotional responses to music (Salimpoor et al. 2011). However, the same cannot be said for the rhythmic element of music. It is not domain specific, and there are other ways in which the processes and effects included in the model can be evoked. The neurological studies discussed in this essay explain how rhythm shares neural pathways with concepts such as movement, sense of time, and arousal. These links suggest it is possible that rhythm's ability to encourage regular and coordinated movement can be elicited from other stimuli that are not music-related, such as walking in time with another person, or listening to a metronome that is providing a regular beat.

What this means is that any effects found in the literature that are linked to rhythm – specifically, the use of music as a tool to impact arousal or social processing – have an alternative method for creating their effects. Music is not the only way to impact arousal or social processing. This opens up alternative explanations for existing results regarding arousal, and provides new possibilities for methods of evoking these effects in future research.

There is evidence of this in the literature, with some studies indicating that positive social effects can result from the use of non-music rhythmic stimuli (Hove and Risen 2009). However, others have shown that using music to create these same effects is a significant improvement over stimuli which includes no pitch elements (Stupacher et al. 2007). Researchers have concluded that music's contribution here may be to "provide an external rhythmic framework to facilitate" the effects of rhythm (Tarr et al. 2014); however, it is not clear what specific benefit is being provided here by the pitch elements, separate from the rhythmic elements. It would seem that some sort of pitch-related processing interacts with rhythm processing to increase the level of arousal or social processing that occurs. Research directly testing this is limited, and has not

been linked to any of the specific constructs included in the model presented here. Therefore, it is proposed that research uses this model as a guide to test this relationship directly.

> **Research direction 9**: Examine whether effects of arousal and social processing resulting from rhythmic stimuli that is absent of any pitch elements are weaker than effects on these constructs that occurs when pitch elements are included in the stimuli

Even in the event that this hypothesis is rejected, and thus rhythm processing can be entirely replaced by non-music stimuli, this does not mean that there is no value in understanding the potential for rhythmic effects. Music's wide existence across societies and the ability for it to be easily included in the background in various environments makes it a good candidate for evoking rhythmic-based effects in an unobtrusive and enjoyable way. However, in this case, researchers should be aware of the potential for these alternate explanations, as they may decrease the internal validity of studies on this topic. Alternatively, if this hypothesis is supported, it is evidence that there is something that music adds to these effects that is *not* entirely analogous to alternative methods of eliciting these constructs. Further research would then be required to determine what this is, and how it can be measured.

Conclusion

Music exists in all human societies, and presents with great variety and complexity. It is studied in a range of fields, including neuroscience, psychology, anthropology, sociology, and consumer behaviour. The current essay brings the findings of these fields together in a theoretical model, advancing the study of music by providing a foundational theory to guide

future research. Rather than considering music as a single element, this essay considers music as two simultaneously-occurring processes, linked to two core elements of music: pitch and rhythm.

The model is built using existing links from the literature, uniting theories on music's purposes and evolutionary origins with the neurophysiological evidence on how music is processed, and with the outcomes that are shown in consumption literature. The reviewing of this literature results highlights the need to discriminate between two core elements of music: pitch and rhythm. Each element can be independently associated with separate effects: pitch is linked to reward value, emotion, and pleasure, and related spillover and transference effects onto environments, products, and organizations; rhythm, on the other hand, is linked to arousal and its ability to impact cognitive processing, and it is also linked to increased prosociality and improvements in interpersonal relationships through heightened social processing. While these two core elements come together to be presented as "music" to a focused and attentive listener, the elements are not always processed equally: it is discussed how the attentiveness of the listener may cause pitch elements to be less likely to be processed, and how the cultural specificity of pitch (but not rhythm) opens the possibility for cross-cultural differences in music-related outcomes.

The model presented is parsimonious, and it is broadly testable: definitions are provided for each included construct, and a series of research propositions are presented to highlight specific questions that can be immediately tested, using the model as a foundational theory.

Future research is needed to refine the model. An overall lack of music-focused research across scientific fields means that it is not possible at the current time to theorize on all the possible links in the model, such as the possibility for interactions between different processing types. Additionally, clarification is needed on the domain specificity of these effects:

neurophysiological evidence suggests that rhythm effects are not specific to music, opening the door to alternative methods of creating what we currently consider to be music-specific effects; at the same time, other research suggests that pitch elements *do* meaningfully add to rhythm's effects. Altogether, more research is needed to better understand the unique ability of music to impact individuals across the range of reported outcomes.

The model provides a clear guide on how music should be used in the future. First, researchers should carefully consider their music stimuli choices. For example, if the purpose is to induce arousal, they should be focused on including music that emphasizes rhythm, rather than choosing music based on loose characterizations such as "familiarity" or "popularity" of music, which both cannot be linked exclusively to the desired outcome, nor will be consistent across the population. Alternatively, if the purpose is to induce emotion, focus should be paid to music's referential processing, and therefore pitch-related elements – although researchers should also be cognizant of the potential for cultural- and attention-related moderating effects, in this case.

Second, practitioners can use this model to guide their choices of music stimuli. By taking into account whether the goals of the use of music are linked to a pitch- or rhythm-related outcome, it can be determined which type of music will be most effective in a given situation. For example, if the purpose is to facilitate social interactions such as dancing, the model explains why using music with strong rhythmic prominence will be most effective.

Finally, the model may also provide hints as to the development of music styles in society over time, by extending the concept that low-complexity rhythm will be prioritized in situations where the goal is to connect with other individuals, while high-complexity pitch elements will be valued when the goal is to compete with others. It is acknowledged that there are a wide range of musical styles in society that have proven difficult to organize and quantify (Aucouturier and

Pachet 2003), and caution is given not to oversimplify something that likely has many social, economic, psychoacoustic, and psychological contributors. However, given that the theory presented here was developed on the basis of the core functions that music is theorized to have evolved for, it follows that this research should be well-suited to also explaining how music continues to evolve in our society today.

Transition between Essays 1 and 2

The first essay presented a conceptual model that outlines the processes by which two core elements of music have effects on individuals. While all of these are hypothesized to be relatively automatic processes, the extent to which they rely on learning differs. The first element, pitch, develops meaning for individuals over time through referential processing; it is strongly linked to an individual's memories, and thus requires the learning of associations between specific sounds and related constructs. In other words, the processing of pitch is highly individual. Therefore, being able to evoke related outcomes such as the transfer of affect and changes in mood involves understanding how these constructs relate to specific patterns of melody and harmony, and likely relates strongly to the culture of the listener.

On the other hand, the second core element of music, rhythm, is processed in ways that do *not* rely on referential processing, linked to memories. Specifically, processing rhythm can impact the arousal level of the individual, and has also been linked to how the individual interacts with others around them. These processes are not hypothesized to be as individualized as the processing of pitch, nor is it assumed that they need to be learned over time. As a result, the processing of rhythm and its related outcomes should be universal across the population.

The second essay investigates one of these links: the heightened social processing that results from the processing of rhythm. This link – and the processing of rhythm more generally – is assumed to be consistent across the population. This makes it makes for a good candidate to investigate effects that can be linked to marketing outcomes, as it does not require managers to tailor specific music to conform to the preferences of each individual. It is hypothesized that the rhythmic effects that exist could affect all individuals across cultures and ages, for example. Additionally, there is an existing body of literature that has identified a specific effect related to

this link (the *synchrony effect*), and there are indications that this effect can lead to managerially-relevant constructs such as helping behaviours and social identification. Both of these aspects make this link an attractive candidate to investigate further.

The purpose of the second essay is to use the model presented in the first essay as a foundation to further understand the synchrony effect, and to apply it to more managerially-relevant settings. The foundation for the design of the experiments and the selection of stimuli comes from the model in the first essay: music is chosen which holds one of the core elements constant (pitch), while varying the other core element (rhythm). Additionally, the model from the first essay guides the investigations of the process by which the effect occurs. Altogether, the second essay investigates a portion of the model presented in the first essay, but it also represents an example of how the model can be useful, and the value that can come from taking the more systematic approach that the first essay advocates.

Essay 2: Clapping to Connect: How a Music Synchrony Task Can Impact Organizations and Brands

Abstract

Engaging in a music task with another person, such as clapping in time with someone to music, can increase social cognition and cooperation – this is referred to as the synchrony effect. Non-musical synchronous tasks, such as walking in time with another person, can also have positive social effects, but there appears to be something unique to music: these music synchrony tasks impact social cognition at a much higher rate than for tasks that do not include music. Based on the model presented in the first essay, it is hypothesized that the improved social link resulting from music synchrony tasks is due to the rhythmic aspects of the music, and that a process explanation for the results shown in the literature could be feelings of affiliation and social bonding, which are anthropologically linked to rhythm. Across five studies, this essay confirms these hypotheses, providing evidence that rhythm-heavy songs are most effective at creating synchrony effects, and that it is feelings of affiliation with the task partner that result, rather than a general feeling of prosociality. The findings lead to managerially-relevant outcomes: individuals are more likely to change their brand preferences to mimic the partner they are in sync with, to report higher evaluations of the organization the partner is affiliated with, and to donate to this organization. This effect occurs even in experiments where a pre-recorded video was used, which improves the feasibility of managerial interventions in practice. Overall, this essay demonstrates the power that music can have in facilitating social relationships and connecting with consumers, as well as the importance of music choice when making marketing decisions.

Introduction

Music has been intricately tied with social relationships throughout human history. Social motives are theorized to be the primary reason why music evolved (Hagen and Bryant 2003), with music being used to improve social bonding. Given this strong link between interpersonal relationships and music, it is not surprising that contemporary literature has identified that completing musical tasks with others can foster and improve relationships, making individuals more prosocial (Cirelli et al. 2014), more likely to join another person in joint action (Wiltermuth 2012), and more likely to identify with each other (Lang et al. 2017).

The literature has identified that these social outcomes are most pronounced after individuals synchronize with each other to the beat, or rhythm, of music. This *synchrony effect* has been widely replicated (Mogan et al. 2017). However, there are shortcomings in our knowledge of this process. While steps have been taken to understand what is occurring within individuals during these joint musical tasks (such as by investigating the neurological processes that occur; Tarr et al. 2014), there is a lack of examination into the outcomes that may result. This is likely because existing literature focuses on how music can change the strength of an interpersonal relationship between people engaging in synchrony, rather than looking outside this context to consider other potential impacts.

This essay shows that music can have a variety of effects apart from interpersonal relationship dynamics. It is shown here that completing a synchrony task can improve donation likelihood to a charitable organization. Donation contexts provide a close conceptual link to prosociality findings of past literature. However, the process by which donations are impacted is shown not to be through generalized prosociality or improved affect; instead, individuals feel closer to the task partner and are more likely to follow their signals. This indicates that social

effects of music are not as context-dependent as may be concluded from the existing literature. A series of experiments in this essay show that music synchrony tasks can influence individuals to adjust their feelings towards organizations and to alter their brand preferences to align with the task partner, even in instances where the partner is identified overtly as a brand representative.

This paper takes a more fundamental approach to the utilization of music. Since the processing of the rhythmic element of music has an anthropological link to social relationships, it is hypothesized and shown that increasing the prominence of rhythm within a song yields stronger synchrony effects. By contrasting different combinations of video and audio included in the task, it is demonstrated that music must be present for these effects to occur, but that they can occur when watching a pre-recorded video.

By extending study of the synchrony effect to consumption-relevant contexts, such as donation intentions and brand preferences, there are actionable managerial implications based on this research. This paper confirms that rhythmic music has the power to increase social bonds, but also finds that the effects are not limited to interpersonal contexts. It is shown how this effect can be harnessed by organizations or brands by using a company representative, which opens a variety of avenues for implementations. Specific suggestions provided in this essay regarding music choice and the use of pre-recorded videos also increase the ease with which these tasks can be effectively implemented.

This research provides several important theoretical contributions. First, by showing effects of synchrony tasks in other domains such as in organizational and consumption contexts, this paper extends the potential for synchrony to be studied in fields outside of psychology. Second, this research concludes that it is the strengthening of identification with the synchrony partner that is the cause for downstream effects of synchrony; in other words, it provides an alternative account

for these effects that does not focus on prosociality, and is therefore divergent from the overall conclusion of past literature in this area. This brings the synchrony effect conceptually closer to studies on social influence and identification, providing many avenues for future research combining the topics of music and social influence. Third, this research contributes to our more general understanding of music processing, providing further empirical support for the link between rhythm and social processing, as well as support for the delineation between the processing of pitch and rhythm in music. Finally, this research extends our understanding of the conditions needed for synchrony tasks to be most effective. It underlines the irreplaceable role that music has in creating this effect, and highlights that the strength of the effect is a function of the prominence of rhythm within the song. The findings suggest that in-person interactions or overt, deliberate movements may not be necessary for the effect to occur, improving the potential to use music in marketing communications in future research and practice.

Theoretical Foundation and Hypotheses

Music processing

Music has a strong link to social relationship dynamics. While music has cognitive and emotional-regulation functions, it appears that music's social functions are the most important drivers of how individuals use and choose music in their everyday lives (Hargreaves and North 1999). This can be at least partially explained by music's aesthetic qualities: as a symbolic good with a high level of complexity and variety, music preferences are often used to communicate one's identity, and individuals often judge each other's personalities based on their music tastes (Rentfrow and Gosling 2006). Normative expectations arise as to expected styles of music within social circles (North and Hargreaves 1999a), often resulting in a similarity-attraction dynamic

where social identities and group formation interacts with music preferences to guide "expected" musical tastes within social groups (Selfhout et al. 2009).

These explanations for music's role in social interactions mostly consider music as a commodity, ignoring the potential for the consumption of music itself to also impact individuals' cognition. Yet, we know from research in other fields that listening to music alone can also yield a variety of complex emotional reactions (Sachs et al. 2015). Early research on music identified a variety of basic associations, such as songs in a major key music being considered "happy" (Hevner 1937), at least in Western cultures. These learned associations begin at an early age: for example, infants begin to associate the higher-pitched, cooing voices of their mothers with calmness, whereas low-pitched, loud, and dissonant sounds become associated with fear (Trainor 2008). Some of these associations are also social, and thus contribute a separate explanation for music's link to social dynamics. In fact, social pressures and the linking of music to social events are seen as key drivers for music preference development, and there is correlation between the peak age of susceptibility to social influence and the development of stable musical preferences (Holbrook and Schindler 1989). In general, associating events and emotions to music is common, with individuals building up in an internal library of sound "templates" over their lifetime to which incoming sounds are referenced (Salimpoor et al. 2015). The cognitions resulting from familiar sounds are strong, resulting in dopaminergic patterns that are otherwise only seen in connection to the basic human functions of food consumption and sex (Salimpoor et al. 2013). At the same time, the social pressure to conform to normative influence regarding musical tastes within one's group is also strong: when music that is considered enjoyable by an individual is shown to be unpopular with others, strong neurological responses consistent with fear and

anxiety occur in the individual (Berns et al. 2010). Altogether, while music evokes strong emotional responses, social dynamics also play a role in this processing.

While this indicates that music is processed by individuals through learned associations, the literature also indicates that there is a more fundamental processing of music as sound that occurs as well. There are separate neural pathways for cognitive and affective processing of music (Peretz et al. 1998), suggesting it is worthwhile to differentiate the outcomes that come from the emotion resulting from music from the outcomes that result due to core elements of the music itself. For this purpose, music can be divided into two constituent parts: pitch and rhythm.[7] This division makes sense not only theoretically; empirical evidence also indicates that the neurophysiology of music processing can be distinguished by these two elements (Peretz 2001). A domain-specific area of the brain is devoted to processing pitch elements of music, while the processing of rhythmic elements of music is found to occur in entirely separate areas of the brain related to spatial processing, temporal awareness, and movement (Peretz and Zatorre 2005).

Researchers have identified that these two core elements of music likely have different evolutionary origins as well (Peretz 2006). It is theorized that the complexity of pitch (and its groupings, termed "harmony") that we see in music today is likely the result of a costly signaling

[7] Here, music is defined as the arrangement of discrete frequencies (or *pitches*) across a temporal space. For example, a melody (a sequence of pitches) will go "up" or "down" as pitches within it are of higher or lower frequency than the preceding pitch. The amount of time between notes of a melody will also vary – sometimes a pitch will last a long time and will not be immediately followed by another, while other times there will be a series of pitches in quick succession – and this constitutes the temporal space, or *rhythm*, of the melody. Additionally, frequency and temporal aspects can be layered to provide for more complexity to a song: in terms of frequency, multiple pitches are often played together as *chords* in a song to provide harmonic structure for the melody, and sometimes a second instance of the melody is added at a higher or lower pitch, in *harmony* with the original melody; in terms of temporal aspects, a consistent rhythm, or "beat", is often overlaid at a regular consistency to provide cadence and time structure to the melody. Finally, music may or may not contain *lyrics* (text which is attached to a melody). However, given that music can occur with or without lyrics, it is not essential to this conversation. Therefore, altogether, music (excluding lyrics) can be divided into two core elements: *pitch* and *rhythm*.

hypothesis, where those who were able to master the art of being able to understand and create complex combinations of sounds were perceived to possess either greater resources, higher intelligence, or both, thus conferring an evolutionary advantage. On the other hand, the importance of rhythm is hypothesized to have developed as a way of engaging in shared tasks, with the ability to conduct joint rhythmic tasks such as drumming and dancing seen as an indication of coalition or group quality (Hagen and Bryant 2003). For example, in choral singing, the purpose is to perform music in unison rhythm with other singers; in one study, those who engaged in choral singing experienced a converging of heart rates between themselves (Vickhoff et al. 2013). This coordinated music-making united them as a group, thus providing a modern example of the ability of joint rhythmic tasks to encourage group cohesiveness. In other words, while pitch processing can be linked to an individual evolutionary advantage, rhythm processing is linked to a group advantage.

Overall, there is a theoretical basis for the idea that including music in a social interaction can affect the individuals involved. The discussion above presented two directions: music can facilitate social interactions, and also impact individual emotions and cognitions. The latter effects are dependent upon the processing of pitch, and on referring this to learned associations of music that have built up across each person's life. This "referential" processing of music cannot be easily manipulated across individuals in a single moment by a practitioner, since it will be relatively unique to each individual and his or her accumulated experiences with music over their life. However, music's ability to influence social interactions through rhythm appears to be consistent across individuals. Therefore, it is most feasible to adjust the rhythm elements within a song in such a way to encourage these social outcomes, since this is not subject to each individual's history with music in the same way as pitch-related effects.

The current research adopts this approach, focusing on eliciting social cognitions in a joint listening environment. It is hypothesized that including music in a social interaction, and especially that which emphasizes the rhythmic elements of the music compared to the pitch elements, should result in stronger social outcomes. Since rhythm is tied to group identification and social bonding in literature, the hypothesized process here is that increasing the prevalence of rhythm in the joint music task should increase the level of identification or similarity the individual feels with the task partner, as they consider them part of their "group".

H1A: Including (vs. not including) music as the focus of a social interaction will result in stronger social effects for those involved.

H1B: Increasing the prevalence of rhythm in music compared to pitch elements during joint music tasks will result in stronger social effects for those involved.

Effects of increased social processing

If individuals increase their identification with the task partner after the synchrony task, they should also be more willing to follow preference cues given by this partner. Specifically, they should be more likely to view explicit or inferred cues about organizations or brands the task partner is involved with as indications on how they, as an individual in the same "group", should also act. In other words, it is expected that they will be more likely to join the individual by expressing this joint membership through cues indicated by the task partner.

H2A: If an individual completes a joint rhythmic-music task with a representative of an organization, the individual's ratings of the organization will be more positive and their

behaviour towards it will be positively impacted, compared to if they did not complete this task.

H2B: If an individual completes a joint rhythmic-music task with someone who displays an association with a brand, the individual's preference for that brand will be stronger and they will be more willing to try products from this brand when compared to those who did not complete this task.

As previously mentioned, much of the synchrony literature focuses on synchrony tasks involving groups of individuals, with strong results found for group-level effects. The current essay posits that rhythm processing is likely related anthropologically to group-level processes of increasing coalition quality. Therefore, relative to studies focusing on dyadic (two-person) relationships, embedding the individual into a group and completing a synchrony task together should lead to strong identification effects with the target individual. One way of viewing this process is to consider a synchrony task in a group scenario as multiple synchrony tasks occurring at the same time, acting to join all individual dyads of members of the task together by increasing their identification with each other, altogether reinforcing the group's bond. Therefore, consistent with music's (and specifically, rhythm's) theorized relationship with group bonding, the joint rhythmic task should also improve the group's ratings of each other – regardless of the ratings they give the target individual.

H3A: Completing a joint rhythmic-music task with a target in a group with other participants will lead ratings of the target individual to be higher than if this task was not completed.

H3B: Completing a joint rhythmic-music task in a group will lead to stronger intra-group ratings than if this task was not completed.

The synchrony effect

The literature already has evidence that manipulating rhythm should change social interactions. Past studies on the *synchrony effect* show that completing a joint rhythmic task (usually clapping) in time with music with another individual results in increased feelings of identity and cooperation with that individual. There are social benefits to joint movement in general (e.g. Durkheim 1915/1965), and therefore a common criticism of this area is that there are benefits to joint action regardless of whether music is involved. However, research has shown that this synchrony effect exists apart from any simultaneous effect that comes from completing a joint task or from synchronizing to a beat without music (Stupacher et al. 2017). There appears to be something unique about music in its ability to facilitate additional social effects, apart from it simply being a joint task. Therefore, music is seen as integral to synchrony effects.

However, there are also limitations in the existing synchrony literature, in both the extent they have examined potential effects that can result, as well as their explanation of the process underlying the effect. A recent meta-analysis on this effect concluded there were four consistent effects of synchrony in the literature: prosocial behaviours (i.e. helping behaviours), social bonding, social cognition, and positive affect (Mogan et al. 2017). With regards to affect, other research has concluded that while positive emotion often occurs, this may be a common result of being involved in a group, rather than an alternative cause for the effect; specifically, positive emotions are not needed to generate synchrony effects (Wiltermuth and Heath 2009).

Among the remaining three outcomes, the most-reported effect is regarding prosociality, with individuals being more willing to help partners on an unrelated task who had previously engaged in synchrony with them (Cirelli et al. 2014). Other studies have found increased neurochemical responses consistent with prosociality (Tarr et al. 2014), supporting the conclusion of a prosocial link to the synchrony effect. The literature generally infers that an increase in social cognition can explain the prosocial and identification results of synchrony (Cacioppo et al. 2014). However, this explanation is not sufficient in explaining *why* the rhythmic or music task would act to focus individuals on the social situation (i.e., what specifically is occurring as a result of music to increase social cognition). Therefore, these results fall short of providing a logical process explanation. Instead, increased social cognition may be an artefact of another result: specifically, in this essay, it is posited that increased feelings of identification with the task partner that result from a synchrony task may cause individuals to be more attuned to other social cues coming from the partner. This would appear in results as an increase in social cognition, thereby explaining past results regarding this construct in the literature. This process explanation of increased identification could also explain existing strong effects of prosociality in the literature: after engaging in the synchrony task, the individual – who now identifies more closely with the partner – will likely be more willing to help them, as they will be more likely to see this action as beneficial to their (shared) group identity, of which they now realize they are both a part.

These findings in the literature regarding prosociality are not inconsistent with the nomological network described in the previous section: helping others within a group could improve the coalition quality of that group. However, based on this discussion, these prosocial acts may be artefacts of a more fundamental concept of group identification. If so, it may be

more prudent to examine rhythm's impact as a social tool in helping an individual to *become* a member of a group or organization, rather than focusing on how to get them to help other individuals once they are already a part of the group. Therefore, this research applies the synchrony effect to situations where the partner in the task is a member of an organization and examines whether the individual's feelings towards that organization improve as a result – in other words, it is examined whether they view the partner as part of a shared group, and thereby join them in their preferences or actions. This also acts to extend the boundaries of the effect to also include its potential to have effects on other associations of the task partner. Rather than limiting to prosocial actions such as helping behaviours, this theory suggests we can look more broadly to consider that anything the partner associates with may have the potential to be joined by the individual – whether these be positive behaviours, preference cues, or even negative actions (such as joining a riot, for example).

The final group of results of synchrony in the literature suggest it can cause increased levels of affiliation with the task partner (Hove and Risen 2009), an increase in the level of overlap the individual perceives between them and the partner (Lang et al. 2017), and an increased likelihood of succumbing to social influence and joining the task partner in an action the partner would prefer (Wiltermuth 2012). These are consistent with the previous paragraph, and also H1A and H1B presented above, which consider increased identification as the process of the synchrony effect. However, rather than these being the result of increased social cognition as suggested in the literature, this essay provides a more detailed theoretical explanation. In this paper, these results are explained as relating to the increased feeling of identification with the task partner, which itself can be explained due to the foundational effect of rhythm in improving social bonds.

Finally, it should be noted that there are no studies linking these effects to consumption contexts. Rather than limiting the focus to one-on-one interpersonal contexts, this essay examines downstream effects on charitable organizations and retail brands, which improves the potential for this research to have a wider array of managerial applications. This also acts to extend the known boundaries of this phenomenon. This will be discussed further towards the end of the essay.

Overview of Studies

The hypotheses presented above are tested in five studies using an experimental methodology. Each study was conducted using a similar procedure, which is explained in the presentation of study 1: participants watched a pre-recorded video which sometimes involved a clapping or tapping task with a confederate, and then completed survey questions which included rating the confederate and then answering preference or intention questions on the associations of the confederate. Study 1 compares the effectiveness of different types of music, showing that stronger levels of rhythm within the same song best facilitate the effect. Study 1 also provides the first test of the pre-recorded video methodology, indicating that these effects can be created even if there is no live (in-person) task. Overall, study 1 provides initial evidence that completing a synchrony task to rhythmic music with a partner can increase subsequent ratings of this partner. Study 2 demonstrates that this synchrony effect can be applied to a managerial context: it increases not only identification with the spokesperson a charitable campaign, but also identification with the charitable organization to which she is linked, and intentions to donate to the organization. Study 3 tests the relationship between these outcomes, showing that identification with the partner is necessary for the other subsequent outcomes to be impacted;

additionally, study 3 is successfully conducted in an online environment, showing that physical presence is not necessary for the effect to occur. Study 4 returns to a lab setting and shows strong levels of synchrony occurring in a group context, consistent with the theory that music works through constructs such as group identification. Finally, study 5 investigates whether these effects extend outside of prosocial behaviours, providing evidence that synchrony tasks can affect brand preference and choice.

Study 1

Study 1 examines the role of the specific music composition in creating synchrony effects. Existing literature shows that music synchrony tasks act to improve feelings towards others who complete the same joint music task. This places the potential utilitarian value of the music in this scenario as that which will support social interactions. The literature also indicates an anthropological link, with music being used to facilitate to social relationships (Hagen and Bryant 2003). Specifically, this social link can more clearly be connected to the presence and intensity of rhythm, rather than to the other core elements of music of pitch and harmony (Peretz 2006). Therefore, study 1 hypothesizes that music that has more prominent rhythmic elements should be better at creating synchrony effects.

To do this, two versions of a song are compared: one has a higher prevalence of rhythmic elements, while the other elements of the music (pitch-related) are identical for both song versions. The songs are compared in their ability to improve the level of affiliation participants feel towards a confederate, or "target", with whom they tapped to one of the song versions. The existing synchrony literature shows increased social bonding as a consistent outcome of music synchrony tasks such as this (Mogan et al. 2017), and so individuals' feelings of affiliation with

the individual are tested after completing the task. Additionally, individuals are asked to synchronize their movements with a pre-recorded video, rather than with another person in the same physical space. The goal of using this methodology is to improve the managerial relevance of this research by showing that synchrony manipulations do not require physical co-location to be effective.

Stimuli development

Use of video as a synchrony manipulation

Past synchrony studies have used a variety of methods in order to create synchrony effects. In studies with infants, this involved bouncing the infant in time with music with the experimenter (Cirelli et al. 2014); with adults, it has involved moving cups in time (Wiltermuth and Heath 2009; Wiltermuth 2012) and rocking in time with music (Demos et al. 2012), and even walking around campus singing 'O Canada' (Wiltermuth and Heath 2009). All of these involved manipulations with a group of other participants and/or confederates. Other studies have used interpersonal interactions involving only a participant and experimenter, such as tapping with the experimenter to the beat of a song (Hove and Risen 2009).

The above-mentioned studies all involved in-person interactions (i.e., completing the task in a shared physical space). The potential for alternative manipulations which do not involve shared space and/or time is not addressed in literature. Only two studies have been noted in this regard: these studies had participants watch a pre-recorded video with people (Knight et al. 2017) or stick figures (Stupacher et al. 2017) who were either walking in sync with each other, or not. The individuals were then asked to ascribe motives to the individuals, or judge the closeness and likeability of them, respectively.

In the field of marketing, there is value in determining manipulations that have fewer necessary requirements such as physical co-location, as these tend to be ones that have increased potential to be managerially-relevant. In this case, evidence that synchrony-like manipulations can create the subsequent interpersonal effects using a video manipulation brings forward the possibility that this type of manipulation can be used without the need for a company or brand employee to be physically present.

All studies in this essay use pre-recorded videos for the synchrony manipulations. In studies 1, 2, 3, and 5, the action chosen for the participant to synchronize is tapping along with a person in the video, who claps in time with music. Because of the laboratory setting in studies 1 and 2, the instruction is to "tap along quietly, on your leg", in order not to disturb other participants in the room; in online studies 3 and 5, participants are asked to click their mouse or trackpad in time with the person in the music. Despite the potentially weaker manipulation, as compared to more overt actions such as clapping, the effects are significant, and are likely to be stronger in situations where an overt action is implemented in manipulations. Study 4, which investigates the intra-group effects of joint synchrony tasks, does use a physical (more overt) manipulation by asking the group to clap together to the video, and strong results are found for interpersonal ratings.[8]

A total of four videos using four different confederates were used across the five studies. In every video, the confederate was recorded sitting in front of a neutral background. Once the

[8] Although it could be that this is confounded with the impact of completing the task in a group, an unreported study conducted prior to study 5 shows that the overt clapping in the group setting shows stronger results than overt clapping in an individual setting (alone in a room, clapping to the video). However, the purpose of study 4 is to investigate the impact of group manipulations, and so the relative impact of overt vs. less-overt manipulations is not compared further.

song begins playing, she is recorded clapping on the beat (i.e., at the beginning of each bar/measure and three times succeeding this per bar, in equal spacing, corresponding to the time signature of the song of 4/4).

Music accompaniment for video stimuli

Synchrony studies in the literature have generally overlooked the specific music stimuli used in their manipulations. One article reported using songs that "had a heavy beat" (Wiltermuth 2012); another used "music than can be comfortably rocked to" (Demos et al. 2012). However, these explanations lack specificity; this makes it impossible to replicate the same music manipulation, and also limits the feasibility of implementing this research in managerial settings.

Choosing different songs to represent high- and low-rhythm conditions is not ideal. This is especially the case because individuals rely heavily on past experiences, such as memory links, when processing even the most basic of pitch-related musical elements (Salimpoor et al. 2013). In choosing one acoustic song and an entirely different rhythmic song, a researcher has also introduced the potential for there to be variation in the pitch-related elements between these two songs.[9]

[9] For example, it may be that the acoustic song has a descending chord progression, which is known to elicit sad emotions in Western listeners (Machlis and Forney 2003). Alternatively, it may include sleigh bells, which many in a Western culture would associate with Christmas – this would be potentially worrisome for the discussion here, as this is seen as a holiday with a strong social element. Either instance would introduce the potential for confounding variables resulting in reasonable alternative explanations for any results found. Existing studies using music have encountered issues with such potential for confounding variables. For example, past studies investigating the impact of familiarity of music on shopping times used "Top 40" (popular) music as "familiar" music, and older instrumental music as the "unfamiliar" music, even though it is entirely possible (and even likely) that Top 40 music is also more upbeat. Therefore, an alternative explanation surrounding upbeat music facilitating faster shopping causes is equally likely, bringing into question the validity of the results.

In order to avoid the potential for confounding music cognition processes, the current study uses two different versions of the same song. The song is titled "Dancing on My Own", by the artist Calum Scott, a UK-based artist. The original single (used as the "acoustic" version in study 1) was released in April 2016; a remix version of the song (used as the "rhythmic" version in study 1 and throughout the remaining studies in this essay) was released by Tiësto in October 2016. Appendix A contains additional information about these audio recordings and how they are integrated into the stimuli presented in this essay.

Method

Study 1 was conducted in a laboratory environment. Eighty-six undergraduate students participated in the experiment, and were remunerated in the form of course credit (50% females; M_{age} = 22.58, SD = 9.03). Participants entered the lab setting in groups of between 5 and 12 and were seated at individual computers, where they completed the entirety of their participation. Computers included headphones, which participants were instructed to wear as soon as the session began.

Participants started the experiment by viewing one of three possible videos of an individual clapping. A still image from the video used in study 1 is presented in Appendix C. The videos were identical, except for the music to which the individual was clapping. Version 1 contained an acoustic version of the song; this was the original recording of the song, and contained only solo voice and piano, in the style of a "ballad". There are only minimal rhythmic elements in this version: the piano provides only a basic rhythmic structure, in most cases only emphasizing the first beat (the "downbeat") of every bar/measure. In Version 2, the individual was clapping along to a rhythmic version of a song. This version was released by the same artist,

and uses the same original voice recording as Version 1, but adds bass, drums, and synthesizer elements that a strong rhythmic component to the song that is lacking in Version 1.[10] In the final condition, the individual in the video was clapping but with no musical accompaniment, and this formed the control condition. To eliminate any potential confounding effect of tapping on other participants in the same room, the instructions asked them to tap along to the video "quietly, on their leg".

Following the video task, participants answered a series of survey questions. They first rated the confederate in the video using a five-item, 7-point scale (1 = not at all, 7 = very much; $\alpha = .87$) from past synchrony research that measures the participant's level of social affiliation with this individual (Cacioppo et al. 2014). They were then asked questions about their demographic profile and music listening habits. They also rated how much they liked the song that was played in the task (1 = not at all, 7 = very much).

At the end of the survey, they were asked how in-time they felt with the confederate when completing the synchrony manipulation, on a sliding scale with two anchors (0 = not at all synchronized, 100 = totally synchronized). This was gathered to control for the fact that the participants were attempting to synchronize with a pre-recorded video. An in-person scenario is more analogous to a real-life scenario than the current setup, which uses a pre-recorded video; contrary to a traditional synchrony scenario, in which both individuals have the ability to adjust

[10] This neutralizes any discussion on the potential for harmonic and/or melodic differences in the recordings to confound the results, as the song's composition and structure is the same. Importantly, the "human" aspect of the recording (which could potentially be argued as also impacting the social processing of the song) has also not changed in this version, as the same voice recording was used. Differences between Versions 1 and 2 affect primarily the rhythmic elements: a layered recording of bass, drums, and synthesizers replace the piano accompaniment in Version 2, providing a much more prominent beat. The mixing and mastering process of the recording also acted to move the vocals away from the foreground, partially through the use of reverb; this makes the vocals seem further away, while simultaneously acting to emphasize the rhythmic elements of the recording.

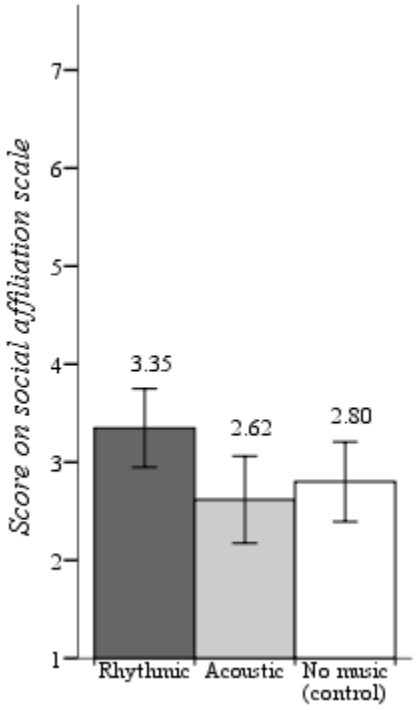
their clapping until they are synchronized, the asynchronous nature of the video scenario will likely be harder for the participant, since they must adapt on their own. The participant will be working to adjust for initial differences in their synchronization with the music, while at the same time, they will also be attempting to reconcile the differences that they have in timing of their taps with the confederate's taps; the latter element would be much easier in an in-person environment, where the confederate could contribute to this adjustment. Furthermore, there was no confederate or experimenter to review, assess, or practice this task with participants. Due to this setup, a self-report was used to assess how well they followed the instructions to tap with the individual in the video, and how successful they thought they were. Since the goal in this article is to understand what may be occurring in synchrony effects in general, it is only helpful to gain information from those who believed they were able to successfully synchronize with the confederate. Therefore, steps were taken to adjust for the less-ecologically-valid video manipulation. More details on these criteria are provided in Appendix C.

Results

Following the arguments presented above, participants were removed if they scored less than one standard deviation below the mean on the sync-with-person measurement (i.e., those who had trouble syncing with the confederate). This removed 10 participants that rated the synchronization of their movements below 39.83 on the 100-point sliding scale. The remaining sample consisted of 76 participants (50% females; M_{age} = 22.49, SD = 9.63).

A one-way ANOVA was conducted to analyze the impact of the independent variable of music synchrony task (tapping to acoustic music, rhythmic music, or no music) on the dependent variable of feelings of social affiliation with the confederate. Results show that the type of music

Figure 2.1. Ratings of individual are higher after tapping to rhythmic music, compared to acoustic music or no music (Study 1)



is a significant predictor of individuals' level of social affiliation with the confederate ($F(2, 73) = 3.41$, $p = .039$, $\eta_p^2 = .085$). Figure 2.1 presents the results of this analysis. Results of planned contrasts between the music types show that rhythmic music appears to be the best stimuli for creating these synchrony effects. However, the contrast between rhythmic music and the no-music condition was only marginally-significant ($M_{rhythmic} = 3.35$, SD = 1.04 vs. $M_{no\text{-}music} = 2.80$, SD = 1.02; $t(73) = -1.88$, $p = .064$). The marginal significance in this initial study may be due to small sample sizes [11] or issues with the manipulation in terms of video and audio syncing, as

[11] Due to the COVID-19 pandemic, it was not possible to return to this study and increase the sample sizes, as the study was conducted in an in-person laboratory environment prior to the start of the pandemic. The pandemic also prevented planned sample sizes in studies 2 and 4, although sample sizes are generally adequate for both. The increase in sample size and the improvement in the quality of the stimuli led to significant contrasts with patterns that are in line with predictions.

discussed previously. Nevertheless, it provides sufficient motivation for further empirical investigation. These issues are addressed in subsequent studies which provide stronger evidence that rhythmic music can increase levels of social affiliation.

The other contrast is of interest here to determine which music is best at encouraging synchrony effects. In comparing the two music conditions, those who tapped with the target to rhythmic music rated her higher than those who tapped to acoustic music ($M_{rhythmic}$ = 3.35, SD = 1.04 vs. $M_{acoustic}$ = 2.62, SD = 1.09; $t(73) = 0.61$, p=.543). Finally, the difference between acoustic music and no-music condition was not significant ($M_{acoustic}$ = 2.62, SD = 1.09 vs. $M_{no\text{-}music}$ = 2.80, SD = 1.02; $t(73) = 2.49$, p = .015).

Discussion

Results of this study show that increasing the prominence of rhythmic elements in a song used to create synchrony effects improves the efficacy of the effect in increasing feelings of affiliation. This supports the theory that social processing is directly related to the rhythmic elements of music, rather than pitch elements such as harmony or melody, which is consistent with the neurophysiological and anthropological literature on music processing.

The finding that the acoustic song did not perform significantly better than when no music was present suggests that music's pitch-related elements (harmony and melody) do not seem to contribute much, if anything, to the synchrony effect.[12] This discussion will be returned

[12] Yet, the literature shows evidence that the synchrony effect specifically does *not* exist when pairs of individuals tap to a metronome, which is entirely rhythm with no melodic/harmonic content. In other words, our analysis does not show any benefit to synchrony in including pitch content, yet not including it appears to remove the effect altogether. Music seems to add something that "turns on" the effect, yet is not quantified through pitch. Future research could investigate this further, to determine the role that the pitch content specifically adds in order to create synchrony effects.

to later in the essay. The contrast of most interest to the current discussion is that between rhythmic and acoustic music: this result shows that rhythmic music is significantly better at encouraging synchrony effects. Therefore, all subsequent studies focus only on rhythmic music in the design.

This study also indicates that it is possible to create synchrony effects without the need to do so in an in-person context, through use of a pre-recorded video. This improves the ease of applying this research; the following studies will continue to use pre-recorded video manipulations, and look to further expand generalizability through the use of online sampling (studies 3 and 5).

Study 2

The primary purpose of study 2 is to investigate whether there are actionable downstream effects of synchrony beyond more favorable social ratings. One of the most common findings in synchrony research is that the effect fosters an increased sense of prosociality (Mogan et al. 2017) – whether this involves helping the other individual when they later need it (Cirelli et al. 2014), or supporting them in other unrelated endeavours (Wiltermuth 2012). However, the potential for effects to exist outside of the interpersonal relationship between two people has generally been ignored. For managers, understanding whether synchrony effects can be extrapolated to related groups or causes is key to determining this research's relevance and applicability to organizations.

Specifically, study 2 hypothesizes that social affiliation towards the target that develops as a result of synchrony will lead to a higher willingness to support items related to the target, as assessed by the willingness to donate to the charitable organization that the target is associated

with. Therefore, study 2 investigates whether charitable organizations can also benefit from a synchrony effect, if they are linked with the target.

To accomplish this, participants are presented with a similar task to study 1, except the confederate in the video is subsequently identified as a representative of a charitable organization. It is tested whether individuals are more willing to donate their time to this organization after completing the synchrony task with the confederate.

Finally, study 1 investigated what type of music was most helpful in creating synchrony effects—acoustic, rhythmic, or no music. However, all participants were still tapping, including in the no-music condition. Study 2 introduces a control condition in which participants do not tap at all. This provides clarity as to the value of implementing synchrony-based interventions, compared to if the intervention was not conducted at all.

Method

One hundred sixty-five undergraduate students participated in a laboratory setting seated at individual computer stations, and were remunerated in the form of course credit (50.9% females; M_{age} = 21.22, SD = 2.73). A partial, three-cell design was used, involving two video-viewing conditions and a control condition. In the video-viewing conditions, participants started the experiment by watching a video of a target clapping to music: one group tapped along with the confederate, following the same instructions as study 1; the second group simply viewed this video, but was not instructed to physically participate. In the final condition, participants skipped the video viewing task altogether and proceeded to the next step of the experiment.

Due to concerns regarding the video quality and synchronization between the clapping and music, a new video was recorded for this study. It followed the same principles as the

original video: using a neutral expression, the confederate, seated in front of a blank wall, clapped in time to music by clapping on the beats of the song. The music stimuli used in the video consisted of the more rhythmic version of the song from study 1. Since the purpose of this study is to understand whether synchrony effects can be linked to outcomes outside of a two-person relationship, it is more prudent to choose the stimuli that is most likely to engender synchrony effects. This mindset also guided the decision to record a new video, and is similar to the argument in study 1 (and subsequent studies) to remove those who did not report feeling like they were able to sync with the confederate. Focusing on some individuals are unable to sync, or examining the likelihood of synchrony effects occurring in inferior conditions, distracts from the study's main purpose. This view also led to the decision to only examine this more-rhythmic song version, rather than continuing to focus on the acoustic song version from study 1. For this reason, the more rhythmic song version from study 1 was used for all subsequent studies presented here.

After completing the video task (or not, in the case of the control condition), all participants were presented with an advertisement for a fictional organization, "A Hand Up", whose mission was stated to be helping homeless youth in the city in which the study was conducted. Both the location and target of the charity (the specific city, youth) were chosen to increase the perceived closeness of the cause to the sample, which consisted of undergraduate university students in the same city. The ad also explained that the organization is short-staffed, and in danger of losing their government funding; this information was given as a cue to increase realism of the behavioural intention measure, which will be explained below. Following the advertisement, participants were then presented with a screen in which the target of the video (confederate) is introduced as a recruitment officer for the charitable organization. It is explained

that she has been hired to raise awareness for the organization within the university community. Participants are reminded that this is the same individual they saw in the video task; however, for participants in the control condition, this is the first time they have seen this individual, and so they are not provided with this prompt. The advertisement and text linking the target to the organization are presented in Appendix C.

Participants then continued by answering survey questions. They were first asked a behavioural intention measure, in terms of how much time they would be willing to donate to this cause, on a sliding scale from 0 to 60 minutes. Given that the ad for the cause mentioned that the organization is short staffed and that help with data is needed for their funding to continue, it is believed that participants should view the option here (coming back to the lab at a later date to help with data compilation) as having the potential to meaningfully contribute to the organization. Participants then indicated their level of social affiliation with the target, as in study 1 ($\alpha = .89$). Additionally, they were asked to rate the target on 7-point scales measuring likeability (1 = very unlikeable , 7 = very likeable), friendliness (1 = very unfriendly, 7 = very friendly), trust (1 = not at all, 7 = very much), and whether they felt they were on the same team as the target (1 = not at all , 7 = very much). They were asked their preference for the song on a 7-point scale (1 = not at all, 7 = very much). Finally, as in study 1, those in the condition who tapped were asked how in-time they felt with the target during this task.

Results

As in study 1, and following the reasoning presented above, participants were removed if they had trouble syncing with the confederate. They were also removed if they reported that they did not like the song, as this had the potential to interfere with the synchrony process. Details on

this are presented in Appendix C. The remaining sample consisted of 118 participants (56.8% females; M_{age} = 20.93, SD = 2.49).

Target ratings

Results for the target ratings appeared to follow one of two patterns, so it was investigated to see if dimension reduction could be used to simplify the results. An exploratory factor analysis on all nine target rating items (likeability, friendliness, trust, same team, and the five items from the social affiliation scale) was conducted using PROMAX rotation, which was chosen because there was an expectation that the resulting factors, although potentially distinct, would likely still correlate with each other. The factor analysis concluded the existence of two factors with eigenvalues greater than 1.00: items loading on the first factor include the ratings of being on the same team, as well as the five items from the social affiliation scale, with the single-factor solution explaining 67.93% of the variance of these six items. The second factor includes the ratings of liking, friendliness, and trust, with the single-factor solution explaining 74.89% of the variance of these three items.

Both of these factor solutions are considered adequate, since they explain greater than 60% of the of the variance of their items (Hair et al. 2009). Furthermore, reliability analysis of the variables showed strong internal consistency between their respective items (first factor Cronbach's α = .91; second factor Cronbach's α = .81). The first factor ("identification") can be interpreted as a more integrative measurement in which the participant determines whether they align themselves with the target, such that they have a common identity. The second factor ("external") can be interpreted as a more external or independent measurement of the target by

the participant; unlike the first factor, the items in the second factor do not require the participant to consider their own identity during the rating process.

For further analyses, the nine ratings were collapsed into these two variables. It is more theoretically important to examine results of the variable where participants rated their identification with the target, since this is the process by which it is hypothesized that the synchrony effect occurs. Therefore, only results for the first "identification" factor are discussed further. Results for the second factor are included in Appendix C.[13]

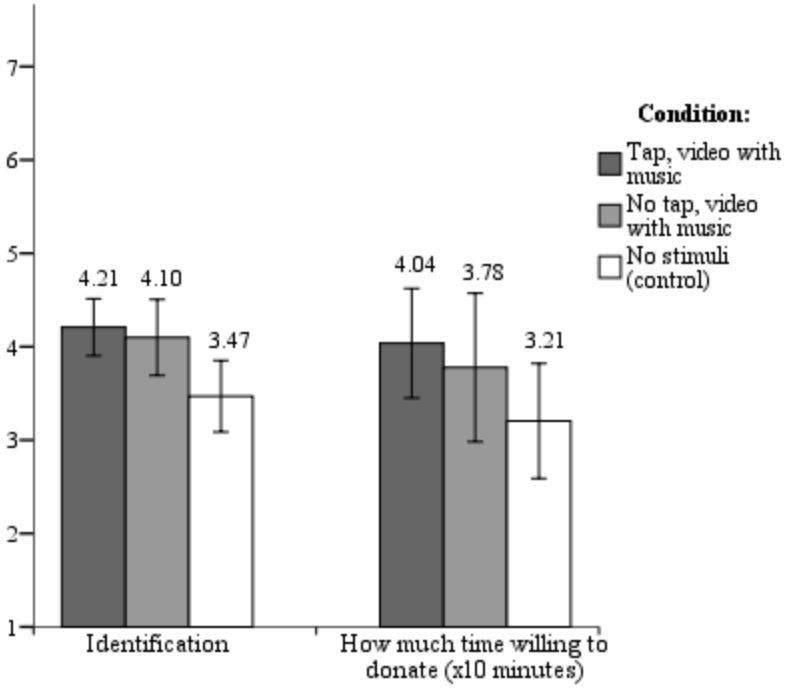
A one-way ANOVA was run with the synchrony condition (tapping, no-tapping, control) serving as the independent variable, and the identification variable from the above analysis serving as the dependent variable. Results show significant differences across synchrony conditions ($F(2, 115) = 5.18$, $p = .007$, $\eta_p^2 = .083$); the pattern of this result is shown in Figure 2.2. Analysis of the planned contrasts shows that individuals who tapped along to the music with the target rated her significantly higher when compared to the control condition ($M_{tap+music}$ = 4.21, SD=1.10 vs. $M_{control}$ = 3.47, SD=1.19; $t(115) = -3.11$, $p = .002$). This provides stronger empirical support for the hypothesis that completing the joint music task improves feelings towards the target.

In the remaining condition, individuals who watched the video but did not participate by tapping along have results that are similar to those who did participate by tapping: for the identification variable, the differences between the tapping condition and this no-tapping condition are not significant ($M_{tap+music}$ = 4.21, SD=1.10 vs. $M_{music-only}$ = 4.10, SD=1.06; $t(115)$ =

[13] Note that the results of the second variable ("external" ratings) are consistent with the hypotheses and are similar to the results of the first factor ("identification"), when examining the impact of the synchrony condition on these two factors. Contrasts for the individual target rating items are also all significant ($p < .05$) when analyzed individually.

-0.41, p = .681), but this no-tapping condition is significantly higher than the control condition ($M_{music\text{-}only}$ = 4.10, SD=1.06 vs. $M_{control}$ = 3.47, SD=1.19; t(115) = 2.24, p = .027). Thus, adding physical participation as a requirement does change the process – synchrony effects are occurring even if the participant does not tap along. This will be further examined in study 5.

Figure 2.2. As a result of completing the joint tapping task, ratings of the individual increase, and they are more likely to report donating time to an associated cause (Study 2)



Organization behavioural intention

Also included in Figure 2.2 is the results of the behavioural intention measure. The analysis again consisted of a one-way ANOVA with the synchrony condition as the independent variable, this time with donation intention (time) as the dependent variable, and with planned contrasts between the three synchrony conditions. Overall, the synchrony condition is not significant in changing this outcome (F(2, 115) = 1.881, p = .157, η_p^2 = .032). However, there

are differences when analyzing the planned contrasts. Participants in the tapping condition appear to be more likely to donate more time to the associated organization than those in the control condition ($M_{tap+music}$ = 4.04, SD=2.11 vs. $M_{control}$ = 3.21, SD=1.92; t(115) = -1.93, p = .056), although this result is only marginally-significant. Thus, there is some indication that the synchrony task could impact individuals' behaviours.[14] Contrast results appear similar for the no-tap condition to what we see for the target ratings, although this time neither contrast between this condition and the other two conditions is significant ($M_{tap+music}$ = 4.04, SD=2.11 vs. $M_{music-only}$ = 3.78, SD=2.06; t(115) = -0.54, p = .591; $M_{music-only}$ = 3.78, SD=2.06 vs. $M_{control}$ = 3.21, SD=1.92; t(115) = 1.21, p = .265).

Discussion

Study 2 indicates that synchrony effects may not be limited to a one-on-one, interpersonal context. The literature shows individuals are more prosocial towards a confederate when they are in need of help (for example, when they have dropped something; Cirelli et al. 2014); however, it is indicated here that individuals may also be more willing to help an organization that is linked to the confederate. This shows there is value to applying synchrony tasks in managerially-relevant contexts involving organizations, not only individual employees, for example.

The domain of study here is charitable donations, which has a proximal link to the hypothesized process of prosociality that is presented in the literature. According to these theories, individuals are more willing to help a target after completing the synchrony task with

[14] Similar to study 1, it was not possible to increase the sample size of this study to adequate levels due to the COVID-19 pandemic. Therefore, again, it is possible that a more robust study with otherwise similar methods could cause some of the marginally-significant results reported for study 2 to rise to significance.

them, and this tendency to feel prosocial then spills over to other associations that the target has. However, it will be shown in subsequent studies that this is not the process occurring here: specifically, study 5 shows that participants' brand preferences can also be affected through a synchrony task, which is not a prosocial task. Furthermore, the construct used in study 2 to measure the effectiveness of the synchrony task is identification, rather than desire to help the target. This means that the results in study 2 are not simply an example of a spillover effect of prosociality. Instead, participants are indicating that they identify more closely with the target, and therefore take cues as to what they should support (i.e. organizations) based on this stronger level of identification. This process is tested in study 3.

In this study, we obtain a better sense of the magnitude of the effect by comparing to a control condition in which the participant does not complete the task at all. This shows the benefit of including a synchrony manipulation, compared to if one had not been implemented at all. Compared to not completing a synchrony task, individuals tapping with a confederate rate them more positively afterwards, and there is some indication that they also show stronger intentions to help a charitable cause with which the confederate is associated. Adding a deliberate physical movement (tapping) seems to increase the significance of the effect compared to conditions that do not involve tapping;[15] however, these results are not consistent across all variables. This is more explicitly tested and discussed in study 5.

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[15] This result seems to go against past research that shows a synchrony effect can occur with a video-only manipulation (Stupacher et al. 2017). However, there are a two possible explanations for this result. First, there is an important distinction between the methodology of Stupacher et al. (2017) and this study; specifically, their video showed *two* figures walking in- or out-of-sync with each other. Thus, the participant did not need to engage in the task (i.e. through clapping or tapping) in order to conclude that synchrony occurred. In the current study, if the participant does not engage in some sort of task, then it is less likely that they will consider this as a "joint exercise", which is key for a synchrony effect to occur. Therefore, it may be premature to conclude that synchrony cannot occur in a video environment without physical participation; instead, it may be that it can occur, as long as the participant is in some way engaged in the joint rhythmic task. Secondly, it is possible that increased engagement in

Finally, it should be noted that the results here could be interpreted as a familiarity effect, as the participants in the two video conditions have additional exposure time to the confederate. Study 5, which adds additional conditions to the design tested here, also provides more empirical evidence that the process here is not simply a familiarity effect.

Study 3

Study 2 infers a link between the increased feeling of affiliation with the target that results from the synchrony task, increased affiliation with the organization linked to the target, and the subsequent behavioural outcomes. In other words, it assumes that affiliation (through two actors) is driving increased behavioural intentions towards the charity. Study 3 explicitly tests this process. It is hypothesized that a serial mediation occurs, where tapping along with the confederate increases feelings of affiliation with them; this leads to increased affiliation with the cause, which subsequently increases the amount they are willing to donate to the organization.

Method

This study was conducted online, using Amazon Mechanical Turk (MTurk). A series of a priori screening rules were used to recruit eligible participants; these are detailed in Appendix C.

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the task could act to draw enough attention to the synchrony manipulation that joint action is not necessary. In the experiments by Stupacher et al. (2017), participants needed to actively watch the screen during the task, and were asked to "imagine being one of [the moving figures]"; in the current study, no such attention is required. Participants were simply instructed to watch the video and listen to the music – not to specifically watch the clapping of the individual, and there was no incentive or instruction to specifically look at this aspect of the video and not, for example, the confederate's face. Therefore, it is possible that one reason why we see more muted synchrony results in the no-tap condition is simply because the tapping condition requires more attention to be paid to the synchrony manipulation (i.e. the clapping) itself. These explanations are further examined and tested in study 5.

The final sample consists of three hundred twenty individuals (35.7% females; M_{age} = 34.75, SD = 10.27). The design, stimuli and procedures were the same as that in study 2, including use of the same video. However, minor changes were needed to adjust for the new sampling strategy using participants on MTurk. To increase relevance, given the potential geographic location of participants across the US, the charitable organization and confederate information (including their introduction as a new recruitment officer for the charity for a specific university, and the location of the charity in a specific city) in the stimuli were revised to remove these links.

For the procedures, the instruction to "tap quietly, on your leg" was removed, as it was no longer necessary to prevent distraction to other participants.[16] Instead, participants were asked to "click your mouse or trackpad" along with the confederate in the video. Otherwise, the procedures remained identical to study 2. After completing the video task (or not, for the control condition), participants viewed the advertisement for the fictional charitable organization, and information about the recruitment officer (confederate) who had appeared in the synchrony task video. Next, participants answered survey questions, beginning with a sliding scale that asked how much money they would be willing to donate to this organization.[17] The scale was bounded by $0 and $10, with labels at every $1 mark. In order to assess the level of affiliation individuals

[16] This instruction was necessary in studies 1 and 2 due to the study environment, but remains a limitation; it is also possible that the results for the tapping condition would be more pronounced in studies 1 and 2 if a more deliberate, overt action was instead implemented. In study 3, it was no longer necessary to limit participants to such an inconspicuous action, given the change in the study environment: since participants were no longer completing this task in a room alongside other participants, the need to avoid distracting other participants was removed. Therefore, the design of studies 3 and 5 accounts for this by adapting the instructions to mouse or trackpad clicking in time with the confederate. This slightly more overt action brings this procedure closer in line with the majority of synchrony studies in the literature, which asks for actions such as clapping or moving a part of their body. It also generalizes the synchrony effect to another type of task (clicking, instead of tapping), while keeping the music task constant.

[17] This replaced the behavioural intention question in study 2 with a measure that was relevant to the sample, as "returning to the lab" to help the organization would not have been relevant to the MTurk participants.

felt with the target organization, a measure was adapted from the social affiliation scale used to assess the target in study 2; these measures reflected participants' feelings of closeness to the organization, on a 5-item, 7-point scale (1 = not at all, 7 = to a great extent; α = .86). Participants then rated their level of social affiliation with the target, as in studies 1 and 2 (α = .91), as well as their preference for the song and how in-time they felt with the confederate when completing the task (for those in the tap condition only).

Results

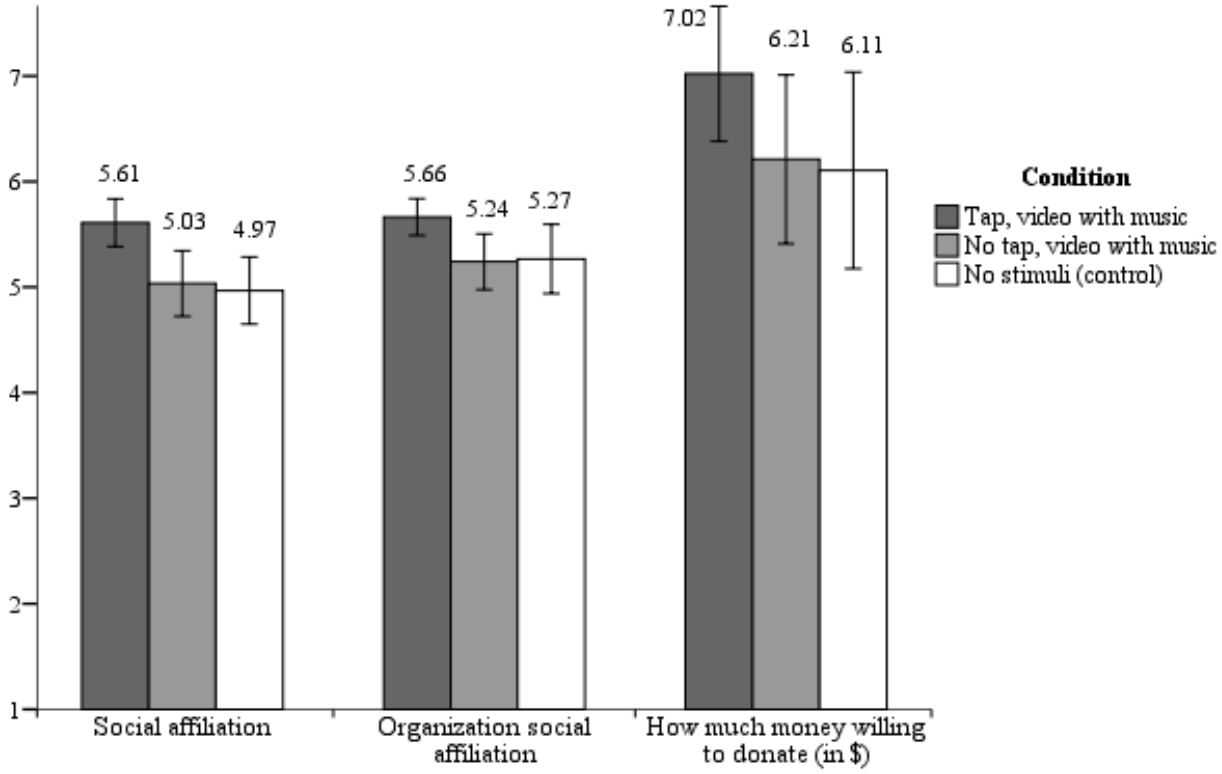
As in the previous studies, participants who had issues synchronizing with the confederate and those who reported disliking the song were removed from analysis. The final sample consisted of 212 participants (39.2% females; M_{age} = 34.69, SD = 10.22).

Three one-way ANOVAs were conducted to test the effect of the synchrony condition (tapping, no-tapping, control) on the three dependent variables. Results show a significant difference between synchrony conditions on feelings of social affiliation with the target (F(2, 209) = 6.72, p = .001, η_p^2 = .060), and feelings of affiliation with the organization (F(2, 209) = 3.75, p = .025, η_p^2 = .035). The final dependent variable – willingness to donate to the organization – did not show significant results (F(2, 209) = 1.74, p = .177, η_p^2 = .016); however, as will be reported below, results of planned contrasts show marginally-significant effects that are consistent with predictions. Results of these three analyses are presented in Figure 2.3.

The results of planned contrasts between the synchrony conditions show patterns consistent with predictions about the tapping condition, and this is also consistent with study 2: those who completed the tapping task report feeling more affiliated to the confederate when compared to the control condition ($M_{tap+music}$ = 5.61, SD = 1.02 vs. $M_{control}$ = 4.97, SD = 1.29;

$t(209) = -3.28$, $p = .001$). This pattern is repeated for ratings of the organization: compared to the control condition, those who completed the tapping task report feeling more affiliated with the organization ($M_{tap+music} = 5.66$, SD = 0.78 vs. $M_{control} = 5.27$, SD = 1.33; $t(209) = -2.26$, $p = .025$). The pattern of the behavioural intention measure of donating money to the organization is directionally consistent with the other dependent variables, but this contrast is not significant ($M_{tap+music} = 7.02$, SD = 2.88 vs. $M_{control} = 6.11$, SD = 3.78; $t(209) = -1.68$, $p = .094$).

Figure 2.3. Completing the joint tapping task increases social affiliation towards the confederate, organization, and influences intention to donate (Study 3)



The pattern of results for the no-tap condition (those who watched the video but did not participate in the joint rhythmic task) is different from study 2. Results of the planned contrasts show that, when compared to those who did the same task but tapped along, participants who did

not tap report feeling significantly less affiliated with the confederate ($M_{music\text{-}only}$ = 5.03, SD = 1.25 vs. $M_{tap+music}$ = 5.61, SD = 1.02; $t(209) = -2.93$, $p = .004$), and less affiliated with the organization ($M_{music\text{-}only}$ = 5.24, SD = 1.06 vs. $M_{tap+music}$ = 5.66, SD = 0.78; $t(209) = -2.40$, $p = .017$). The final contrast for these groups, in terms of donation intention, is not significant ($M_{music\text{-}only}$ = 6.21, SD = 3.23 vs. $M_{tap+music}$ = 7.02, SD = 2.88; $t(209) = -1.48$, $p = .140$). The no-tap condition was not significantly different ($p > .10$) than the control condition in any case. Again, the possible explanations discussed in reference to the results of study 2 could also apply here, since a similar video manipulation was used.[18]

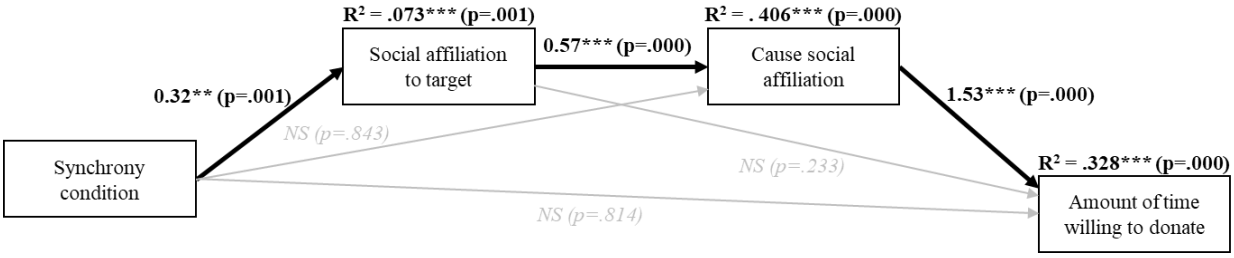
Gender was included as a covariate or moderator in the ANOVAs for all studies. This analysis did not reveal any significant effects except for study 3 ($p < .05$). In study 3, the gender term was significant ($p = .001$); however, the interaction term was not. Importantly, the condition's effect on the dependent variable remained significant in the analysis (at $p < .001$). Given that gender is leading to consistent results across studies, it is not discussed further in this essay.

[18] These outlined that (1) the current study differs from past literature in that participants in the no-tap condition in the current study may not necessarily be as engaged in the joint rhythmic task apart from simply watching it in an analogous way to the past literature, and (2) it could be that participants were not paying enough attention to the synchrony manipulation (i.e. clapping) specifically, when compared to other elements in the environment, such as the confederate's face. These arguments are perhaps even more relevant here, since the variable testing environment that comes from conducting a study online (i.e. through MTurk) has been noted to potentially lead to distraction or lack of participant motivation, particularly for tasks that are more difficult or require more cognitive attention – for example, participants could easily be making breakfast or watching TV in the background while completing this task (Crump et al. 2013). If this were true, we would see lower synchrony effects in study 3 for the no-tap condition when compared to study 2, in which we could control the environment in the lab to include no potential distractors. Since the tapping condition required the participant's undivided attention, they should not be as influenced by environmental distractors, and we should see no difference between the results of study 2 and 3. This pattern of results corresponds to the results here, and so this is a potential explanation for the divergence of results for the no-tap condition.

Serial mediation

One goal of study 3 is to test the previously inferred process relationship between the synchrony manipulation and the outcome measures. For this, a mediation model comparing the tapping condition to the control condition was conducted using Hayes' (2017) PROCESS Model 6. Results show evidence of a fully-mediated relationship, where the synchrony manipulation increased social affiliation with the confederate, which increased social affiliation with the organization, which then increased the amount of time participants were willing to donate to the organization (β = .059, SE = .027, 95% CI = [.017, .126]); the indirect paths between these constructs were not significant in any case. This mediation is presented in Figure 2.4.

Figure 2.4. Social affiliation with the target (confederate) and with the organization mediate the effect of the synchrony manipulation on donation intention (Study 3)



Discussion

Study 3 finds a pattern of synchrony effects similar to those shown in study 2, this time using a more diverse sample in an online environment. This shows it is still possible to experience these effects even in less-controlled environments. By removing the links that were seen to increase social closeness for the student sample in study 2 (youth-related, in the same city), study 3 also shows that synchrony effects can still have impacts on organizations, even if they are not as relevant to individuals' daily lives.

Altogether, studies 2 and 3 contribute to our understanding of the synchrony effect by demonstrating impacts outside of an interpersonal relationship: organizations can also benefit. This has important managerial implications, providing the first evidence that behaviours towards an organization can be changed by engaging in synchrony tasks. This study suggests the first step to influencing donation behaviours in this way is to make sure individuals feel connected to an organization representative, since this is the process by which the effect occurs.

The mediation analysis in study 3 outlines this process, showing that it is affiliation that drives the effects found, rather than a spillover effect of heightened prosociality. Specifically, the increased closeness participants feel towards the confederate leads them to also feel more affiliated with other associations that they link to the confederate – in this case, a charitable organization. Once this connection is made, participants are then more likely to donate to that organization. Study 5 will provide more evidence that it is an affiliation process occurring, rather than generalized prosociality, by showing that there can be impacts on other, non-charitable (i.e. non-prosocial) links, such as associations the confederate has with branded products.

Another remaining question regarding the process of the synchrony effect is the extent to which this process would change if more individuals were involved. Past studies often required participants to move or sway in time to music in groups of participants (Wiltermuth and Heath 2012); however, the procedures so far in studies 1, 2, and 3 have only involved one-on-one interactions. The results of studies 2 and 3 conclude that the process occurring is one of affiliation; it is not clear whether individuals will still be able to affiliate with a confederate in a setting in which they are also attempting to synchronize with other individuals, or whether the group scenario will instead act to distract from an ability to effectively connect with the confederate. Study 4 will test this by conducting a synchrony manipulation in a group scenario.

Study 4

Study 4 tests how the synchrony effect changes when the task involves synchronizing to the video along with a group of other participants. Since the process identified in study 3 is one of affiliation, it is possible that the group scenario makes it more difficult to identify with a target when one is also working to clap in time (and, thus, connect) with a group of other participants.

At the same time, it is possible that the group manipulation may work to enhance the effect. As mentioned previously, theorists in anthropology believe that rhythmic music is related to cooperation, social relationships, and group dynamics. Evidence of this includes the complex joint music and dance patterns found throughout history in various cultures around the world (Hagen and Bryant 2003). Since the foundational theory for the synchrony effect posits that rhythm evokes heightened social awareness, completing a synchrony task in a group could actually heighten the effect, causing social bonds between all participants to become stronger than if individual synchrony tasks had been completed between each of them.

To test this, participants in study 4 complete a synchrony task similar to that in studies 1 and 2, but do so in a group scenario. After the initial group task, participants complete individual surveys in which they answer questions about the other group members, the confederate, and the charity to which she is connected. The focus of the analysis is on the salience of the effect on the target and organization, and the intra-group ratings between participants.

Method

Study 4 was conducted in a laboratory setting. One hundred thirty-two undergraduate students participated and were remunerated in the form of course credit (50% females; M_{age} = 21.72, SD = 7.42). A partial, two-cell design was used, involving two video-viewing conditions

and a control condition. The video stimuli were re-recorded, this time using another confederate but with the same (rhythmic) song playing in the background of the video. Again, the confederate was seated in front of a blank wall and stared at the camera as she clapped on the beat to the music that was playing.

Participants arrived at the laboratory in groups of between 7 and 12 participants.[19] Half of these groups were assigned to the "clapping" condition: they began the experiment in a separate room, where they sat in a semi-circle facing a screen. They were instructed that a video would play, and they were to clap along together as a group with the person in the video, who was clapping along to music. Speakers in this room played the video and music at a volume that was determined to be loud enough to be heard over the group's clapping. An image showing the room setup for this condition is presented in Appendix C.

After this task, participants moved to a separate room, where they completed the rest of the experiment. The remaining groups of participants, forming the control condition, skipped this first step and began their participation sessions in the second room. Apart from the fact that they did not complete the clapping task, the remaining procedures for the control condition were identical to that presented to the group clapping condition, starting with the presentation of the same cause-related information.

In the second room, all participants then began a task at individual computer stations. First, they viewed the advertisement for the fictional charitable organization, and information about the recruitment officer (confederate) who had appeared in the synchrony task video.

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[19] Group size has not been shown to be a significant predictor of social bonding in past studies (Mogan et al. 2017). Therefore, it is not expected that there should be a meaningful difference in the results between the groups at the upper and lower ends of this range.

Participants then answered a series of survey questions about the organization, confederate, and other group members.[20] The behavioural intention variable from study 2 was used, which asks the amount of time individuals would be willing to donate to this organization on a sliding scale with anchor labels of 0 to 60 minutes. The five-item organization affiliation measure from study 3 was again included ($\alpha = .87$). However, it is not clear whether the results in study 3 are specifically due to individuals' increased affiliation with the organization – an alternative explanation for the result is that their feelings of the cause itself (i.e. the support of homeless youth more generally) could instead be influencing the subsequent increase in the donation behavioural intention measure. In order to see whether there was a difference in the impacts of the synchrony task between the organization itself (i.e. the company) and the cause that it supports (i.e. support of homeless youth), a second scale was added which asked specifically about participants' feelings of closeness to the cause. Again, the five-item social affiliation scale was adapted to the cause by changing the wording to specifically ask about the cause, rather than the organization or the confederate. If there was a significant difference in these results, it could indicate an alternative process explanation for synchrony's effects on subsequent behavioural intentions. The five-item measure was measured on a seven-point scale (1 = not at all, 7 = to a great extent; $\alpha = .85$).

Participants were asked to rate the other members of their group on four measures. The first was a four-item, seven-point scale (1 = not at all, 7 = very much; $\alpha = .84$) from a previous synchrony study in the literature which had also implemented a group manipulation: this

[20] Individuals in the control condition also completed the same measures asking them to rate other participants in the group. When these questions were posed to the control condition participants, the question wording asked them to rate the other participants who were currently in the room with them.

measure asks participants how connected they felt with the other participants, how much they trusted them, and how similar they thought they were to the other members (Wiltermuth and Heath 2009). The second measure was an adapted social affiliation scale: similar to how it had been adapted for the organization in study 3 and for the cause in study 4 (as mentioned above), it was also adapted here to ask about the level of closeness the participant felt to the other members of their group; this was a five-item, seven point scale (1 = not at all, 7 = very much; α = .91). Finally, the individuals were asked to rate the likeability (1 = very unlikeable, 7 = very likeable) and friendliness (1 = very unfriendly, 7 = very friendly) of the other group members.

As in study 2, participants then rated the target (confederate) on a number of measures, including likeability, friendliness, trust, whether they felt they were on the same team as the target, and the five-item scale measuring their feelings of social affiliation with the target (α = .91). They were also asked their preference for the song and how in-time they felt with the target when completing the task (for those in the tap condition only).

Results

Unlike the other studies, participants who had issues synchronizing with the confederate were not removed, due to concerns this may confound with perceptions of synchronizing and connection with the group, which is a variable of interest; this is further discussed in Appendix C. Outliers who reported low values on the song preference measure were still removed. The final sample consisted of 100 participants (49.1% females; M_{age} = 21.09, SD = 2.76).

A similar analysis to that in study 2 was conducted to reduce the number of confederate ratings. A factor analysis again resulted in two factors: the first factor ("identification") extracted 72.05% of the variance from six items, including ratings of feeling on the same team as the

confederate, as well as the five items from the social affiliation scale. These items showed high internal consistency (Cronbach's $\alpha = .92$), so they were combined into a single variable. Since this factor has more theoretical relevance than the remaining factor ("external" ratings of the confederate), it was retained for the analysis reported here.

A series of one-way ANOVAs were run for the dependent variables to measure how the independent variable of synchrony condition (clapping vs. no clapping) impacted the dependent variables of confederate ratings (specifically, the resulting "identification" variable discussed above), group ratings, organization ratings, and behavioural intentions. The ratings of the confederate show strong significant differences between the clapping condition and the control condition, as seen in Figure 2.5 ($M_{tap+music} = 4.13$, SD = 1.08 vs. $M_{control} = 3.12$, SD = 1.15; $F(1, 99) = 20.78$, $p = .000$, $\eta_p^2 = .173$).

Figure 2.5. Completing a joint clapping task in a group increases ratings of the confederate (Study 4)

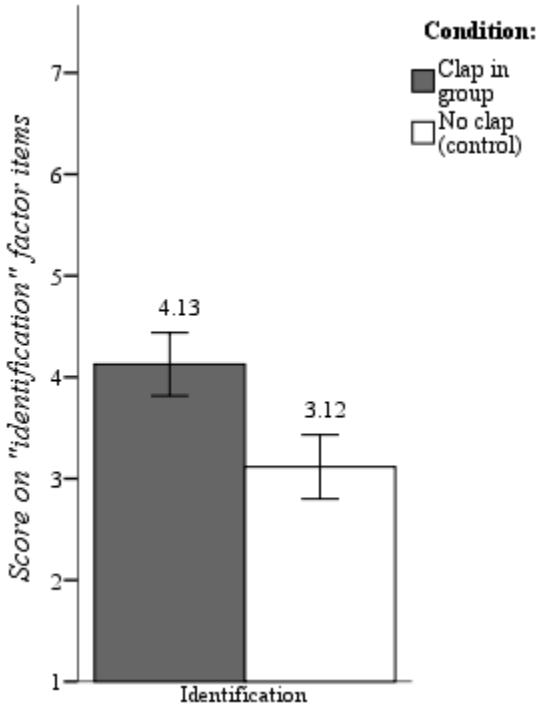


Figure 2.6. Completing a joint clapping task in a group increases intra-group ratings (Study 4)

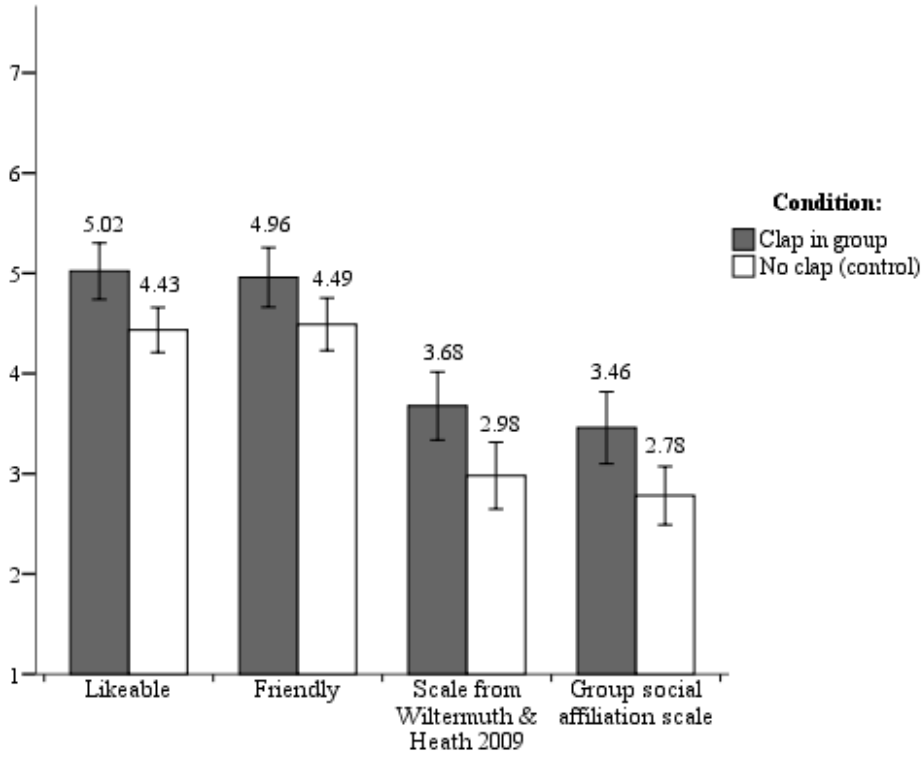


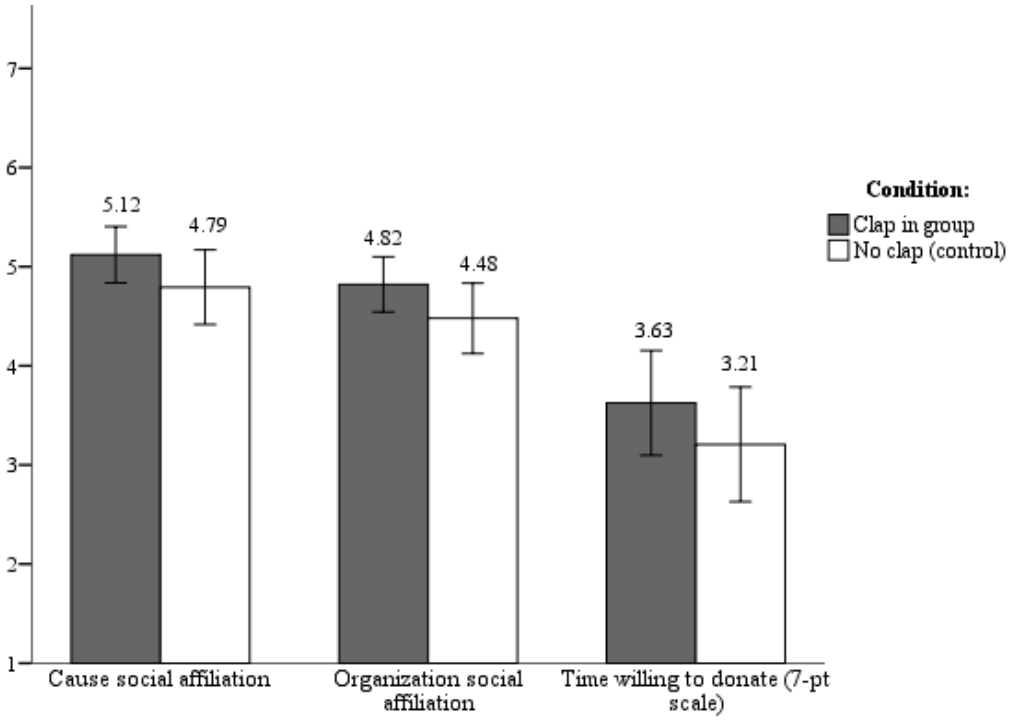
Figure 2.6 shows the results of the four intra-group ratings. When compared to the control condition, participants who completed the clapping task rated their group members as significantly more likeable ($M_{tap+music}$ = 5.02, SD = 0.98 vs. $M_{control}$ = 4.43, SD = 0.82; $F(1, 99)$ = 10.74, p = .001, η_p^2 = .098) and friendly ($M_{tap+music}$ = 4.96, SD = 1.03 vs. $M_{control}$ = 4.49, SD = 0.95; $F(1, 99)$ = 5.62, p = .020, η_p^2 = .054), and also rated them higher on both the scale from Wiltermuth and Heath (2009) ($M_{tap+music}$ = 3.68, SD = 1.18 vs. $M_{control}$ = 2.98, SD = 1.21; $F(1, 99)$ = 8.52, p = .004, η_p^2 = .079) and the group social affiliation scale ($M_{tap+music}$ = 3.46, SD = 1.25 vs. $M_{control}$ = 2.78, SD = 1.06; $F(1, 99)$ = 8.68, p = .004, η_p^2 = .081).

The results of the cause ratings can be seen in Figure 2.7. Contrary to expectations, neither the cause ($M_{tap+music}$ = 5.12, SD = 0.98 vs. $M_{control}$ = 4.79, SD = 1.37; $F(1, 99)$ = 1.88, p = .173, η_p^2 = .019) nor the organization ($M_{tap+music}$ = 4.82, SD = 0.96 vs. $M_{control}$ = 4.48, SD = 1.29;

$F(1, 99) = 2.23$, $p = .138$, $\eta_p^2 = .022$) showed significant differences in ratings when comparing the clapping condition to the control condition.

Finally, there was also no significant difference between these conditions in the amount of time participants were willing to donate to the organization by returning to the lab ($M_{tap+music}$ = 3.63, SD = 1.83 vs. $M_{control}$ = 3.21, SD = 2.11; $F(1, 99) = 1.12$, $p = .292$, $\eta_p^2 = .011$).

Figure 2.7. Completing a joint clapping task with a confederate in a group does not appear to change ratings of an associated cause (Study 4)



Discussion

Study 4 shows that completing a synchrony task together in a group strengthens group dynamics. This is consistent with the theory that music is well-suited to encouraging social bonding. The wide improvement found in confederate ratings after completing the group task (compared to the control condition) conform to expectations that a group scenario should

encourage strong interpersonal effects. However, this result should be interpreted with caution, since this study does not include a control condition in which individuals completed the same video task, but in an individual (rather than group) environment. Future research can design an experiment that includes such a condition, to better understand the magnitude change that completing a synchrony task in a group can have to potentially increase ratings of a confederate – above that which is possible in an individual (one-on-one) task.

However, we do not see a similar effect from the synchrony task on the associated organization in this study. This differs from what is found in studies 2 and 3. One explanation for these diverging results is that the affiliation with those involved in the clapping task did increase (indeed, group ratings were found here to improve after the synchrony task), but that the task acted to bring the confederate into the group, rather than to move the individual participant to a closer identification with the confederate and subsequently be affected by her associations. In other words, it could be that the group affiliation process brought on by synchrony is so strong that it overrides the individual synchrony effect that was found in previous studies. If this is the case, then actions which would benefit the group (i.e., a prosocial act that the individual could do to "sacrifice" for the group) would show significantly different results when compared to the control condition. This also suggests that in a group scenario, the confederate may hold less relative power to change something such as identification, and that she contributes her associations (i.e. organization associations) as much as any other member of the group. If so, the likely requirement for synchrony effects to have an impact in a group scenario will be for an organization or association to be linked to the *group's* identity as a whole. Future research could investigate potential impacts and processes here, as well as the strength and adaptability of this effect.

One possible alternative explanation in Study 4 is that a familiarity effect occurs, where the fact that participants in the group condition participated longer in a task including the confederate leads to participants' higher ratings of her in this condition. As was discussed previously, study 5 provides empirical evidence that this alone is not likely to be the case.

Study 5

Study 5 looks to generalize the synchrony effect by showing that its impacts are not limited to prosocial actions, and can occur with regard to any associations of the task partner that are made salient. Studies 2, 3 and 4 focus on donations to a charitable organization as the context of study. This is a logical link, given that past studies have generally concluded that synchrony manipulations result in an increase in prosociality (Mogan et al. 2017). However, the process explanation provided in study 3 is that feelings of affiliation with the organization are impacted, and that this is what leads to increased donation intentions. In other words, it is an association with confederate that is impacted, and not the prosocial act directly – the organization ratings mediate the effect that the synchrony manipulation has through the confederate on the prosocial DV (donation intention). Therefore, if associations of the confederate can be impacted by the synchrony manipulation, then it may be possible to change participants' preferences based on other associations that the confederate has, outside of a prosocial (donation) context.[21]

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[21] There is some discussion in the literature that supports this theory. Coordinated action has been linked to feelings of connectedness, a blurring of self-other boundaries (Lang et al. 2017), and perceived similarity (Cacioppo and Cacioppo 2012); increasing social bonds through these coordinated actions results in neurological responses associated with third-person perspective-taking and mirroring (Cacioppo et al. 2014). Combined with the impact that we know synchrony can have on social affiliation, this suggests that individuals may be identifying more with the other individual, and might therefore adopt similar products or associations the other individual has, even if these have nothing to do with prosociality. Consumption literature supports the idea that even brief interactions with others can impact consumer preference (Söderlund 2011). Consumers draw clues about product and brand

Specifically, if the confederate indicates a preference or association with a brand, it is expected that those who complete the music synchrony task with the confederate will indicate a higher preference for products from that company, compared to those who did not complete this task.

The design of study 5 adds experimental conditions to understand more about the hypothesized process of the synchrony effect. Studies 2, 3, and 4 included control conditions in which no synchrony-like task was included, which helped to understand the contribution that comes from including a synchrony task, compared to if no task was implemented. In study 5, this condition is still included, but a new condition is added in which participants watch a video and tap along, but do so without the musical accompaniment used in the experimental conditions in past studies. Comparing the music and no-music conditions allows us to examine whether the inclusion of music is indeed necessary for the synchrony effect.[22]

Method

Study 5 returns to an online environment, again using MTurk to recruit participants. Similar a priori screening rules were used as to those in study 3, with minor differences; details are presented in Appendix C. The final sample consists of one hundred ninety-eight (54.0% females; M_{age} = 35.54, SD = 11.26).

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preferences from others' consumption as a way of determining their identity (Bearden and Etzel 1982, Edson-Escalas and Bettman 2005), especially through conspicuous consumption (O'Cass and McEwan 2004). Therefore, it is theorized here that those who feel they are closer to the confederate (as a result of the synchrony task) will be more attuned to any symbolic consumption or presentation of brands by the confederate, and will be more likely to change their preferences in a subconscious attempt to reflect an identity that is congruent with the confederate.

[22] This condition was added to neutralize any concern that the clapping task alone could be creating the interpersonal synchrony effects, and that the music was unnecessary. Although past studies indicate that music is a substantial addition, and that synchrony effects do not occur in the same way when synchronizing only to a beat (Stupacher et al. 2017), it was decided to replicate this in the current experimental context.

Participants were randomly assigned to one of four conditions. The first condition is similar to those from past experiments, where the participant watched the video and engaged in the synchrony manipulation with the confederate. In this case, due to the online methodology, participants were asked to click their mouse or trackpad along with the clapping, similar to study 3. The second condition completed the same procedures, but did not click along with the confederate. This condition is also similar to that which was implemented for studies 2 and 3. The third condition was a control condition, again similar to studies 2, 3, and 4: these participants did not view the clapping video or music. However, they did view a portion of the video in which the confederate speaks briefly. The confederate was not wearing the Starbucks apron in this video, and portions of the text that identified Starbucks were removed. In the final condition, participants viewed the video of the confederate clapping along and were asked to click along with her, but they heard no music accompaniment.

The stimuli and procedures were the same as that in study 3, including the instruction asking participants to click their mouse or trackpad instead of tapping. However, a concern about the methodology so far, especially in study 3, is that participants may not be paying attention during the synchrony manipulation. To control for this, a measure was gathered which identified whether participants were actually following these instructions. Details on this can be found in Appendix C.

The video stimuli were re-recorded, again using a new confederate. The same setup was used, with the confederate again seated in front of a blank wall and staring directly at the camera as she clapped on the beat to the music that was playing. The same (rhythmic) song as past experiments was playing in the background of the video. However, this time, the confederate was presented as a Starbucks employee. To project this identity, the confederate wore a

Starbucks apron, identical to the one worn by baristas in the company's retail locations. She also drank from a Starbucks cup immediately before and after completing the clapping task. The Starbucks logo was prominently displayed both on the cup and on the apron. Finally, she also recited a script at the end of the video which clearly identified her as a member of the Starbucks organization; the script also provided an explanation for why the clapping task was occurring, in order to increase realism. This script, as well as a screenshot from the video, are presented in Appendix C.

After completing the video task that was appropriate to their condition, participants continued by answering survey questions. First, brand preference for Starbucks was measured using a number of 11-point bipolar scales, with anchors for strongly preferring Starbucks and strongly preferring "other brands of [the item in question]". This was asked for five categories of Starbucks products, including coffee and tea; details are presented in the Appendix C. In addition, participants were asked their likelihood of trying a new product if it was released by Starbucks (1 = not at all likely, 7 = very likely), and their willingness to pay for Starbucks compared to other brands (-100 = will only buy from Starbucks if it is priced 100% lower than other brands, +100 = will buy from Starbucks even if it is priced 100% higher than other brands). Similar to studies 2 and 4, participants were asked a variety of measures about the confederate, including their likeability, friendliness, trust, the extent the participant felt they were on the same team as the confederate, as well as the five-item scale about their feelings of social affiliation with the confederate ($\alpha = .91$). As in past studies, those in the two tapping conditions also reported their preference for the song, and how in-time they felt with the confederate when completing the task.

Results

Target ratings

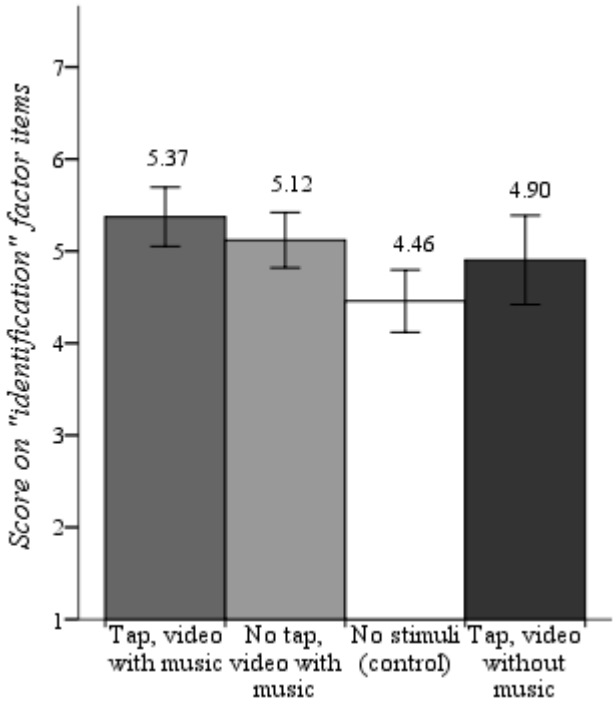
As in studies 2 and 4, ratings of the target were analyzed in a two-factor solution: the first factor ("identification") extracted 74.30% of the variance from six items, including ratings of feeling on the same team as the confederate, as well as the five items from the social affiliation scale. These items showed high internal consistency (Cronbach's $\alpha = .92$), so they were combined into a single variable. Since this factor has more theoretical relevance than the remaining factor ("external" ratings of the confederate), it was retained for analysis.

A one-way ANOVA was conducted on the identification factor to measure how the independent variable of synchrony condition (tapping, no-tapping, tapping-without-music, control) impacted the dependent variable of confederate ratings. Results show a significant impact of the synchrony condition on identification with the confederate ($F(3, 194) = 5.11$, $p = .002$, $\eta_p^2 = .073$). Results of this analysis are presented in Figure 2.8.

Planned contrasts were also analyzed to compare the results between the specific synchrony conditions. Consistent with predictions and results of earlier experiments, completing the music task while tapping along resulted in the strongest effects on ratings of identification with the confederate. This contrast is significant compared to the control condition ($M_{tap+music} = 5.37$, SD = 1.15 vs. $M_{control} = 4.46$, SD = 1.21; $t(194) = -3.76$, $p = .000$), and shows a marginally-significant difference to the condition where participants tapped but did not have music accompaniment ($M_{tap+music} = 5.37$, SD = 1.15 vs. $M_{tap-only} = 4.91$, SD = 1.27; $t(194) = -1.76$, $p = .081$). In this latter, no-music condition, the ratings of the confederate also showed marginally-significant differences from the control condition ($M_{tap+no-music} = 4.91$, SD = 1.27 vs. $M_{control} = 4.46$, SD = 1.21; $t(194) = 1.67$, $p = .098$). In contrast to study 3, the current study finds that

engaging in the joint tapping does not result in significantly different ratings of the target than simply viewing the video, as this contrast is not significant ($M_{tap+music}$ = 5.37, SD = 1.15 vs. $M_{music\text{-}only}$ = 5.12, SD = 1.67; $t(194) = -1.08$, $p = .281$). However, viewing the video with music without tapping along does result in significantly higher confederate ratings than the control condition ($M_{music\text{-}only}$ = 5.12, SD = 1.67 vs. $M_{control}$ = 4.46, SD = 1.21; $t(194) = 2.83$, $p = .005$).

Figure 2.8. Completing a joint clapping task results in higher confederate ratings and stronger identification than if the task is completed without music or if participants view but do not participate (Study 5)



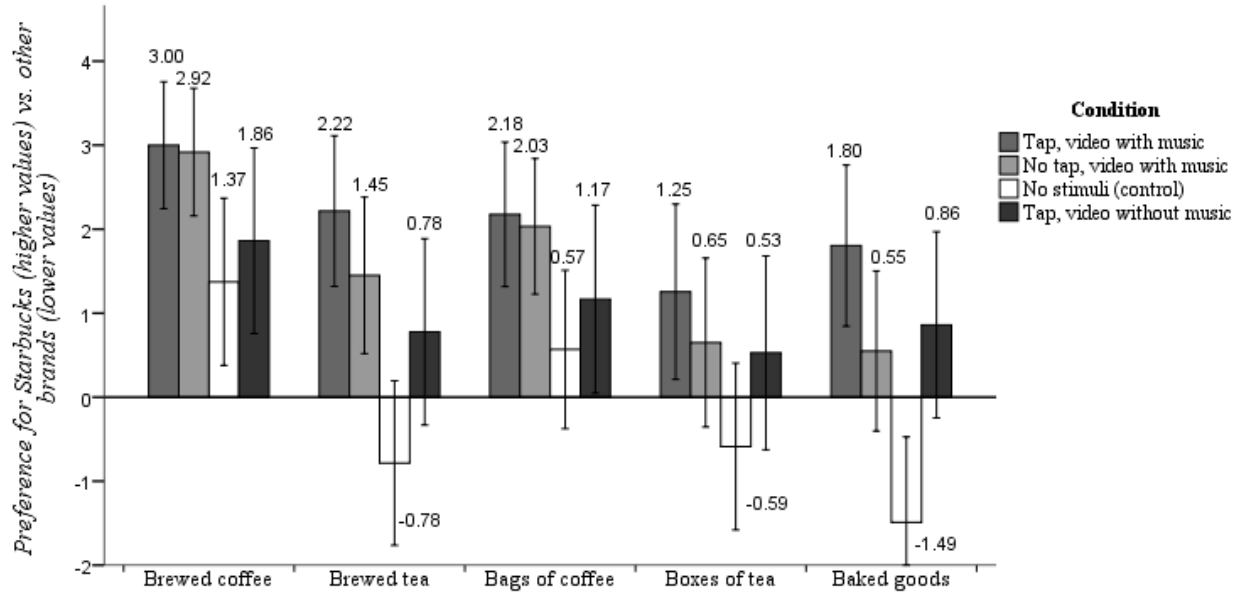
Brand preferences

Results for the brand preference variables are shown in Figure 2.9. It should be noted that there was a general baseline preference for Starbucks over other brands in general in this sample for the products of brewed coffee and bags of coffee. However, participants generally preferred other brands for tea (both brewed and in boxes) and baked goods. This is represented by the

control condition in Figure 2.9, as they were not shown any Starbucks-related primes or treatments during the experiment.

In all cases, completing the task with the Starbucks "employee" (confederate) acted to move individuals' preferences towards Starbucks. However, when compared to the control condition, this difference was only consistently significant for the tap-with-music and no-tap-with-music condition; while the tap-no-music condition was significant in a couple of cases, this was only for brewed tea and baked goods. Additionally, the tap-with-music condition resulted in marginally-significantly higher ratings compared to the tap-no-music condition for brewed tea, and in no cases was the magnitude of the improvement in Starbucks ratings compared to the control condition higher for the no-music condition than either of the music conditions.

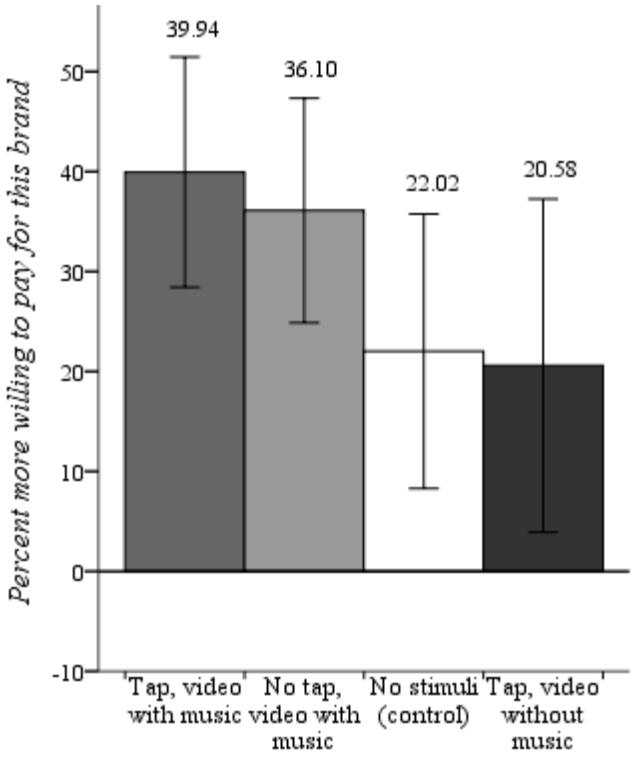
Figure 2.9. Completing a joint clapping task with an individual increases preferences for a brand associated with them (Study 5)



Behavioural intention measures

Two one-way ANOVAs were conducted to measure the impact of the synchrony condition on the two brand-related behavioural intention measures. First, it was found that the synchrony condition significantly impacted participants' reported willingness to try a new product from Starbucks ($F(3, 194) = 6.35$, $p = .000$, $\eta_p^2 = .089$). Generally, the pattern of the results of planned contrasts between synchrony conditions for this dependent variable is similar to the results found for the confederate ratings. Compared to the control condition, participants who tapped to a video with music ($M_{tap+music} = 5.51$, SD = 1.67 vs. $M_{control} = 4.16$, SD = 1.85; $t(194) = -3.87$, $p = .000$) as well as those who did not tap but simply watched the confederate clap to music ($M_{music\text{-}only} = 5.38$, SD = 1.55 vs. $M_{control} = 4.16$, SD = 1.85; $t(194) = 3.65$, $p = .000$) were both significantly more willing to try a new product from Starbucks. These two music-involved conditions were not significantly different from each other ($M_{tap+music} = 5.51$, SD = 1.67 vs. $M_{music\text{-}only} = 5.38$, SD = 1.55; $t(194) = -0.38$, $p = .707$), which is consistent with the results seen for ratings of the confederate, as discussed above. The no-music tapping condition showed only a marginally-significant difference from the control condition ($M_{tap\text{-}only} = 4.83$, SD = 2.09 vs. $M_{control} = 4.16$, SD = 1.85; $t(194) = 1.76$, $p = .080$), and the tap-with-music shows a marginally-significant difference compared to this tap-without music condition ($M_{tap+music} = 5.51$, SD = 1.67 vs. $M_{tap\text{-}only} = 4.83$, SD = 2.09; $t(194) = -1.76$, $p = .080$). The marginal significance of these results suggests any interpretations here should be done with caution; however, the pattern of this result suggests that even if the no-music tapping condition is slightly better than the control, adding music to the task is an improvement. Overall, this result is very similar to the pattern of results seen for the ratings of the target, as previously shown in Figure 2.8.

Figure 2.10. Completing a joint clapping task with an individual increases willingness to pay for an associated brand (Study 5)



Second, a one-way ANOVA shows that there is a marginally-significant difference in participants' reported willingness-to-pay for the brand, depending on the synchrony condition ($F(3, 194) = 2.18$, $p = .092$, $\eta_p^2 = .033$). Figure 2.10 shows the pattern of this result. Those who completed the music tapping task report that they are willing to pay a significant amount more (approximately 19%) for Starbucks than those in the control condition ($M_{tap+music} = 39.94$, SD = 41.17 vs. $M_{control} = 22.01$, SD = 49.08; $t(194) = -1.98$, $p = .049$). This music-tapping condition also has a marginally-significant difference in willingness to pay compared to the condition in which participants tapped without music accompaniment ($M_{tap+music} = 39.94$, SD = 41.17 vs. $M_{tap\text{-}only} = 20.58$, SD = 50.04; $t(194) = -1.95$, $p = .053$). Otherwise, all other contrasts were not significant ($p > .10$). It should be noted that there is a baseline preference for Starbucks here as well, as seen by the already-high willingness-to-pay of the control condition.

Discussion

Study 5 shows that synchrony effects are strongest when engaging in a joint task, but only if this task includes music: the no-music clicking condition did not elicit a significant increase in ratings of the confederate compared to the control condition. This suggests that the synchrony effect operates at least in part due to music, rather than through joint synchronization alone or in completing a joint task. Specifically, both conditions which included music showed significant differences on the outcome variables compared to the control condition, while the condition without music (but with tapping) was not consistently and significantly different from the control condition. While this is a slight departure from the pattern of results seen in studies 2 and 3, improvements to the methodology for study 5 that account for attention paid to the manipulation provide more confidence in the results here.[23] This finding is encouraging for purposes of managerial and practical implications. It suggests that an overt and explicit motion on the part of the individual is not necessary for synchrony effects to occur. As long as they are paying attention, simply observing another person acting in time with music is enough to improve the extent to which the individual identifies with the other person in the joint task.

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[23] The results for the target ratings show that the addition of tapping may not be significantly improving confederate ratings: compared to the control condition, the tapping (with music) and no-tapping (with music) conditions are not significantly different. A similar pattern is found for the behavioural intention measures and many of the brand preference measures. This result differs from the conclusions of study 2, and especially study 3, in which the no-tapping condition was not significantly different from the control condition. However, attentional issues were presented as a post-hoc explanation for the pattern of the no-tapping condition in studies 2, and especially in study 3. The implementation of a sampling strategy for study 5 that removed participants who did not follow instructions provides more confidence in the fidelity of the results here regarding attention to the confederate than for these previous studies. Therefore, it is believed that if the results between studies 2 and 3 and study 5 are interpreted as inconsistent, the controls implemented in study 5 should cause its results to be interpreted with more confidence than those from studies 2, and especially 3. Given this, it is concluded that if attention to the confederate is equal, the addition of a specific joint motion (tapping – or, specific to studies 3 and 5, clicking) should not significantly change the magnitude of synchrony effects. The key for future studies, it seems, is to make sure attention can be drawn (and held) to the confederate, as this seems to be the method by which synchrony effects are created.

These results also help to neutralize familiarity as an alternative explanation for the effects found here. If this were the case, and participants who spent more time watching the confederate reported higher ratings of her, we would expect a similar level of identification with her across all conditions that watched a video (i.e., all conditions except the control condition). The fact that the condition which tapped, but not to music, is only marginally-significantly different from the control, and that the conditions which included music are higher than this former condition, indicates that exposure to the confederate is not sufficient to create the effects found here. Instead, these results indicate the effects are more attributable to music, and possibly the tapping task, rather than simply familiarity.

Beyond improved interpersonal ratings, study 5 also generalizes the results of the synchrony effect, showing an impact in a domain unrelated to prosociality. Specifically, this study shows that synchrony tasks can lead an individual to be attentive to other cues given by the partner in these tasks, such as their brand associations. After completing the synchrony task, participants showed stronger brand preferences for the brand that was associated with the target, when compared to other brands in general.[24] This is consistent with the theory that participants feel like their identity more closely matches their task partner's after the task, and look to maintain or build consistency with them through other associations that the partner displays, such as brand associations. A similar pattern was also shown for two behavioural intention measures.

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[24] A separate study was conducted in which lab participants completed identical procedures to study 5 (and in which the confederate was associated with Starbucks), but were asked to rate their preferences on a sliding scale in which Starbucks and a competing brand of Starbucks (Second Cup) acted as anchors for the scale, instead of Starbucks and "other brands", as is implemented in study 5. It should be noted that Second Cup is another popular coffee chain in the location the study was conducted, so it would be viewed as a direct competitor to Starbucks for this sample of participants. Results of this study showed a similar pattern of results for the choice variables as to what is reported here for study 5. In other words, even if "other brands" may appear to be too unspecific as a comparison for the brand choice variables, including a different company as a contrast to Starbucks did not change the results.

These findings bring strong managerial implications to our understanding of the synchrony effect, suggesting that tasks like this may be a meaningful way to improve consumers' brand feelings and preferences towards organizations, even if the purpose of these organizations is not prosocial. It shows that the synchrony effect can be applied in domains that are unrelated prosociality, which is an important contribution in our understanding of the synchrony effect more generally.

General Discussion

Completing a joint musical task with another individual has been shown to improve interpersonal dynamics, with the literature focusing on the prosocial nature of these "synchrony effects". Across five studies, the current essay extends our knowledge on this effect in two ways. First, it is shown that the process by which this occurs is through increased identification with the task partner, rather than increased prosociality. Although studies 2 and 3 show an effect of increased donation intentions, which is consistent with a prosociality process explanation, it is shown through a mediation analysis in study 3 that this actually occurs because individuals feel closer to an employee of the charitable organization after completing the synchrony task with them, and are willing to follow their signals. This means that the effect of synchrony is not limited to helping behaviours, and individuals may also become more attuned to other, non-prosocial associative signals of the synchrony partner. This is demonstrated in study 5, where participants change their preferences for branded products to be consistent with the synchrony partner. Thus, individuals can be affected by music synchrony tasks in ways that do not necessarily help the other individual, or society in general. The findings here mean that that synchrony tasks can be harnessed by organizations or brands using company representatives to

increase ratings of the organization and preferences for products from the brands that the partner signals identification with, regardless of whether they have a prosocial link. This occurs even if the partner is presented as an employee of the organization; this facilitates easier managerial application of this research, as it does not require disguising the organization in the task.

Second, insights are gathered on how best to implement synchrony tasks in practice. Rhythm is confirmed as important in facilitating stronger identification effects: this is consistent with a more fundamental understanding of the origins of music, which links the rhythm element of music (rather than the pitch element) to increasing social bonds within groups. This finding not only helps to guide the creation of synchrony manipulations in the future, but also provides straightforward practical recommendations for choosing music to be played to achieve specific goals, such as when the purpose of including music is to facilitate social interactions in retail environments. Additionally, this paper supports existing evidence in the literature that a pre-recorded video manipulation is sufficient to achieve synchrony effects – in-person manipulations are not required. This allows for this research to be applied in a wide variety of managerial contexts.

Theoretical Implications

This research contributes to our understanding of the synchrony effect, providing a process explanation that can explain past results in the literature, while also opening new theoretical possibilities. Furthermore, there are impacts for future research on the synchrony effect through the methodological insights of these studies. Finally, this research also contributes more broadly to understanding the role of music in social dynamics.

Identification as a process explanation for synchrony

This is the first known study to examine the potential for synchrony to have impacts outside of an immediate interpersonal relationship. While the literature has concluded that there are strong effects from synchrony tasks on prosocial behaviour, social bonding, social cognition, and positive affect (Mogan et al. 2017), no studies have examined whether there are other benefits to such a task. This essay first shows an effect in a donation context, which has conceptual proximity to the prosocial effects found in past literature. However, the route of this effect indicates that it is not simply that individuals gain a more prosocial mindset, and that this is what drives donation behaviours. Instead, this research shows that individuals identify with the individual following the music task, and are willing to follow their preference signals.

This is an important theoretical addition to our understanding of the synchrony effect, since it indicates that anything the synchrony partner associates with may also be impacted. This is most evident in study 5, when even non-charitable and seemingly non-social associations of the individual (brand preferences) are affected. If synchrony acted through prosociality, as the literature indicates, these effects could not be explained. The impact of this result for our theoretical understanding of synchrony is great, since it suggests that these joint music tasks have the potential to strongly affect the preferences and behaviours of individuals in a much wider array of situations. If simple cues of preference can show such strong effects, it is possible that other sorts of cues can be changed to also change consumer views, preferences, or opinions. Importantly, this means that the synchrony effect has implications for research areas outside of psychology, such as consumer behaviour and sociology, among others. This greatly broadens the potential for a variety of research questions to be developed, and suggests many potential avenues for further examination.

In the literature, prosociality is identified as one of the key outcomes of the synchrony effect (Mogan et al. 2017). This essay is not arguing that this conclusion is incorrect. Rather, in expanding the context of study, it is shown here that the increase in prosociality identified in past literature is just one of the possible outcomes. The results of study 3 indicate that the process by which the synchrony effect acted to change behavioural intentions was through a shared identification with the synchrony partner, rather than a spillover effect of prosociality. This indicates that any prosocial effects found in the literature (for example, willingness to join a confederate in a task; Wiltermuth 2012) could be explained through processes such as empathy or perspective-taking. This corresponds to a body of literature on the synchrony effect that finds links between synchrony tasks and self-other overlap (Cacioppo et al. 2014; Lang et al. 2017; Tarr et al. 2014).

If synchrony tasks occur because of identification rather than generalized prosociality, then the target of the prosocial act matters, and it is unlikely that prosocial acts that are seen as unrelated to the target will experience the positive impacts that past studies predict. This suggests merit for one article, which was inconsistent with past literature, which showed that dancing in synchrony led individuals to report feeling more socially bonded, but not more cooperative or altruistic on a separate task (Tarr et al. 2016).

Overall, this essay argues that increased identification is a more detailed process explanation that can explain how synchrony operates, and that this can lead to prosociality, but also to other types of impacts, such as changes in preference. In the very least, prosociality and identification with a synchrony partner should be treated as separate (but potentially linked) constructs in future synchrony research.

Contributions to music research

Second, this research has theoretical implications for research on music. The results here suggest that the impact of music-related tasks is more general than may have otherwise been assumed, and music has the potential to impact preferences and behavioural intentions in seemingly unrelated areas. Specifically, even after identifying in study 1 that rhythm is a key component of the synchrony effect, study 5 confirms existing literature (Stupacher et al. 2017) that the harmonic or pitch elements cannot entirely disappear: synchronizing only to clapping did not yield synchrony effects in the same way that synchronizing to music did. This suggests that there is something unique that music – the combination of rhythm *and pitch* elements – that brings individuals closer to each other. The current essay provides support for this process, explaining why this is the case. However, further research is still needed to understand what is specifically happening, from a cognitive perspective, to bring about positive effects in this way through the implementation of music. In other words: if pitch elements must be present, what are they contributing?

Synchrony manipulations

A third series of theoretical implications come by providing more insight into the conditions needed to elicit the synchrony effect. Here, insight is gathered regarding the music stimuli, the use of a pre-recorded video, and the level of involvement required on the part of the participant.

First, while we know that music must be present for the synchrony effect to occur (Stupacher et al. 2017), the stimuli used in the literature varies widely – from listening to the Beatles' song "Twist and Shout" (Cirelli et al. 2014) to jointly singing the national anthem "O

Canada" (Wiltermuth and Heath 2009), among others. Some research has indicated the value of a more present beat in the song, where the drums and bass elements of the song are dominant in the sound experienced by the listener, compared to vocals, pitch, or harmonic elements – for example, some authors chose music that "had a heavy beat" (Wiltermuth 2012), while others chose that which "could be comfortably rocked to" (Demos et al. 2012). However, there is no theoretical explanation given as to why a heavy beat seems to be better for synchrony tasks, and the authors of past studies do not generally provide insight into their choice of stimuli.

The current essay provides a theoretical explanation for why a present beat makes for a better stimuli choice, specifying that rhythm should be more important because of its evolutionary connections with social bonding. More importantly, this theory is empirically tested here by manipulating the music stimuli, and it is shown that the rhythm present in a song is what leads to synchrony effects, not harmonic or melodic elements. It should be noted that the more acoustic version of the song (i.e., without a present beat) performed more similarly to the control condition than to the rhythmic version in study 1. Altogether, this should greatly help future research in this area, since accidentally choosing a less-rhythmic song could result in an inability to create synchrony effects where they otherwise could occur. Similarly, it is possible that existing effects found in the literature could have been strengthened, had they chosen songs with more present rhythmic elements. Rhythm therefore seems to constitute an important boundary condition to the synchrony effect.

Second, this study confirms that using a pre-recorded video is sufficient to create synchrony effects. Two previous studies have used pre-recorded videos: they involved instructing participants to watch a person (Knight et al. 2017) or two stick figures (Stupacher et al. 2017) walking in time with music and "imagine being one of them". The current paper's

methodology does not require perspective-taking exercises such as this; by involving participants directly in the task instead of using a recorded intermediary, it brings the task closer to the participant, likely increasing the salience of the effect. Therefore, the implementation in this paper shows that synchrony effects can occur *through* a video (i.e., the relationship between the recorded individual and the individual watching is affected), which both improves upon the methodology of past video studies as well as increases the practicality of such a task being implemented in a consumer context, as will be discussed below.

Nonetheless, while the current essay improves upon these two previous articles using video manipulations, likely all of these present actionable possibilities for implementations of this research. Importantly, the perspective-taking requirements of these past articles are consistent with the process explanation developed in this essay: imagining oneself as one of the figures in the video requires the individual to embed themselves into the task, which is likely a precondition for increasing feelings of identification with the other actor in the task, which itself is shown as the process explanation by which synchrony effects occur. Overall, the current study adds to the literature by showing that it is possible to use pre-recorded videos to elicit synchrony effects through increased identification. This stands in contrast to the rest of the synchrony literature, which involves in-person manipulations requiring two individuals to clap or move together in a live, physical setting. The use of pre-recorded videos significantly improves the potential for managerial applications of this research.

Finally, the results here also inform as to the level of involvement required on the part of the participant in order to elicit synchrony effects. It is shown that synchrony effects may be able to occur simply by watching a video, rather than actually participating in some way. While study 2, and especially study 3, indicated that clapping along to the video yielded the strongest

synchrony results, methodological improvements to study 5 led to a result that is consistent with the theory that simply observing the video, without participating in any overt actions, can still lead to strong results. In fact, the way in which improvements were made to study 5 – by requiring participant attention – indicate a process explanation for when observation-only conditions will still create synchrony effects. As long as participants are paying attention to the video, they can still experience synchrony effects, even if they don't physically participate in the rhythmic task.

Managerial Implications

As the first study to apply synchrony research to a consumer context, a key managerial implication of this research is in showing that this type of task can be used to affect consumer preferences and intentions, rather than just affecting interpersonal relations. Studies 2 and 3 show that engaging in a joint musical task can improve donation intentions in a charitable context. Having a representative of the organization engage in this joint behaviour improves organization ratings, which then leads individuals to be more likely to help the organization. This is important as it is not specific to donations, and there is the potential for this sort of task to also be used to increase awareness or attention to a cause as well. Furthermore, effects are also not limited to charitable organizations. Study 5 shows that if a brand is associated with the synchrony partner, the individual's views of the brand can be changed. Starbucks was used as a brand for the purposes of this experiment, and coffee and related products are the core offerings of this retail consumer brand, rather than any charitable purpose. This suggests that potentially any brand can use a synchrony manipulation in a similar way in order to receive the benefits-by-association

outlined here – it is not limited to those organizations that have a specifically social (or prosocial) purpose.

The process explanation identified in study 3 leads to an important conclusion for managers: it is not simply that participants want to help the employee with whom they engaged in the synchrony task; instead, they actually improve their evaluations of the related organization. In other words, organizations themselves have the potential to benefit, even if the task involves a single organizational representative.

The fact that all studies here identified the synchrony partner as an employee of the related organization could also be seen as a benefit for the ease of implementing this type of task. Even if individuals suspected an ulterior motive for the synchrony task because of the use of a company representative, the results still showed positive impacts for the company. From a managerial perspective, this means that organizations can use employees and identify them as such, and still implement synchrony tasks. They do not need to "hide" the company identification, or plant confederate "consumers" in synchrony contexts to elicit these effects. However, it is also possible that using individuals who are not related to the organization could actually increase the magnitude of the effects found here, and future research could identify whether this is the case.

This essay provides a series of methodological improvements over past studies, which eases the application of this research. The use of a video manipulation shows that a live synchrony task (involving two individuals in the same physical environment) is not required to create these effects. This means that organizations have the freedom to apply this research on a wide scale in any environment in which a consumer watches a video, rather than requiring one-on-one interactions with company employees. Furthermore, the fact that participants in study 5

still experienced synchrony effects even when they only watched the video (but did not participate) is also promising, as it indicates that organizations do not have to find a way for consumers to engage in an overt action along with a video. However, comparing the methodologies and results of studies 2 and 3 to study 5 indicate that in order for viewing-only synchrony effects to occur, managers will need to make sure that participants are engaged in the video: if consumers do not pay enough attention to the synchrony video, the effects disappear.

Finally, this essay provides actionable recommendations regarding the use of music. As shown in study 1, music which is more rhythmic in composition is best-suited to encouraging increased identification with others. Further, it should be noted that more "acoustic" music (that did not have strong rhythmic elements) performed similarly to if no music was included. Based on this conclusion, managers who want to encourage social connection should consider adding rhythm-heavy music to their environments, in which the drums and bass elements are more prominent than in other types of music. This relatively straightforward recommendation is easily implementable in a variety of contexts; yet, as suggested by the results here, it has the potential to even impact perceptions of the organization, if companies can find ways to rhythmically involve themselves or their employees in the music in a way that retains customers' attention.

Limitations and Future Research

The current research takes an effect previously limited to an interpersonal context and applies it to a more practical, consumer context. Two contexts – charitable donations and brand preferences – are examined here. Given that the theory underlying these effects indicates that any associations of the synchrony partner could be affected, there is a possibility for further generalizability of these results to any situation in which perspective-taking may be helpful. In

the current study, perspective-taking in terms of brand associations was examined; however, this could apply to opinions of the individual (e.g., in order to come to joint consensus), or in "icebreaker" scenarios in which the goal is to have people associate with each other. It could also apply to negotiation contexts, where understanding opposing sides can be the first step to resolutions. There are likely other potential avenues for further managerial outcomes linked to perspective-taking as well.

Apart from increasing feelings of identification, this essay also shows that the effect goes further, impacting people's preferences. In the current studies, this was operationalized through brand preferences. However, there are also possibilities for this research to be applied in other ways, such as by creating social influence effects that encourage individuals to act in ways that are coercive in nature. There is already evidence that individuals engaging in synchrony in a group context may be more likely to follow the group in actions that would be considered amoral (Wiltermuth 2012). As a result of the current research, we know that this is likely because individuals feel they belong to this group, and must comply. Future research can explore this area more to understand ways in which individuals can be encouraged to take other actions outside the consumption-based actions explored in the current research.

While this essay further proves that synchrony manipulations can be successfully created through the use of video tasks, further research is needed to identify more ecologically-valid contexts for such manipulations. For example, brands may wish to identify ways in which video advertisements could include synchrony manipulations. The results here support this as a possibility. However, the creators of such videos must be mindful of what is learned in study 5 regarding the importance of having videos that attract attention to the synchrony task.

A limitation of the current study was the repeated concern regarding individuals' ability to successfully synchronize with the video. It is believed that this is at least partly because of an inability to perfectly combine audio and video files that were recorded separately. However, in an in-person environment in which two individuals are completing a synchrony task in the same room, they both have the ability to adjust their clap timing until they collectively achieve synchrony with the music stimuli. Conversely, individuals watching and attempting to synchronize with a pre-recorded video are entirely responsible for making up differences between their clap timing and the beat timing, as well as the clap timing of their "partner", even though it is not possible for the participant to change the latter. Therefore, it is also possible that these are inherent limitations in using video stimuli. This emphasizes the importance in making sure that the video is as close to perfectly synchronized as possible.

The fact that individuals can still report feeling synchronized with the confederate in the current studies indicates that it is possible to do so, and for the purposes of this research, it was prudent to only examine those who felt like they had the ability to be in sync with the confederate. However, on a more fundamental level, we cannot exclude the possibility that there are natural individual differences in terms of how likely a person is to become synchronized with a target. Existing literature suggests, for example, that spontaneous coordination is moderated by an individual's level of social value orientation (Lumsden et al. 2012); similarly, there may be some individuals who are more likely (or even more motivated) to synchronize with another individual. While level of music engagement (i.e., amount the individual listens to music per week) was measured and was not significant in analysis, it is possible that this individual difference is unrelated to music experience and more related to internal perceptions of time, for example.

The purpose of this research was to generalize the synchrony effect, rather than to examine one's likelihood of engaging in synchrony. This is why it was seen as best to focus only on those participants who actually successfully engaged in synchrony. However, future research could help to understand whether there is variation not only in individuals' likelihood of being able to engage in synchrony (as discussed above), but also their likelihood of spontaneously engaging in synchrony without a prompt. In the current study, participants were directly instructed to participate in the task. The result of the video-only condition where participants did not tap (study 5) indicates that even without being directed to act, participants viewing the video experienced synchrony-like effects. Altogether, research that examines individuals' likelihood of engaging in synchrony in these environments (or even their likelihood of being able to engage in it successfully at all) would be helpful to move this research area forward and overcome the issues outlined here.

As discussed in study 3, the results of the gender analyses indicates that there may be slight differences in terms of the ability of the synchrony effect to encourage increased feelings of social affiliation, and this can be explored in future research. However, the fact that the manipulation is still able to significantly affect social affiliation even when gender is accounted for indicates that the synchrony effect is not specific to one gender.[25]

An ongoing limitation in the studies presented here is a result of the inability to conduct in-person laboratory experiments during the COVID-19 pandemic. This is discussed throughout

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[25] It should be noted that the target of the video in all studies was a female confederate. Thus, while we understand from the analysis above that male-watching-female and female-watching-female synchrony tasks do not show significant differences from each other in a consistent way, we cannot discount the possibility that male-watching-male or female-watching-male tasks may elicit different responses in terms of their ability to encourage synchrony. Along with further understanding the impact of gender as discussed previously, future research could look to analyze these combinations as part of a more in-depth study on gender and its interplay with the synchrony effect.

the essay. For example, this prevented the collection of a full sample in study 1, and limited the study design in study 4. However, this did not limit the studies in a way that prevented conclusions from being drawn, and when possible, online data collection was used to respond to these limitations: for example, while studies 2, 3, and 4 have the potential for an alternative explanation of familiarity with the confederate, the design of study 5 neutralizes this as a potential explanation.

Another related limitation of study 4 is its design, since a control condition in which an individual completed a similar task would be a better comparison to understand the true role of a group scenario; while this could not be gathered at the current time, and could not be replicated in an online environment, future research should focus on the role of groups in general, at a time when safe in-person data collection is possible again.

A line of examination is opened in study 4 regarding the impact that a group scenario can have. Results of this study indicate that group scenarios can very effectively create synchrony effects, and have the potential to override the role of a single individual involved in the synchrony task. In other words, it appears that the group becomes the "driving force", overriding the associations of any one individual. In study 4, this meant that the confederate was seen as a single individual of the group, and individuals were not willing to follow just her associations, as there was no indication it represented a consistent association for the group. There are many potential avenues for future research here. Among them, it would be interesting to know the strength of these group effects: perhaps the effect is strong enough that it can override otherwise strong opinions or preferences of individuals. If this is the case, the synchrony effect is likely acting to bond individuals closer to groups, and so any existing social influence effects or group identification effects could be heightened. Another line of questioning could come by

introducing groups instead of individuals as the video "targets" (confederates): if this is done, does the strength of the effect also increase here? Additionally, in this context, it may be interesting to examine the role that entitativity plays – in other words, does it matter how related the group individuals appear, or how succinctly they move together? Is this key to the effect occurring?

Finally, a more fundamental area of future research is to examine why music needs to be included for synchrony effects to occur. Study 1 shows the importance of rhythm: when the pitch elements of music are controlled for, changing rhythm prominence makes the difference between the effect existing, or not. According to this understanding, increasing the ratio of rhythm-to-pitch to the point in which there is no pitch elements should yield the strongest effects – yet, the results of study 1 and study 5 indicate that synchrony likely *cannot* be created in rhythm-only environments. It seems that music indeed "provides an external framework to facilitate synchrony" (Tarr et al. 2014), but it is not clear why music – and specifically, pitch elements – must be present. Future research should aim to examine this fundamental question, since it seems that the pitch elements of music bring something of value to the relationship between rhythm and social interactions.

Concluding Remarks

Our understanding of music has suffered from a lack of deliberate study. In the marketing literature, music is predominantly studied in terms of its potential as an atmospheric element in a retail setting, and is usually only applied as a moderating effect. Despite this, music is the basis of a large consumer industry: sales of recorded music, taking online streaming of music into account, reached $20 billion in 2019 (IFPI 2019), and the proliferation of smartphones and digital technology has meant that music plays an increasingly important and ever-present role in our everyday lives. Given this, it is important to develop a better understanding of how music preferences are shaped, and how music affects individuals.

This dissertation is a step towards a more thorough understanding of music – of how we process it, how it develops meaning for us, and the ways in which it can affect us. The first essay starts by presenting theories on how music may have evolved in human societies: this can explain how it has come to have such importance in our lives, and why it can have such strong, visceral effects on us that are otherwise only reserved for important biological functions such as food and sex (Salimpoor et al. 2013). The essay deconstructs music into two core elements – pitch and rhythm – which can be clearly linked to these original evolutions and purposes in our society. Importantly, the model outlines a network of relationships between these core elements and various effects that past researchers have shown music to have on us. As a result, we can explain that music's ability to change our moods (Kawakami et al. 2013), or to relax us (Demoulin 2011) results specifically from the pitch elements of music. Conversely, music's ability to change our perceptions of time (Kellaris and Kent 1992, Bailey and Areni 2006, Oakes and North 2008), or its ability to interfere with our ability to process other aspects of our

environment, such as advertisements (Kang and Lackshmanan 2017) or driving (Day et al. 2009), can be linked to the rhythm element of music.

Finally, music has the ability to bring people together. It facilitates groups of people in strengthening their bonds as a group (Hagen and Bryant 2003), and encourages individuals to "converge emotionally" with one another (Lang et al. 2017). These social processes are also linked to the second element of music – rhythm. This is demonstrated in the second essay of this dissertation, where it is shown that increasing rhythm within a song strengthens these effects, even though pitch elements of the music are held constant. Apart from this, the second essay also shows that music can serve as the foundation to relationship-building: when individuals completed a rhythmic music task with another individual, they were more likely to engage in a variety of actions related to that individual's identification as a member of an organization or brand. Specifically, they were more likely to donate to the individual's charitable cause, and in a subsequent study they were more likely to try a new product from the brand that the other individual worked for. These sorts of impacts demonstrate that music can bring people together, and that it can be an effective way for individuals to find common ground. This is even the case in these managerially-relevant situations, such as when a consumer interacts with a brand employee, and can even occur when this interaction is with a pre-recorded video of the employee.

The fact that we can link core elements of music (pitch, rhythm) to these different outcomes is important, not only for the specific instances outlined above. Being able to draw these links also provides us with the ability to choose music that is best-suited to the purpose at hand. For an individual consumer, this can be helpful in choosing music to listen to during a variety of daily activities, such as while studying, exercising, or dancing with others, for example

(North and Hargreaves 1996a). For managers, being able to understand these links can also help them determine the specific types of music that would be best for their environments, whether the purpose is to make people feel more comfortable while waiting (Cameron et al. 2003), have them shop faster (Yalch and Spangenberg 2000), or have them be more willing to approach employees (Hui et al. 1997).

Overall, these examples show that both individual consumers and managers can benefit from the understanding of music presented in this dissertation. However, while the model in essay 1 is meant to be comprehensive in its coverage of the main methods of music processing, it is not a complete work, nor is it the only thing required in order to create meaningful studies on music. Future research is needed, both to refine the model presented in the first essay, as well as to better understand some of the links in the model itself. Suggestions for what to do next are outlined in a series of research propositions presented in the first essay of the dissertation, as well as in Appendix B. In other words, this model is a first step.

In the meantime, the second essay provides evidence that taking this general approach – that is, adopting a more systematic and deliberate view of music – can provide valuable insight. Music processing is complex, and involves a variety of individual and environmental aspects. Even if refinement is needed in the future, acknowledging the complexity of music is an important first step that can improve the quality of future investigations on this topic.

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Appendix A

Audio files used as examples in the text

Track 1: Haydn's Surprise Symphony

Haydn, Franz Joseph (1792), "Symphony No. 94 in G major, Second Movement," [Recorded by Orchestra of the 18th Century; Frans Brüggen, cond.], on *Haydn, Symphonies No. 94 "Surprise", Nos. 95 & 96 "Miracle"* [CD], London, UK: Universal/Philips Classics (1992).

Link: https://www.youtube.com/watch?v=lLjwkamp3lI
NOTE: the "surprise" moment referred to in the text occurs at 0:34 in this version

Track 2: Dido and Aeneas

Purcell, Henry (1689), "Dido's Lament" from *Dido and Aeneas*, Act III, [Recorded by Lorraine Hunt; Philharmonia Baroque Orchestra; Nicholas McGegan, cond.], on *Dido & Aeneas* [CD], Los Angeles, CA: Harmonia Mundi (1994).

Link: https://www.youtube.com/watch?v=uGQq3HcOB0Y#t=0m56s
NOTE: the descending passage referred to in the text begins at 0:56 in this version, and corresponds with the text "When I am laid in earth…", whenever it occurs or repeats

Track 3: We Will Rock You (Queen)

May, Brian, (1977), "We Will Rock You" [Recorded by Queen], on *News of the World* [LP], London, UK: EMI/Elektra (1977).

Link: https://www.youtube.com/watch?v=-tJYN-eG1zk

Track 4: Iko (Dr. John version)

Hawkins, Barbara, Rosa Hawkins, Joan Johnson, and James Crawford, (1953), "Iko," [Recorded by Dr. John], on *Dr. John's Gumbo* [LP], New York, NY: Atlantic/ATCO (1972).

Link: https://www.youtube.com/watch?v=S_UYPu5RFXI

Track 5: Faith (George Michael)

Michael, George, (1987), "Faith," on *Faith* [CD], New York, NY: Columbia/Epic (1987).

Link: https://www.youtube.com/watch?v=6Cs3Pvmmv0E#t=0m55s
NOTE: the "clave" rhythm referred to in the text begins at 0:55 in this version

Track 6: Desire (U2)

U2, Bono, (1988), "Desire," [Recorded by U2], on *Rattle and Hum* [CD], London, UK: Island Records (1988).

Link: https://www.youtube.com/watch?v=z8rQ575DWD8#t=0m24s

Stimuli used in Essay 2

Video stimuli is used in all experiments presented in Essay 2. While the video portion of the stimuli was created specifically for these experiments, the background audio which accompanies the video comes from two existing audio recordings. In study 1, the "rhythmic" and "acoustic" versions of the song result from two versions of the song: "Dancing On My Own," by UK-based artist Calum Scott. The "acoustic" version is the original recording, consisting only of Scott's vocals with piano accompaniment; the "rhythmic" version is a remix created by the artist Tiësto, which overlays various effects on top of the original ("acoustic") recording. Both songs appear on the Deluxe edition of Scott's album *Only Human*, released in 2016. While both versions are used in study 1, only the "rhythmic" version of the recording is used for studies 2 through 5.

Rhythmic version:
Scott, Calum, (2016), "Dancing On My Own," on *Only Human (Deluxe)* [CD], Los Angeles, CA: Capitol Records (2016).

Acoustic version:
Scott, Calum (2016), "Dancing On My Own (Tiësto Remix)," on *Only Human (Deluxe)* [CD], Los Angeles, CA: Capitol Records (2016).

Example of video stimuli: rhythmic song version with confederate clapping, as used in study 2:

Link: https://www.youtube.com/watch?v=0EP1-TeWiIg

Appendix B

Research direction 1: propositions for the processes of music effects found in literature

The purpose of this section is to arrange the managerial and interpersonal effects of music found in literature into groupings based on the hypothesized processes that are responsible for them, using the organization presented in the model of music processing developed in essay 1. These propositions have been organized into three groups, based on whether the underlying process develops from (A) referential processing, (B) arousal, or (C) social processing of music. Each proposition is a hypothesis on how that specific effect from the literature occurs, with the hypothesis delineating a specific path through the model, starting with a core music element and continuing with related processes. Each hypothesis in this section is testable, using constructs from existing research but adapting the music stimuli according to the theory discussed in this essay.

Research propositions 1A: implications of referential processing of music

Referring to Figure 1.2, the first group of effects in the literature relates to affect or mood-related processes. The individual's mood is specifically identified as the process by which there are positive effects of music on willingness to wait (Hui et al. 1997), for example. However, each of the studies mentioned in this grouping either demonstrates or infers that the individual listens to music on their own, processes it, enjoys it, and then that this positive emotion transfers – to a product (Gorn 1982, Bruner 1990), or environment, such as a store (Morin et al. 2007; North and Hargreaves 1996a) or restaurant (North and Hargreaves 1996b), for example. Other implications of deriving emotion from music in a retail context include

effects on sales (Milliman 1982, Smith and Curnow 1966), purchase intent (Alpert et al. 2005, North et al. 1997, North et al. 2016), or intention to visit a store (Spangenberg et al. 2005).

The reason for arranging these implications together is that they all are dependent on some sort of internal reward to be gathered from the music, or some sort of affect to be perceived from it. Both of these require that the individual derives emotion from the music – either from cultural associations attributed certain sound groupings (i.e., hearing "happy" sounding music) or from an individual hearing music that sounds similar to what they have heard before and what they would consider preferred or enjoyable music. In other words, the literature presented here can all be linked to an underlying requirement that the individual processes the music referentially. Based on this, we can therefore link the pitch-related aspects of music to these effects, and can hypothesize that these should be the most important music elements present in a song if the goal of listening to it is to elicit these effects.

> **Research proposition 1A-1**: Affect transfer resulting from the referential processing of the pitch elements of music can impact product evaluations and the environment, leading to changes in sales and consumer intentions to visit retail stores
>
> **Research proposition 1A-2**: Improved mood resulting from the referential processing of the pitch elements of music can impact perceived density within an environment, willingness to wait, and desire to affiliate with employees in a retail setting

Research direction 1A: interrelations between constructs related to referential processing

Interrelations between some of the constructs and effects in this grouping could benefit from further examination. For example, it is identified above that emotion is derived from music,

and that this can be transferred to perceptions of a retail environment (Morin et al. 2007). Other studies identify that individuals are more likely to visit a store (Spangenberg et al. 2005) or purchase more at it (Milliman 1982, Smith and Curnow 1966, Alpert et al. 2005), and this is also linked to emotion.

One hypothesis is that the former relationship is a mediator, such that emotion adjusts the perception of the retail environment, and that this is what affects store visit intention or purchase intention. Similarly, music playing in a waiting room could improve an individual's mood, and so this internal mood regulation could mediate the impact that music has on willingness to wait in a retail setting. Such interrelations between the constructs are outside the scope of the current essay, which focuses on linking the core music elements and processing types to the implications in the literature (to this end, note that all of the above relationships still result from the pitch element of music and referential processing). Regardless, understanding the relationships between related outcomes would be key to developing actionable recommendations on how to apply this research effectively in managerial settings.

> **Research direction 1A**: Examine the potential for outcomes resulting from affect and mood (resulting from the referential processing of the pitch elements of music) to be related to each other, such that effects on perception may influence implications such as sales or other behavioural outcomes

Research propositions 1B: implications of arousal resulting from music

The second group of effects in Figure 1.2 can be linked to the arousal that results from music listening. As discussed earlier in this essay, arousal in terms of music processing relates to

music's ability to provide a regular meter and thus keep an individual focused on a task, or to encourage a speed and consistency for a simultaneous activity, for example.

In the literature, the arousal construct leads to two categories of outcomes. The first is when music changes individuals' perceptions of their environment and therefore leads them to change their behaviours relating to that environment, such as when music affects the pace of store traffic (Milliman 1982) or the overall amount of time that individuals spend shopping (Yalch and Spangenberg 2000). Specifically, the literature indicates this is a mediated effect, such that individuals perceptions of time are affected as a result of music (Kellaris and Kent 1992), and this is what changes subsequent behaviours (Yalch and Spangenberg 1990, Bailey and Areni 2005, Oakes and North 2008).

> **Research proposition 1B-1**: Changes in arousal resulting from processing the rhythmic elements of music influences perceptions of time and the shopping experience, which subsequently impacts the pace of store traffic and the amount of time an individual spends shopping in a retail setting

The second category of effects resulting from arousal due to music is related to cognition. Specifically, the literature indicates that tasks that require executive attention – such as processing advertisements (MacInnis and Park 1991, Hahn and Hwang 1999, Kang and Lackshmanan 2017), driving (North and Hargreaves 1999b, Brodsky 2002, Day et al. 2009) or managing stocks (Mayfield and Moss 1989) – can be impacted if individuals are required to listen to music at the same time. The literature is not consistent on the direction of this effect: for example, in literature examining driving, music that is (rhythmically) complex and highly

arousing has been shown both to help (Day et al. 2009) or hinder (North and Hargreaves 1999b, Brodsky 2002) driving performance. Regardless, the arousal level of the music appears to be related to these effects. The previous sections of the essay discussed how arousal is related to the rhythmic elements of the music rather than the pitch elements, and therefore we can propose that if one wants to impact the processing of simultaneously-occurring stimuli, they should focus on the rhythm aspect of the music to induce or attenuate arousal.

> **Research proposition 1B-2**: Changes in arousal resulting from processing the rhythmic elements of music impact how an individual processes information, such as which information contained within an advertisement is retained
>
> **Research proposition 1B-3**: Changes in arousal resulting from processing the rhythmic elements of music impact an individual's ability to conduct other simultaneous cognitively-demanding tasks, such completing mathematical tasks and driving

Since music is often used in the background of one's daily life as they go about everyday tasks such as cleaning, studying, or exercising (Levitin 2007), there are a variety of potential impacts that arousal resulting from music can have. These are discussed further in another of the research propositions.

As will also be discussed in a separate research direction, it is possible that arousal resulting from music could have a link to internal mood regulation, suggesting an alternate outcome possibility for music that focuses on adjusting arousal in listeners. However, both groups of implications that are tied to arousal are hypothesized to *only* result from this construct, and not from either of the other types of music processing (referential or social). Thus, the

hypothesis is that if a manager wishes to evoke one of the implications listed in this section, they only need to consider how to evoke arousal through adjustments to the rhythm element of the music; they do not need to consider the other elements of the music (specifically, pitch) or other types of processing.

Research propositions 1C: implications of social processing of music

The final group of effects in Figure 1.2 is that which results from the social processing of music. Literature shows joint music tasks such as clapping together to music lead to a closer identification with the other individuals involved in the task (Cacioppo et al. 2014, Tarr et al. 2014, Lang et al. 2017). This is not limited to one-on-one relationships, and group-level integration is also found to be a result of music listening (Hagen and Bryant 2003, Wiltermuth and Heath 2009).

> **Research proposition 1C-1**: Processing rhythmic elements of music leads individuals to identify more closely with others involved in the music listening experience, encouraging closer social bonds and group-level integration with those involved

Apart from these psychological outcomes, the literature also indicates that individuals become more cooperative and more likely to engage in prosocial acts after tasks which involve manipulating or participating in the rhythmic aspect of music (Cirelli et al. 2014, Mogan et al. 2017). It is hypothesized here that this willingness to help another individual, or complete a prosocial act which helps the individual, is a result of the increased identification and closeness that is felt towards the others who were also engaged in the music consumption activity.

Research proposition 1C-2: Processing the rhythmic elements of music leads individuals to identify more closely with others involved in the music listening experience, which motivates them to help these other individuals

Research proposition 1C-3: Processing the rhythmic elements of music leads individuals to identify more closely with others involved in the music listening experience, which leads these individuals to be more susceptible to cues or suggestions given by the others involved

The theorized evolution of rhythm is linked to its ability to help groups and individuals come together through joint music-making and dancing. Given this, a link can be drawn to the rhythm element of music as leading to the social effects identified above, rather than pitch elements. This hypothesis is directly tested in the second essay of this dissertation, which shows that the same song with less-prominent rhythmic elements is not able to replicate positive impacts on identification as a more rhythmic version of the same song. Results of this second essay thus support research propositions 1C-1, 1C-2, and 1C-3.

However, further research is needed in order to understand this relationship. The results which will be presented in the second essay of this dissertation show a mediated model in which rhythm has these effects through increased identification with the task partner, but it is also possible that increased social cognition or social awareness as a result of the music could still act to change individuals' social actions even if another individual is *not* involved in the music listening activity. This is indicated in the results of the experiments that are reported in the second essay, but this possibility needs further study. As will also be discussed, it seems that pitch elements must at least be somewhat present in the sound in order for these effects to occur,

since entirely removing them does not result in the same effects. For the purposes of parsimony, it is proposed that managers looking to evoke social awareness in individuals should focus on music which presents with a stronger prevalence of rhythmic elements compared to pitch elements.

Appendix C

Methodological details appendix (MDA) for experimental studies presented in Essay 2

Study 1 Methodological Details

Additional information about stimuli

A still image from the video used in study 1 is presented below.

In order to avoid the potential for confounding variables, the current study uses two different versions of the same song. Details of the two versions are presented in the body of the essay. The song was titled “Dancing on My Own”, by the artist Calum Scott, a UK-based artist. The original single (used as the “acoustic” version in study 1) was released in April 2016, a remix version of the song (used as the “rhythmic” version in study 1 and throughout the remaining studies in this essay) was released by Tiësto in October 2016. Appendix A contains additional information about these audio recordings and how they are integrated into the stimuli presented in this essay.

Supplementary measure description

Social affiliation scale (Cacioppo et al. 2014). This six-item scale was used in past synchrony research to measure feeling of closeness to the synchrony task partner. Five items of the scale were used here ($\alpha = .87$), on a 7-point Likert-type scale (1 = not at all, 7 = very much). The five items included: "How much do you trust this person?", "How much do you like this person?", "How much would you like to work with this person?", "How much would you like to confide in this person?", and "How close do you feel to this person?".

Song preference. Participants were asked a single-item measure on a 7-point, Likert-type scale (1 = not at all, 7 = very much), with the text reading: "How much did you like the song that was played during the task?"

Synchronization with the person in the video. Participants were asked a single-item measure on a 100-point sliding scale, with anchor labels (0 = not at all synchronized, 100 = totally synchronized); the numerical values were not visible to participants. The specific text read: "Overall, how synchronized (together) do you think your movements were with the person in the video during the task?".

Additional information about removal of participants

As reported in the body of the essay, participants who completed the tapping task were asked to self-report the extent to which they felt in time with the target in the video. This measure is presented in the previous section of this appendix and are used throughout the studies reported in this essay. These synchrony self-reports are specific to the manipulation, and therefore do not occur across conditions. For example, participants in the no-music condition do not rate the extent that the target was in sync with the music, since no music is present in the

video presented to them). This means that it cannot be introduced as a covariate in the analysis, and can only be used to exclude participants from analysis.

Study 2 Methodological Details

Additional information about stimuli

Advertisement/scenario stimuli

As discussed in the body of the essay, participants were presented with a fictional charitable organization "A Hand Up". On the next page of the survey, they were presented with information that linked the confederate from the video task to this fictional organization. These two pages of the survey are presented below.

Homeless youth in Montreal face brutally cold temperatures, rain and snow, and physical threats. They often end up in these situations because they are escaping abusive environments, and have no other choice. They feel helpless and alone.

The purpose of A Hand Up is to provide a safe place for homeless youth to stay at night, as well as access to counselling and youth services.

The government funding A Hand Up receives requires up-to-date statistics on how much their service is used. Since A Hand Up is short-staffed, they have not had time to compile the data. Without additional funds and volunteer hours, homeless youth will be forced to go through the winter without shelter and food.

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A HAND UP
Helping homeless youth across Montreal

Concordia University has partnered with A Hand Up to support the organization. To help with this, a recruitment officer has been hired (pictured to the right) to increase awareness for A Hand Up within the Concordia community.

This is the same person you tapped with in the previous task.

Additional information about removal of participants

As in study 1, participants were removed if they had trouble syncing with the confederate, as determined by a score of less than one standard deviation below the mean on this measurement. This removed 14 participants.

Examination of the song preference scores shows a high rating for the song (M = 6.05, SD = 0.85), with only 17 participants rating the song below the midpoint of the 7-point scale. Therefore, these 17 participants were removed from analysis. This pattern continues for the remaining studies, with the scale midpoint corresponding approximately to one standard deviation below the mean preference score. Since a dislike for the song could interfere with a person's ability to focus on synchronizing to it, it was decided to remove these participants for this and future studies.

Additional information on target ratings

Participants were asked a variety of measures about the target, including their likeability, friendliness, trust, the extent the participant felt they were on the same team as the target, and the five-item scale about their feelings of social affiliation with the target. As discussed in the text, a factor analysis was conducted to reduce the number of individual analyses, since it was believed that there should be similarities between many of the target ratings. Results indicating the existence of two factors are presented in the text: the first factor relates to integrating the target into one's identity, and includes the ratings of being "on the same team" and the five items of the social affiliation scale. The second factor includes more external ratings about the target, and includes ratings of the target's likeability, friendliness, and trust. Results for the first factor are presented in the text; however, as mentioned in the text, the pattern of the results for the second factor is similar, and is also significant ($M_{tap+music}$ = 5.18, SD = 0.93 vs. $M_{control}$ = 4.86, SD = 0.94; $F(2, 115) = 6.20$, $p = .003$, $\eta_p^2 = .097$).

Study 3 Methodological Details

Sampling strategy information

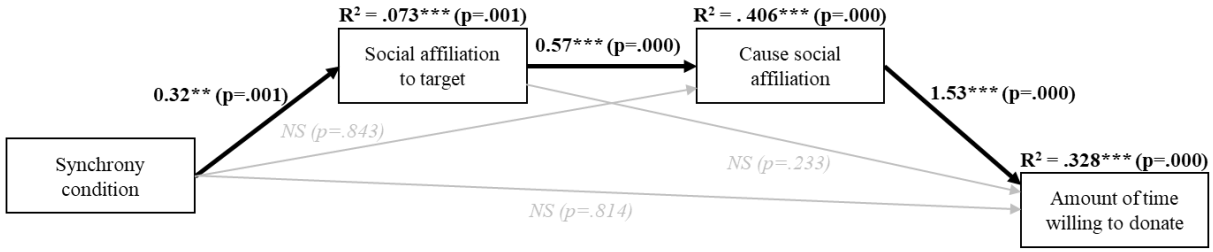
Study 3 was conducted online, using Amazon Mechanical Turk (MTurk). There are a few advantages to using this sampling strategy. First, this allows for a generalization to a larger, more diverse population. Undergraduate students in North America have been highlighted as a less-than-ideal in terms of their representativeness towards human behaviour more generally (Heinrich 2010); by using MTurk, we are able to access a population of survey-takers that is more diverse in education, income, and geography, among other variables. Generally, results of experiments on MTurk have been considered comparable to lab studies (Buhrmester et al. 2011, Crump et al. 2013), as long as various criteria are met in the study design (Mason and Suri 2012).

In this study, requirements for participation that were implemented on MTurk included that participants were US-based, and that they had at least a 95% approval rate for previous tasks on the site. In addition, since the manipulation included a video embedded into the survey, it was required that participants could stream video and listen to audio on their device. The control mechanism that was implemented (as will be discussed below) also required the use of a mouse or trackpad, so participants were required to complete the task on a desktop or laptop computer. A test video and series of checks (including browser checks to confirm that the participant was completing the task on a desktop or laptop computer and not a mobile phone, for example) was implemented at the beginning of the survey to confirm that participants fulfilled these technical requirements. After data collection, similar criteria were used to remove participants from analysis as in study 2.

Supplementary measure description

Organization social affiliation. This measure was adapted from the *social affiliation scale* initially taken from Cacioppo et al. (2014) and used in the previous studies in this essay. The five items used in studies 1 and 2 were adapted, and now included: "How much do you trust this organization?", "How much do you like this organization?", "How much would you like to work with this organization?", "How much do you trust that supporting this organization will help to solve the problems faced by homeless youth?", "How close do you feel to this organization?".

Details on mediation analysis



Indirect paths	Effect	Boot SE	BootLLCI	BootULCI
synchrony condition → social affiliation→ donation intention	.098	.093	-.049	.333
synchrony condition → social affiliation → cause-SA → donation intention	**.282**	**.110**	**.098**	**.538**
synchrony condition → cause-SA → donation intention	.022	.105	-.169	.244

Study 4 Methodological Details

Additional information about stimuli

The video stimuli were re-recorded, this time using another confederate but with the same (rhythmic) song playing in the background of the video. Again, the confederate was seated in front of a blank wall and stared at the camera as she clapped on the beat to the music that was playing.

Information on procedures

Participants arriving to the lab for the group condition began the experiment in a separate room, as detailed in the body of the essay. An image showing the room setup for this condition is displayed below.

Supplementary measure description

Cause social affiliation. In study 3, a social affiliation measure is adapted from the original social affiliation from Cacioppo et al. (2014) to assess changes in participants' feelings towards the organization. However, it is not clear whether the results in study 3 are specifically due to individuals' increased affiliation with the organization – an alternative explanation for the result is that their feelings of the cause itself (i.e. the support of homeless youth more generally) could instead be influencing the subsequent increase in the donation behavioural intention measure. Therefore, the social affiliation was again adapted to specifically ask about the cause that the organization supports (i.e. support of homeless youth). Both the original social affiliation (asking about the confederate) and the organization social affiliation (asking about the fictional company "A Hand Up") was also included. The new *cause social affiliation* measure included five items,

again adapted directly from the five items originally taken from Cacioppo et al. (2014) and asked on 7-point Likert-type scales (1 = not at all, 7 = to a great extent). Items included: “How much do you trust homeless youth?”, “How much do you like this cause?”, “How much would you like to work to help homeless youth?”, “How much do you trust that supporting this cause will help to solve the problems faced by homeless youth?”, and “How close do you feel to the cause of helping homeless youth?”.

Group evaluation, Wiltermuth and Heath (2009) scale: In order to measure differences in individuals’ perceptions of other participants in the room with them, a scale was taken from a past synchrony study by Wiltermuth and Heath (2009). Participants were asked to “Please answer about the other people who are in this study with you today (the other participants in the room)” on a 7-point, Likert-type scale (1 = not at all, 7 = very much). The scale consisted of 5 items: “How connected do you feel with these people?”, “How much do you trust these people?”, “How much do you feel you are on the same team as these people?”, and “How similar are you to these people?”.

Group social affiliation. Similar to the adapted social affiliation scale for the organization and cause, the original five items from Cacioppo et al. (2014) were adapted to ask about the other participants in the room. The new *group social affiliation* measure included five items, again adapted directly from the five items originally taken from Cacioppo et al. (2014) and asked on 7-point Likert-type scales (1 = not at all, 7 = to a great extent). As for the Wiltermuth and Heath (2009) group scale above, participants were asked to answer about the participants in the room with them. Items included: “How much do you trust these people?”, “How much do you like these people?”, “How much would you like to work with these people?”, “How much would you like to confide in these people?”, and “How close do you feel to these people?”.

Additional analysis

Confederate ratings

Participants were asked a variety of measures about the confederate, including their likeability, friendliness, trust, the extent the participant felt they were on the same team as the confederate, and the five-item scale about their feelings of social affiliation with the confederate. As discussed in the text, a factor analysis was conducted to reduce the number of individual analyses, since it was believed that there should be similarities between many of the confederate ratings. Results indicating the existence of two factors are presented in the text, along with the results for the first factor; however, as mentioned in the text, the pattern of the results for the second factor is similar, and also significant ($M_{tap+music}$ = 5.16, SD = 1.00 vs. $M_{control}$ = 4.73, SD = 1.07; $F(1, 99) = 17.34$, $p = .000$, $\eta_p^2 = .149$).

Mood analysis

Study 1 was designed to rule out a mood-based explanation for the results by using a song with a similar structure and similar melodic and harmonic elements, and only adjusting the rhythm. The assumption is that if the task was acting to influence participants' mood, it should do so similarly for both the rhythmic and non-rhythmic (acoustic) song versions. However, it is possible that mood is perceived differently depending on the rhythm of the song (Hevner 1937); furthermore, since the task in the current study is a joint task, it is also possible that the act of completing the exercise with others could be influencing mood. To rule out these mood-related explanations, participants reported their mood on a five-item bipolar scale at the start of the survey. Their answers were included as a covariate on the analyses reported in the body of the essay for study 4. In no cases did the results change in significance compared to what is reported

above. Therefore, it is concluded more definitively that the effects of synchrony do not occur due to increased positive affect resulting from either the song or from completing the joint task.

Decision not to include inclusion criteria from past studies

The synchronization manipulation check was not applied here. Since one of the purposes of the group task was to measure differences in intra-group ratings, it would be counter-productive to remove participants based on whether they scored low on subjective ratings of the group's ability to keep in time with each other, even if it also reflects inability to keep time with the person in the video. Since their joint task in this study has the potential to impact two relationships – that of the confederate and individual, and the group and individual – it was not possible to remove participants from the analysis in the same way as past studies, since we would not be able to discern whether the person was having issues syncing with the group, or with the confederate, or both. Therefore, it is possible that individuals who had an issue syncing with the confederate are still in the sample, and so the results presented here could likely be stronger in a situation where it was possible to have a more synchronous manipulation (such as an in-person task). However, participants were still removed from the sample if they reported low values on the song preference measure. The final sample included 107 participants.

Study 5 Methodological Details

Sampling strategy information and screening criteria

MTurk was again used for sampling for this study. Due to changes in the MTurk population – specifically, the intrusion of "bots" and a resulting lower quality of participants – the requirements for participation were slightly adjusted. Participants were now required to have

at least a 99% approval rate for previous tasks on the site. This was in addition to the other criteria that were used in study 3: participants needed to be US-based, and be able to stream video and listen to audio on their device.

Due to the online sampling strategy, procedures similar to study 3 were implemented which instructed participants in the tapping (clicking) condition to "click your mouse or trackpad along with the person in the video". Given the above-mentioned concerns regarding participant attention, it was decided to try to implement tools that could verify that participants in the sample were following instructions. The survey software used (Qualtrics) can identify the number of clicks that a participant makes with their mouse or trackpad on a single screen. Therefore, it was possible to remove participants from the study if they did not correctly follow the instructions when asked to click along. It was determined that approximately 150 clicks would correspond to the number of claps in the video; participants who clicked less than 50 times were therefore given a warning, and asked to complete the task again. If, on the second attempt, participants still did not click at least 50 times during the video, they were removed from the sample.

To ensure that the removal of participants was not confounded with the conditions they were assigned to, participants who were not in the clicking (video tapping) condition were also presented with this video and the clicking instructions at the end of the survey, after completing all other tasks and measures; these participants were subsequently removed from the sample according to identical rules as those in the clicking task were subject to.

Additional information about stimuli

As detailed in the body of the essay, the video stimuli were re-recorded, again using a new confederate. A similar setup was used to past studies, except the confederate was presented

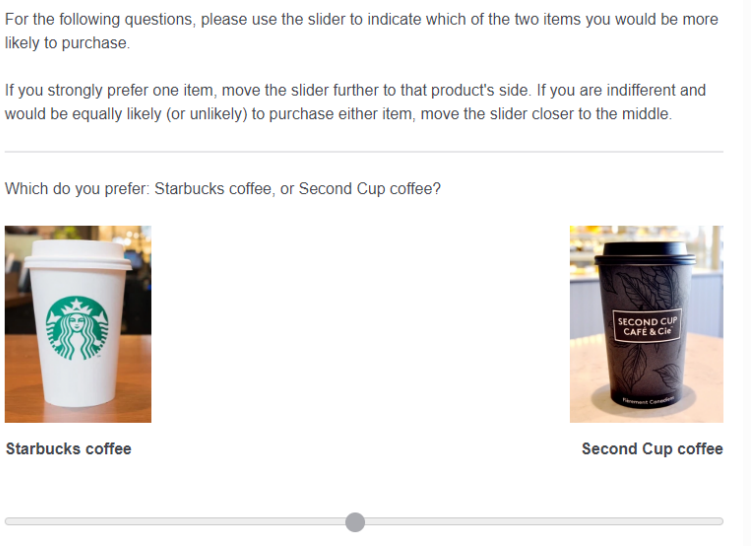
as a Starbucks employee by wearing a Starbucks apron and drinking from a Starbucks cup immediately before and after completing the clapping task. The Starbucks logo was prominently displayed both on the cup and on the apron. A still image from this video showing the confederate and display of the brand is presented below.

Apart from drinking the beverage at the start and end of the video, the confederate also recited a script after the clapping task concluded. Specifically, she stated: "At Starbucks, we believe that understanding other peoples' point of view is important. Doing activities like clapping together brings us one step closer to a world that is more fair, equal, and understanding." The reason for this script was first to provide some realism for the task, since the clapping task on its own did not have a clear motive and was likely to be questioned by participants. Second, it further emphasized the identity of the confederate as a representative of Starbucks.

Supplementary measure description

Brand preference. To measure brand preference, participants were first presented with a number of discrete choices, using a bipolar sliding scale. Participants were asked to move the slider based on the strength of their preference: if they strongly preferred Starbucks over other brands for that product, they were to move the slider to one side, and if they strongly preferred "other

brands of [the item in question] in general", they were to move the slider to the opposite side. This was coded on an 11-point scale, ranging from -5 (prefers other brands) to 5 (prefers Starbucks), although these numbers were not displayed to participants. Due to the fact that the participants were not limited to a specific region of the United States, and since there is not another coffee brand in the United States that shows as complete coverage in terms of locations or distribution, it was not possible to provide a realistic counter-brand, and so using "other brands… in general" was seen as the best option. It was assumed that participants would likely place their own preferred brand in this psychological location when making their decisions. The instructions for these tasks read: "For the following questions, please use the slider to indicate which of the two items you would be more likely to purchase. If you strongly prefer one item, move the slider further to that product's side. If you are indifferent and would be equally likely (or unlikely) to purchase either item, move the slider closer to the middle". Participants were asked to rate in this way for five items: brewed coffee, brewed tea, bags of coffee, boxes of tea, and baked goods, and generally responded similarly for all questions (Cronbach's alpha for the five items: $\alpha = .88$). An example of how this question was displayed to participants is presented below.



Willingness to try new product from brand. In addition to the discrete choices, participants were asked how likely they would be to try a new product if it was released by Starbucks, on a seven-point, Likert-type scale (1 = not at all, 7 = to a great extent).

Willingness to pay for brand. *Participants were* asked their willingness to pay for Starbucks on a sliding scale. The scale had anchor points at -100% and +100%, with anchor labels (-100% = will only buy from Starbucks if it is priced 100% lower than other brands; +100% = will buy from Starbucks even if it is priced 100% higher than other brands). There were additional percentage labels at each 25% increment between these values.

Additional analysis

Confederate ratings

Participants were asked a variety of measures about the confederate, including their likeability, friendliness, trust, the extent the participant felt they were on the same team as the confederate, and the five-item scale about their feelings of social affiliation with the confederate. As in studies 2 and 4, a factor analysis was used to reduce the number of analyses, resulting in two factors of "identification" and "external" ratings of the confederate. The pattern of results for second factor ("external" ratings of the confederate) is generally similar to that of the first factor, with significant differences found between the synchrony conditions and these external ratings of the confederate ($F(3, 194) = 6.84$, $p = .000$, $\eta_p^2 = .096$). However, detailed analysis of this factor and its contrasts is not focused on here, as it has less theoretical relevance than the first factor ("identification"), the results of which are reported in the text.