THE OPTIMAL MUSICAL PAUSE:
THE EFFECTS OF EXPECTANCIES, MUSICAL TRAINING, AND PERSONALITY.

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Tiivistelmä – Abstract

The *musical pause* is an acoustic space between musical phrases, and is an important auditory quality because it can enhance tension by delaying the expected. It has been proposed that expectancies develop from long-term schematic knowledge learned through exposure; however, the *dynamic attending theory* indicates that expectancies arise from localized short-term knowledge found in the stimulus. This study aims to measure the optimal duration of the pause by assessing the influence of low-level musical features, long-term familiarity, musical ability, and personality. Musical excerpts were chosen from a variety of genres to include two phrases (separable by a silence), from which participants were asked to create and to rate the pauses. Results indicated that, while preferences and choices of pause durations were partially influenced by low-level features, they were more often affected by long-term schematic learning. Despite discrepancies in the relationship between the pause and metre, there was high consensus that pauses not exceeding three beats were favoured. Results also implied that expectations might change depending on the listening intent of the individual, which could have implications for perceptual differences between performer and audience.

Asiasanat – Keywords

silence, musical pause, expectation, dynamic attending theory, entrainment, prediction effect, schematic learning, familiarity, long-term memory, short-term memory

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CONTENTS

1 INTRODUCTION

Silence has been described as a *frame*—drawing attention to music by defining a space for the sounds to claim (see Littlefield, 1996). However, “silence does not simply mean oblivion” (Debussy, as cited in Orledge, 1982; p. 205), and may be more analogous to the canvas than to the frame: It is another state of sound, equally contributing to the music by influencing the texture, tone-colours, and interpretation. The symbolic meaning of both sounds and silences are enhanced by how they interact (Saville-Troike, 1985). The silence not only provides opportunities to process and learn from what was heard (Catterall, 2005; Sutton, 2007), but communicates (Margulis, 2007), has aesthetic qualities (Voegelin, 2010), and directs the listener’s attention (Kallen, 1997). Hence, like sound, silence must rely on similar cognitive processing, e.g., being subjected to expectancies espoused by the listener.

It has been suggested that music-induced emotions result from the anticipation and resolution of auditory expectancies (Meyer, 1956). However, research diverges when attempting to explain from whence these expectancies arise. Cognitive mapping is complex, yet, it appears likely that auditory expectations are compiled from two memory sources: *long-term memory* (LTM) and *working memory* (WM) (Koelsch & Siebel, 2006). LTM is built on an individual’s past experience, meaning that memories and expectations develop from reoccurring events, i.e., through data-driven and statistically learned information. Therefore, the more often an event occurs, then the more often it is expected to reoccur in similar situations. It is argued that this process—of retesting and assessing previously learned auditory expectations—originates emotional responses to music (Eerola, 2003; Huron, 2006; Krumhansl, 1997, 2000, 2000a; Palmer & Krumhansl, 1990; Meyer 1956; Ullal-Gupta, Hannon, & Synder, 2014; Zajonc, 1968). Contradictorily, the *dynamic attending theory* (DAT) suggests that individuals develop expectancies primarily from local context-dependent information. Expectations develop and fluctuate on a moment-to-moment basis as the individual interacts and subconsciously synchronizes with a sequence of stimuli (Jones, 1976; Barnes & Jones, 2000; Large & Jones, 1999): Thus implying a greater usage of WM when listening to, anticipating, and responding to music.

It appears evident that both *long-term* (LT) and *short-term* (ST) expectancies contribute to auditory experiences. It has been shown that animals prefer familiar stimuli (Pratt & Sackett,

1967) and that repeated exposure to a stimulus enhances increasing preference in humans (Harrison, 1968; Meyer, 1903; Zajonc, 1968). Meanwhile, numerous studies have found that individuals will spontaneously synchronize to an external stimulus (Jones, Moynihan, MacKenzie, & Puente, 2002; McAuley, Holub, Jones, Johnston, & Nathaniel, 2006): a reaction that is affected by cueing and the temporal contextual sequences (Barnes & Jones, 2000; Clayton, 2007; Phillips-Silver, Aktipis, & Bryant, 2010; Large & Jones, 1999; McAuley, 1995).

The purpose of this research is to measure an optimal duration of a musical pause, while concurrently evaluating whether participants' preferences are predominantly guided by LTM or WM, i.e., by LT or ST expectations. This was pursued with a two-part experiment, which asked participants to both create and rate musical pauses. Data gathered were analysed to examine the effects of any potential influential factors: low-level musical features; measure of familiarity with the music from which the excerpts were taken; and additional factors pertaining to the individual, i.e., musical training and personality traits measured as levels of extraversion.

It could be posited that if the DAT guides expectancy through a pause, then the data will show a stronger influence from the low-level temporal events, such as the *metre*, *beats per minute* (BPM) or *tempo,* and *pulse clarity* (i.e., how perceivably evident the metre is). However, if LT knowledge has a greater influence during music listening, then data will appear more subjective and unique, varying depending the individuals' personal traits, and with their familiarity to the musical excerpt. Furthermore, consideration will be given to two of the different listening approaches: listening with the intent of interacting, where participants must respond dynamically to the music as it plays; and listening reflectively, where participants listen first and then must respond after it has played. By doing so, this research may assess whether individuals treat these different types of listening approaches equally.

2 THEORETICAL BACKGROUND

2.1 Distinguishing a *pause* from a *silence*

A measurable absolute silence cannot exist as long as the auditory cortex is activating (from either external or internal triggers). Hence, for the purpose of this study, silence shall be considered, not as an entirely pure state of non-audible sounds, but in relation to an audio source. Akin to the definition given by the Oxford English Dictionary as, “the fact of abstaining or forbearing from speech or utterance” silence will be considered in respect to a particular sound source, as it is the moment when that sound source is removed, i.e., below a certain decibel threshold. To narrow the focus on a type of silence, this research shall focus primarily on the musical *pause*. The pause shall refer to those silences located between musical phrases, which emerge within a musical source without wholly disjointing the surrounding musical content.

Pauses occur naturally in both music and speech as they provide a type of breath between statements, and often function as a marker of the boundaries between phrases and sub-phrases in both music and in linguistics (Doctor, 2007; Knösche et al., 2005; Margulis, 2007, 2007a; Saville-Troike, 1985; Steinhauer, Alter, & Friederici, 1999). Thus, pauses allow for syntax parsing (Steinhauer 2003; Steinhauer & Friederici, 2001), the prolonging of a sense of tension (Huron, 2006), or the redirecting of attention towards future events (Edgar, 1997; Knösche et al., 2005). In speech, it may be that pauses arise from hesitation resulting from the cognitive demand of language (Marler, 2000) or perhaps even from the technical demand of speaking. Whereas in modern music, such causes for pauses are technically unnecessary: Practice may remove much of the semantic or syntactic cognitive demand, and certain instruments and the use of technology mean that music may continue seamlessly if so desired. For example, modern *electronic dance music* understandably does not require the inclusion of any silence, and yet silence is considered one of the more important tools when creating an effective *drop*, i.e., the musical climax (Matla, 2014).

Consequently, the musical pause may more often serve aesthetic purposes: used for effect; or as a way of mimicking speech. For instance, it was found that in the recorded renditions of classical musical scores, audible pauses were present despite not being notated (Margulis, 2007). The same study similarly found that not all written silences were included on the recording (as notes where held through the silence). This suggests that the treatment of musical pauses is less rigid than other features when reproducing a classical work, and relies much more on the performers' interpretations of how phrase endings should be treated. Thus, while pausing in music is less necessary and rarely instructed, Margulis (2007) explains their appearance between phrases endings as, "the hesitations of highly personal speech and helps construct an atmosphere of communicative intimacy" (p. 269). More importantly however, is to note that such pauses do not seem to disrupt the metrical structure as they do not require an entire beat or notated bar, but borrow only a moment of time from the surrounding framework, adding to the music rather than taking anything away.

Silence consists of only duration (Margulis, 2007a), and yet provides a meaningful focus of study because, despite its minimal properties, it evokes a multitude of interpretations. Since at least the 1940s, the examination of silence has been used in linguistic studies to better understand speech, conversation, and interactions (Chapple & Harding, 1940; Crown & Feldstein, 1985; Goldman-Eisler, 1968; Jaworski, 1997, Kurzon, 1998; Scollon, 1985; Sobkowiak, 1997), and has been recognized as a fundamental requirement in the act and study of communication (Saville-Troike, 1985). The use of silence for study of auditory domains has similarly been applied to music analysis and perception (Cobussen, 2015; Clifton, 1976, Edgar, 1997; Lissa, 1964; Littlefield, 1996; Margulis, 2007; Sutton, 2007; Voegelin, 2010).

Depending on duration and context, silence may provoke individuals to actively listen and gain an enhanced sense of contextual- and self- awareness, thereby exposing expectations (Margulis, 2007; Voegelin, 2010). It might appear louder than sound, by invoking in listeners a greater sense of awareness than experienced in the sound that preceded it. It may invoke tension as it prolongs the arrival of an anticipated sound (Huron, 2006); and it may hold semantic associations, able to provoke a range of positive or negative attitudes within music as well as language (Margulis, 2007; Allen as cited in Tannen, 1985; Saville-Troike, 1985). This versatility makes silence an appealing focus of study, because it encourages listeners to fill the absence with their own thoughts, assumptions, and expectations (Margulis, 2007).

2.2 *Gestalt theory of mind* and *auditory stream analysis* (ASA)

The *Gestalt theory of mind* suggests that to make sense of a continuous flow of information, individuals categorize and group, or *chunk*, features from a stimulus thereby allowing for a greater ease in cognitive processing. Chunking is the grouping of temporal events, the boundaries of which are perceptually created from “a conception of distinct spans of time—at several hierarchical levels” (Tenney & Polansky, 1980, p. 205). Accordingly, perceptual boundaries in the auditory domain may be indicated by a pause: This has been recognized in classical music where the pause has often been used to distinguish sections (Doctor, 2007).

The patterns that interchange with perceptual chunking may often be imposed upon the stimulus, i.e., how individuals choose to categorize streams of information will in turn affect how they are perceived. It has been found that when listening to a succession of identical regularly occurring tones, individuals will perceive some tones as being more salient, most often creating a binary metric structure (Brochard, Abecasis, Potter, Ragot, & Drake, 2003). The tracking of a stimulus will also include the tracking of the different low-level features within that stimulus, e.g., identifying the timbre of an instrument allows it to be distinguished against the orchestra. This ability, to construct a mental description for separate sounds sources in a single audio stream, is manifested in the theory of *Auditory Scene Analysis* (ASA).

ASA proposes that, in a given audio stream, the individual sound sources may be distinguished separately by Gestalt-based information grouping features, such as pitch, frequency, and regularity. For instance, if two sine waves of different frequencies begin at different times, they are more likely to be perceived as separate sound sources, whereas if they begin at precisely the same moment they are generally heard as a single, more complex, tone. Tracking and chunking streams of information is a natural ubiquitous process performed upon all forms of stimuli as a way of making sense of the surroundings. However, the specific way an individual chunks that information appears to be a combination of innate and acquired knowledge based on LT expectations and familiarity. Vocabulary and musical scales are two examples of acoustic patterns—each upholding sets of expectations—acquired through familiarisation and learning (Bregman, 2007).

2.3 Long-term (LT) *schemata* and the *prediction effect*

It is commonly advocated, "Passive exposure to music leads to implicit knowledge of tonal relations, musical preferences, and expectancies for melodic continuations" (Thompson, 2008, p. 103), and that this implicit knowledge from LT exposure forms schematic models. Huron (2006) proposed a five-step physiological process explaining how LT auditory expectations evoke emotions during music listening: The stages are *imagination*, *tension*, *prediction*, *reaction*, and *appraisal* (ITPRA). These steps occur before and after a given point in the stimulus. If a stimulus is expected to be encountered, the anticipation is first cultivated with *imagination*. As this continues, *tension* is enhanced until finally the event occurs; here the *prediction* includes an initial assessment of the accuracy of the situation. This is followed by a spontaneous *reaction*, which varies depending on the degree of surprise. The level of surprise also results in varying degrees of positive or negative *appraisal*, which then becomes associated to the stimulus.

In summary, the ITPRA process—also described by Huron (2006) as the *prediction effect* and by Zajonc (1968) as the *(mere) exposure effect*—results in positive and negative emotions as the cognitive way of rewarding or punishing the individual's predictions. These feelings are then misattributed towards the stimulus, so that correct predictions of a musical phrase will result in a preference towards it. Huron further proposed that greater pleasure may arise from music that momentarily diverges from the expected: In such moments, the listener firstly experiences a negative surprise that then yields to an enhanced sense of pleasure when initially predicted sounds then appear. Huron describes this as *contrastive valence*. Indeed neural research supports that there is activity in regions of the brain connected with emotion during passive listening, such as the limbic and paralimbic systems (Brown, Martinez, & Parsons, 2004). It was also found that *stimulus-offsets*, or moments of silence, activate the limbic system, reflecting processes related to attention and memory as well as emotion (Knösche et al., 2005). Hence, the use of an unexpected pause may too evoke a pleasurable response from listeners: The pause causes a momentary lapse of the expected events thereby enhancing the musical enjoyment.

The prediction effect encourages the LT learning of patterns, as then the individual may develop more accurate and longer patterns of predictions. Learning what to expect is a subconscious process resulting from an initial reaction to a stimulus. Automatic reflexes respond to surprise as quickly as 150 ms in what is deemed the *fast track* brain. This area of the brain controls heart rate and blood pressure and so responds more regularly to familiar stimuli (Huron, 2006). To avoid surprises and reserve energy, the brain creates statistical models to predict the likelihood of encountering different sequences of events. Gradually, these sequential hierarchical models develop to larger scales called *schemata*. Schemata allow for a greater ease of cognitive processing when dealing with ASA, as they allow for greater degrees of chunking, and are what guide responses during music listening as they are continually reassessed for accuracy.

2.3.1 Influence of familiarity

Research indicates that the learning of data-driven information begins from prenatal or birth. It was found that Turkish and American infants already showed preferences for musical metre from their own culture (Soley & Hannon, 2010), while new-borns showed a preference for their mother's voice (DeCasper & Fifer, 1980) and for their native language (Moon, Cooper, & Fifer, 1993). Studies, comparing different cultures, also support that passive learning and exposure to repeated hierarchies results in a subconscious recognition and preference for familiar schemata in melody (Krumhansl, 2000a; Eerola, Louhivuori, & Lebaka, 2009), rhythmic perception (Palmer & Krumhansl, 1990), synchronization (Ullal-Gupta et al., 2014), and rhythmic processing (Cameron, Bentley, & Grahn, 2015).

Linguistic studies have similarly shown that language processing relies upon implicitly learned schemata. It was found that during the reading of different texts, prose reading used shorter silences than poetry, and spontaneous narratives included shorter silences than story-telling (Scollon, 1985). This finding implies that each style of reading contains its own unique set of expectancies, which includes the expected usage of pausing. These schemata support a theory that pausing is learned alongside melodic and metrical expectancies. Therefore, both musical and linguistic schemata allow for locations where a pause *is not* expected, and locations where a pause *is* expected.

Electroencephalography (EEG) has been a useful tool in demonstrating how LT semantic understandings may affect how an individual responds to a stimulus. It was shown that musical phrases, e.g., linguistic sentences, are capable of eliciting the same responses to expected and unexpected target words, meaning each provide associative expectancies (Koelsch et al., 2004). Many similar studies have found that unexpected auditory events elicit a cognitive response in both language (Besson, Faita, Czternasty & Kutas, 1996; Besson & Faita, 1995; Friederici, 2002) and music (Koelsch, 2009; Koelsch, Gunter, Freiderici, & Schroger, 2000; Saarinen, Paavilainen, Schöger, Tervaniemi, & Näätänen, 1992).

A language study using EEG again revealed that pauses are expected to belong at certain points in speech: During the speaking and reading of both familiar and unfamiliar proverbs it was found that, even in unfamiliar proverbs, participants still elicited larger responses from the unexpected delays (of 600ms). This implies that features such as syntax, grammar, and context play an important role in guiding a listener's expectations (Besson et al., 1996). These results further suggest that while listening to any stimulus, individuals are constantly categorizing and analysing in a constant effort to predict the next event, be it sounds or silence, and furthermore, that those expectancies at least in part draw upon implicitly learned LT knowledge.

Functional magnetic resonance imaging (fMRI) has also revealed that unexpected silences (appearing as embedded moments in familiar songs) can activate the auditory cortical region: It was found that heightened activity in the cortex correlated with the song's familiarity, as well as with lyric content (Kraemer, Macrae, Green, & Kelley, 2005). It was suggested that the resulting activity might have been present because participants often reported reacting to the unexpected silence by imagining the missing musical content (Kraemer et al., 2005). This action could have been spurred on by a cognitive desire to again hear the most probably outcome, or as a way of better predicting what to expect should the music return. The cause of these resulting cognitive activations found during the silences may even parallel the underlying reason for spontaneous activity in the auditory cortex, i.e., *auditory hallucinations* (as described by Hunter et al. 2005). Perhaps auditory activity in the moment of silence is a subconscious testing method to rehearse previously heard sounds so that they become familiar and therefore less surprising if heard again in the future, providing better knowledge for future expectancies.

Furthermore, evidence indicates that the learning of schemata in one sensory domain may influence schemata in others. For example, the rhythmic patterns in spoken French and English have been shown to individually correspond to rhythmic patterns in French and English music, and share prosodic features when comparing stress-time and syllable-timed languages by use of comparing vowels to musical tones (Patel & Daniele, 2003). It was similarly found that Japanese speech resembled traditional Japanese music (Malm, 1986). However, others argue that the difference between rhythmic stressing in the cultures' respective musical styles resulted from vowel usage—which may vary between language types (Grabe & Low, 2002)—and/or from the quantity of consonant groupings (Ramus, Nespor, & Mehler, 1999). Yet, the overlapping of schematic qualities from different activates may be a result of the overlap in cognitive real estate, as it has been shown that music shares many of its neural networks with other activities such as speech (Besson, Chobert & Marie, 2011; Moreno et al., 2009; Patel, 2014).

Comparable, or even shared, schemata have also been found between auditory and motor tasks: Musical *ritardandi* have been found to correlate to the rate of the deceleration when runners come to a stop (Friberg & Sundberg, 1998). Such a finding may imply a pre-existing familiarity from one source as creating a template of expectation for the other; conversely, it may reflect an underlying and innate set of expectancies surrounding any type of rhythmic attending. Therefore, individuals might provide similar motoric responses to any temporal event, regardless of the sensory domain.

2.4 The *dynamic attending theory* (DAT)

It is argued that music listening not only utilizes LT knowledge, but also involves finding patterns in localized temporal information guided by the WM, through an occurrence called *entrainment* (Koelsch & Seibel, 2006). The DAT was proposed to describe the effects of entrainment to local on-going events on attention, memory and expectation (Jones, 1976). It was suggested that different modes of attending occur depending upon the focus of the individual, altering expectancies based on the occurrences and patterns within local events (Jones & Boltz, 1989). Therefore, as individuals become entrained (or synchronized) with a temporal stimulus such as audio, they develop expectations based on the patterns perceived from the stimulus, and may weigh greater significance towards events that normally would not be considered as important.

This is similar to how ASA operates, where importance is given to patterns found in local events, described as the "cumulative effects in sequential grouping" (Bregman, 2007, p. 865). Bregman describes the phenomenon:

> It is as if the ASA system kept a record of "evidence" from the recent past, and strengthened the tendency to form a stream defined by a narrow range of acoustic properties, when newly arriving frequency components fell repeatedly within that range. (p. 865)

Hence, the occurrences of ST patterns may greatly affect the interpretation of an audio signal or signals. Thus, low-level features such as rhythmic grouping and the regularity of pulse, may not only alter a listener's understanding of the audio source and texture, but also may cause the listener to develop different expectations, and therefore preferences.

The perceptual influences—caused by tracking confined serial relationships—are found also in non-auditory stimuli. One popular example is the phenomenon *gambler's fallacy*, which causes statistically independent events to be mistakenly perceived as dependent on one another. Consequently, if an individual were to find an arbitrary pattern in a sequence of independent events, it may result in the individual mistakenly believing that the pattern could then be used to predict future independent events. Barnes and Jones (2000) argue that these low-level pattern-based features have a greater influence on listeners than do high-level statistical-learned concepts. Barnes and Jones further note that the phenomenon is more evident with temporal events, as individuals react dynamically to their environments.

Various studies provide evidence of rhythmic entrainment and its effects through cueing and tapping experiments (Barnes & Jones, 2000; Clayton, 2007; Phillips-Silver et al., 2010; Jones & Boltz, 1989; Large & Jones, 1999, McAuley, 1995), and through full body synchronizing tasks geared towards spontaneous movement to music (Burger, Thompson, Luck, Saarikallio, & Toiviainen, 2014; Toiviainen, Luck, & Thompson, 2009). Findings support that musical stimuli and metrical patterns provoke continuous real-time responses and expectancies from individuals based on the dynamical changing environment.

Stimulus entrainment appears also to affect physiological systems: Haas, Distenfeld, and Axen, (1986) found that individuals' breathing rates were affected after five minutes of either tapping along to a metronome or musical stimulus. This finding indicates that rhythm significantly affects entrainment during music listening. Haas et al. further noted that, while many participants' breathing rates were affected, that those affects indeed differed among participants. This further alludes to a high diversity between individuals. Thus, while everyone succumbs to the effects of pulse and rhythm, they express it differently.

Similarly, contextual manipulation of a temporal stimulus has been shown to affect the awareness of musical pauses. Margulis (2007a) reported that when a 500 ms acoustic silence was included amongst notes lasting 500 or 1000 ms that listeners reported hearing a silence 92% of the time. Yet, when the same 500 ms acoustic silence was embedded between notes lasting 200 ms, listeners reported only perceiving a silence 14% of the time, and otherwise understanding the silence as belonging to the previous note creating staccato articulation. Hence, when silence is short enough in relation to the relative sounds, it is heard as rhythm, and awareness of it is relative to the surrounding context. This confirms the statement by Barnes and Jones (2000), that "moment-to-moment attending to events such as speech and music is controlled, in part, by their relational properties, e.g., rate and rhythm" (p. 261), as it demonstrates how listener synchronizes with an on-going metrical structure, consequently affecting the perception of silences. Furthermore, this study highlights how tempo could play an important role in the listener's perception of a pause.

EEG studies have also been used to support rhythmic implementations of the DAT by employing the *oddball* paradigm, i.e., using a deviant oddball stimulus in a repeated stream of otherwise standard events. Zanto, Snyder, and Large (2006) used silence as the oddball in a stream of sounds and found that the silences did indeed elicit responses. The tracking of local temporal events meant that the absence of one event in a stable sequence invoked surprise. Certainly, this supports the notion that the absence of an event may alter a listener's attention, causing them to refocus or to become alert, because it implies that the situation is changing, and change is what alerts surprise. However, not all silences are surprising.

Phrase endings—which must virtually always be followed by a silence to denote the ending—have been found to be predictable, and people have been found to easily predict when a spoken utterance will end, despite not always knowing the speakers native language (Huron, 2006). EEG studies often use full sentences and melodies as a baseline, because they contain no oddball deviation: This implies the conclusion of the phrase is not considered wholly unexpected. Hence, pauses do not necessarily provoke listeners to elicit surprise. This is interesting as it again implies that, even in regards to the DAT, a silence may appear as either unexpected or expected depending on its location.

2.4.1 Influence of low-level musical features: metre; BPM; and pulse clarity

Tse, Intriligator, Rivest and Cavanagh (2004) reasoned that the perception of duration could be influenced and distorted by the individual's attentional orientation. Tse et al. found that events occurring later than expected (i.e., later than the previous events in a given sequence) were perceived as lasting longer. McAuley and Fromboluti (2014) obtained similar findings using the oddball paradigm. McAuley and Fromboluti found that, depending on the deviant's relationship to the strong beat, participants perceived it as lasting different durations. These experiments indicate that individuals give increased attention to more expected events and that those expectations develop from repeating patterns. This implies that individuals may develop expectations for the duration of a pause based on the metre.

Logically, the attendance to a metre relies on how perceivable that metre is: "The sensation of pulse may be the essential factor distinguishing musical rhythm from nonrhythm" (Parncutt, 1994, p. 409). Therefore, in tracking the metre, the pulse clarity can be expected to affect the judgement of the listener in a localized manner. Furthermore, it has been found that clearer pulses react with the entire body (Burger, Thompson, Luck, Saarikallio, & Toiviainen, 2013) and that beats which follow a clear reoccurring pattern are easier to track and attend (Jones, Johnston, & Puente, 2006; Repp, Iversen, & Patel, 2008). Consequently, it may be expected that ST expectancies will be expressed more strongly in music with a higher degree of pulse clarity, because in such music the underlying metrical patterns are clearest.

Tempo is another fundamental aspect of the metre, which may alter entrainment, and therefore similarly alter preferences and perceptions of pause durations. Evidence indicates that individuals respond better within a certain tempo rate: Parncutt (1994) asked participants to tap the beat guided by a cyclic rhythmic pattern at different tempi from which measures of perceptual salience of the beat were taken. Responses tended towards a pulse period of 600–700 ms, although agreement of the actual underlying beat in a rhythmic sequence tended to be quite uncertain: Only did participants more often agree on beat location on longer rhythmic features in rhythmic sequences of faster tempi. Parncutt's findings agreed with a quantitative model on beat salience, as he found that the pulse appears most salient when occurring at approximately 100 BPM. Thus, it may be expected that tempo will be a significant factor in participants' choices for pause durations: It could be expected that individuals may respond better to tempi that are neither too fast nor too slow.

2.5 Expected findings and potential influential factors

The question to be addressed is what causes the greater influence on a pause: Is it the reliance upon LT probability or the influence of ST sequences? Some difficulties may arise when answering this question since both theories can be proved by the same data. For instance, both LT and ST expectancies support a preference for the strong beat in a meter. A *goodness of fit model*, i.e., testing the preference of certain values in a sequence, showed that Western schemata displayed hierarchical preferences for tones that fell on different beats. Preference was given to those that occurred on the strongest beat, then on lesser beats, then on half-beat divisions, and least favoured were those that did not coincide with any beat (Palmer & Krumhansl, 1990). This is consistent with alternative findings that are used to support the DAT, which similarly noted that listeners' attention was most acute during strong metric locations during stimulus-driven attending involving temporal expectancies (Jones, et al. 2002).

While there may be some similarities between LT and ST expectancies, it could be posited that if participants follow primarily localized information, then all participants will treat the pause approximately the same and display a high awareness of low-level features such as metre, BPM, and pulse clarity. Whereas if familiarity plays the primary role in music listening and attending, then it could be expected that participants' responses and choices for both the creation and the perception of pauses will be more greatly affected by their individual background, displaying affects from previously learned schemata. Similarly, it is conceivable that those more familiar with the tracks will be more accurate in recreating the duration of the original pause, because the familiarity with the original guides their actions more than any localized information. Moreover, Huron (2006) indicated that the extending of temporal space, such as with a pause, often occurs towards predictable points in the music, such as at phrase endings. The delaying of the inevitable is a way of prolonging a sense of tension and results in contrastive valence when the predicted sound finally returns. Thus, it should be that participants most familiar with the musical excerpts might even prefer the surprise of longer pauses when indicating ratings of musicality.

2.5.1 Influence of musical training

Neuroimaging studies have found that cognitive activity differs between musicians and non-musicians during music listening (Parsons & Thaut, 2001) and in response when listening to pitch and rhythm violations during familiar and unfamiliar musical excerpts (Besson & Faita, 1995). Generally, it is recognized that, “musical training seems to lead to more efficient and more refined processing of auditory temporal patterns” (Jongsma et al., 2005, p. 199). Compared to non-musicians, musicians have been shown to produce less variability and fewer anticipation errors when synchronizing tapping to inter-onset intervals between 1000 and 3500 ms (Doggett & Repp, 2007), as well as a greater discernment when perceiving accents of metre among hierarchical levels of accent strengths (Palmer & Krumhansl, 1990). Furthermore, the level of musical training has shown corresponding levels of responsiveness to rhythm: Musicians trained from an earlier age were found to be better at recreating a temporal rhythmic structure than those who began training later in life (Bailey & Penhune, 2010).

These differences between musicians’ and non-musicians’ responses to rhythmic aspects of music may partly arise from a difference in motor skills rather than in cognitive awareness. Regardless, if the metre is important in the duration of a pause, then there is reason to believe that musicians will display greater adherence to the beat. Should this be the case, it may indicate that musicians’ involvement with the metre is a result from LT familiarisation, because they are trained to be more conscious of such temporal events. However, since LT familiarity results from mere exposure it should mean that non-musicians would also tend to observe the pulse. Alternatively, attention to the metre may also result from the tracking of ST features, as individuals will most likely notice and entrain to the same underlying localized patterns. Therefore, it could be expected that both musicians and non-musicians will attend to the metre, and musicians will be more accurate in displaying this attention.

McAuley and Semple (1999) asked participants to tap to a variety of rhythmic patterns at different tempi, and found that musicians and non-musicians differed in how they perceived the strong beat: Compared to non-musicians, musicians' choices varied more when selecting the pulse. This study indicated that musicians are more inclined to perceive a protracted pulse, which encompasses more rhythmic patterns per beat, whereas non-musicians more often focus on a shorter time-scale, allowing each note act as an important metrical event. McAuley and Semple point out that a surprise, i.e., a deviation from a pattern, is "often the intent of the performer or composer… but in other instances of temporal tracking, it is better not to be surprised" (p. 187). For this reason, it is possible that pause expectations will change depending on types of listening. Therefore, when creating a pause, participants may be likely to attend to the local temporal patterns, continuing with the expected temporal events, whereas when assessing the musicality of tracks, they may be more inclined to prefer excerpts with unexpected surprising pause durations.

Moreover, it has been found that the amount of musical training alters an individual's internal natural tempo. Increased musical training slows the average spontaneous tapping rate, and improves attunement (that is the ability to synchronize and discriminate tempi), as well as improved focal attending, e.g., found that musicians displayed a greater range of tapping rates and hierarchical levels than non-musicians (Drake, Jones, and Baruch, 2000). Similarly, it was found that age correlates with the spontaneous tapping rate of individuals, i.e., younger individuals tap faster while adults prefer slower tapping rates (Baudouin, Vanneste, & Isingrini, 2004). Additionally, age correlates to response time to faster and shorter language, i.e., young participants synchronize better with faster rates (Drake et al., 2000; Provasi & Bobin-Bègue, 2003), adults' memories for heard information benefit when speech rates are slower (Holland & Fletcher, 2000), and older adults prefer slower speech utterances than younger adults (Sutton, King, Hux, & Beukelman, 1995).

For these reasons, it may be expected that those with more musical training will perceive larger metrical structures, and be more accepting or prefer longer pauses. Additionally, it may be that musicians show greater accuracy or ability for locating the metrical beat. However, since these findings allude only to metrical features that could develop from localized or LT knowledge, it will be difficult to assess whether their actions result from LT or ST sets of expectancies.

2.5.2 Influence of personality: extraversion and introversion

Personality is a complex concept, and so this study shall focus specifically on how individuals interact with a stimulus by measures of *extraversion* and *introversion*. These categories were established to describe how an individual interacts with the surrounding world: Extraverts are considered responsive and interested by external objects, as they show greater attention and awareness to the external stimuli (Jung, 1917, as cited by Kaufman, trans. 2015), while introverts are considered as being indifferent towards the rewards of the world (Nettle, 2007). Hence, since levels of extraversion appear to reflect levels of interactions with external stimuli, such personality traits could parallel how an individual may respond to surprise.

Huron (2006) states that three responses—to *fight*, *flight*, or *freeze*—depict the natural reactions to surprise (i.e., when predictions of the future are found to be inaccurate). Huron suggests that when surprise occurs, but there is no real threat, each response will convert into a sensation: to fight results in chills; to flight (or flee) results in laughter followed by a gasp; and to freeze results in awe. Huron explains that the fight response is gaining the most command of the situation, and along with flight, is considered an active response, which suggests a level of interactivity from a situation, or extraversion. However, Huron describes freezing as a passive response, reflecting a loss of command, which may be considered as not fully interacting with the surroundings and therefore potentially the response of an introvert.

The enjoyment of music has often been related to the sense of chills, or frisson (Blood & Zatorre, 2001; Grewe, Nagel, Kopiez, & Altenmüller, 2005; Panksepp, 1995; Plazak, 2008; Sloboda, 1991). If these sensations result from interaction and awareness of external stimuli, could it be that extraverts are more likely to experience them. Furthermore, if chills result from unexpected events, then when a pause is different from the original it could be that extraverts show a greater preference towards it. If this is the case, then it may be that extraverts will prefer non-original stimuli when listening to musical excerpts.

The behaviour of extraverts and introverts is often associated with talking, and it is commonly stereotyped that extraverts talk more. Crown and Feldstein (1985) questioned whether introverts and extraverts exhibited different linguistic stereotypes by examining speech rate and pausing. They considered an assortment of experiments, and determined that silence is perceived and utilized differently depending on the personality and culture of a conversational pair. Furthermore, the studies exposed that alongside levels of extraversion, differences in race and gender affected how participants "paced their sounds and silences" (p. 35). Thus, stereotyping may reflect some truth, as it often appears that while introverts do occasional talk continuously, it occurs more frequently with extraverts (Nettle, 2007). Thus, if preference of a pause reflects the stereotypical traits of a personality type, then it would be that introverts might tend to create longer silences in the conducting experiment, while extraverts will conduct shorter ones.

Crown and Feldstein (1985) also found that individual traits, like extraversion, race, and gender, affected how positively or negatively silence-usage was perceived, which they suggest may have resulted from the population studied. This particular finding heavily implies that how silence is perceived and used is learned in conjunction with language and culture. Therefore, it may be anticipated that if the data gathered reflect strong differences between introverts and extraverts, this may reflect a LT expectation for them to act in such a manner, and therefore support the notion that LTM is the dominant factor governing participants' choices.

2.6 Research question

Previous research indicates that the musical pause is an important tool for enhancing the auditory composition as well as for studying auditory perception. Yet it is unstated, how long is an optimal musical pause? The preference for different pause durations may provide insight as to how individuals create expectations when listening to music because it appears that individuals show a preference for familiar stimuli that they can predict (Pratt & Sackett, 1967; Harrison, 1968; Meyer, 1903; Zajonc, 1968). By asking participants to assess preference for different types of musical pauses, it may be possible to recognize whether LTM or WM is more important when listening to music. Insight shall be inferred through examination of the effects from either LT familiarity with the music and from ST low-level features within the music. Alongside which, attention will be given to the impact of musical training, and levels of extraversion.

To achieve these goals, and to gather contrasting and complimentary data, two experiments were created. The first requested that participants create a musical pause between two phrases, thus ensuring a dynamic interaction with the stimulus comparable to the perception of either a performer or conductor. The second experiment requested that participants respond (by rating the level of perceived musicality) after listening to an excerpt. This was intended to encourage reflective listening, analogous to how music is perceived by the average listener, such as an audience member.

Results from both experiments were then considered in combination to assess the influence of ST low-level features, LT familiarity, and traits pertaining to the individual (i.e., musical training and levels of extraversion). Additionally, the results were also contrasted, to assess whether there is some difference depending on the listening approach. Potentially, interactive experiences such as creating music may better reflect ST influences, because individuals may undergo a higher degree of entrainment when actively attending to the stimulus. However, reflective listening may allow for a greater influence from LT influences, because the entrainment process may weaken where there is less pressure to interact with the stimulus, and the lack of control of events may require the listener to rely more on LTM.

3 METHODS

The two-part experiment was created online at *spaghetticode.net/fmb*. It was available to take over the course of approximately four months, and was advertised through various social networks and by word of mouth. A username was requested upon entry to the site, allowing participants to do the two experiments on different occasions. The experiments were labelled *conducting experiment* and *critiquing experiment*, and could be taken in any order. Participants were also asked to complete a demographic survey and the *ten item personality index* (TIPI) taken from Gosling, Rentfrow, and Swann, (2003) (see appendix 1). These data were gathered to allow for a comprehensive analysis of the pause durations in relation to localized factors such as track tempo and pulse clarity, as well as to LT factors such as the participants' personality, musical training, and listening habits. A comments section was also included at the end of each experiment, which allowed participants to voice any concerns or opinions.

Of 31 participants, three did only half of the experiment and hence shall be excluded. The remaining 28 participants (16 male) were mostly between the ages of 25 and 34, eight were 24 or younger, and the remaining five were 35 or older.[1] The survey data revealed 14 musicians: Participants were considered a musician if they had played an instrument 10 or more years or if they had ever played an instrument for three or more years and were currently actively playing. The TIPI provided a 7-point measure of extraversion (M = 3.73, sd = 1.64). Participants who scored 5.5 or more, where categorized as *extraverts* (n = 5), while those who scored 2.5 or less, where considered *introverts* (n = 8). Participants primarily came from Ireland (n = 9) and Finland (n = 8), as well as Australia, China, Germany, Greece, Netherlands, and the UK. However, the majority of participants resided in Finland (n = 15) and Ireland (n = 7), as well as Australia, Germany, Netherlands Spain, the UK, and the US.

[1] Participant ages were asked in categories: 12 or less; 13–17; 18–24; 25–34; 35–44; 45–54; 55–64; 65–74; 75 or more

3.1 Conducting Experiment

The conducting experiment comprised of a series of 10 tracks, each containing two phrases. Participants were asked to time the entry of the second phrase after the first had ended, thereby creating a pause of whatever duration that they found to be the most appropriate.

3.1.1 Stimuli

The 10 tracks used in this experiment (listed in Table 1) were selected from a range of classical, folk, rock, pop, metal, and dance genres. Excerpts, lasting between 15 and 36 seconds, were taken from each track to encompass a transition between two phrases. Eight of these excerpts included an audible pause already within the recording, while the remaining two (*Brian Boru's March*, and *Etude op. 21, no. 10*) were selected to include a point between phrases where a pause could technically go.

Excerpts were then analysed using *Audacity 2.0.6*. The built-in features, *Silence Finder* and *Sound Finder*, were used at default settings to automatically locate the perceivable pause boundaries. These locations were then considered as the end and start points of phrases *A* and *B* respectively, and any silence between the phrases was removed. To facilitate the most natural sounding break between phrases, a fade out of no more than two seconds was added when necessary to the end of phrase *A*. Finally, the excerpts were normalized to maintain an equal balance of loudness. A three second fade in and fade out were also included at the very start and very end of all excerpts.

Table 1: List of tracks used in conducting experiment. * indicates those tracks with no original pause.

Composer / Artist	**Title**
Franz Ferdinand	*Take me out*
LaBouche	*Be my Lover*
Led Zepplin	*Tangerine*
D. Shostakovich performed by Royal Scottish National Orchestra. Conducted by Neeme Järvi	*Polka From Ballet Suite no.2*
Deathlike Silence	*Nosferatu*
Alanis Morissette	*All I Really Want*
H. Duparc, sung by Kiri Te Kanawa	*Le Manoir De Rosamonde*
The Chieftains	*Brian Boru's March**
Buddha Surfers	*Ugh! We Come in Peace*
F. Chopin, performed by Vladimir Horowitz	*Etude op. 21, no. 10**

The low-level musical features were assessed using *MirToolbox* in *Matlab 2014a*. The function *MirPulseClarity* was used on phrase *A* of each excerpt to assess how clearly and regularly the beat occurred—i.e., how perceptually clear was the metre or pulse—up until the pause. It was decided that excerpts scoring less than .25 on this scale would be labelled as having *unclear pulse clarity*, while excerpts .25 or higher were considered as having *clear pulse clarity*.[2]

The BPM were initially taken from the *MirToolBox* feature *MirTempo*, as well as from *Audacity's BeatFinder*. The automated BPM were then confirmed, or altered, based on the measurements taken from two independent raters, who each responded to the stimuli using online beat tracking software (Reel, 2011). For the majority of pieces, measurements were consistent, and required little or no adjustment. However due to rubato or an unclear pulse, some excerpts' BPM required further consideration and comparison with additional sources, i.e., referring to tempo markings in original scores, and comparing that BPM to an online source that provides the tempi of various songs (Songbpm, 2016). Of these excerpts, the primary issue regarding the BPM was having all sources agree on a scale. For instance,

[2] This threshold meant that *Take me out* had a clear pulse clarity, while *Manoir de Rosamonde* had an unclear pulse clarity.

Nosferatu was recognized by *MirTempo* as approximately 123 BPM, from online sources as 125 BPM, and by raters as 83 and 72 BPM. Ultimately, 62 BPM was selected as a way of compromising between computerized sources, which agreed on the regularity of the pulse, and the human sources, who perceived the beat as being slower.

When all the BPM were selected, the excerpts were divided into three groups of *slow*, *moderate*, and *fast* tempi, which respectively represented excerpts of less than 90 BPM, excerpts between 90 and 130 BPM, and excerpts over 130 BPM (based on these categories, the conducting experiment included no fast excerpts). In addition, the length of the pause extracted could then be calculated in beats by dividing the pause duration (in seconds) by the BPM divided by the amount of seconds in a minute, as shown in Equation 1. Measuring the pause in both absolute seconds and in beats thereby allowed for an analysis on the exact duration of participants' pauses as well as its relationship with pulse and tempo.

Equation 1: To find the ratio length of pause compared to beat (*RL*), where *P* is the duration of silence in seconds and BPM is the beats per minute of the piece.

$$RL = \frac{P}{(60/\mathrm{BPM})} \tag{1}$$

3.1.2 Experiment design

Participants were given an overview of the experiment upon entering the platform. For each excerpt they had to conduct, they first listened to its parts, *A* and *B*, at least once. After this familiarisation process, participants then proceeded to indicate where *B* should begin after *A* had ended. This section of the experiment was navigated using the spacebar, which on the first press would begin track *A*. When *A* was finished playing, pressing the spacebar again would then play track *B*. The duration created between the phrases was recorded.

After each of the 10 conducting tasks, participants were requested to listen to the full excerpt of what they had created, and select whether they were "happy" or "unhappy" with it. This gave an indication whether or not the result effectively matched the intended desired effect. Additionally, participants were asked to rate on a 5-point Likert scale how musical they considered their conducted excerpt to be (1 = not musical; 5 = very musical), and how familiar they were with the music from which the excerpt was taken (1 = not familiar; 5 = very familiar). The whole experiment took approximately 30 to 40 minutes to complete, and was followed by the demographic survey.

3.2 Critiquing Experiment

The aim of the critiquing experiment was to measure how listeners considered three durations of pauses: no pause, an original pause, and a longer pause. Results were intended for comparison with data gathered from the conducting experiment.

3.2.1 Stimuli

Eleven tracks (listed in Table 2) were selected from a range of classical folk, rock, pop, metal, and dance pieces. Excerpts, lasting between 17 and 45 s, were taken from each track to include a transition between phrases. Of these, nine already utilized an audible pause, while the remaining two (*Black Friday Rule*, and *Hungarian Rhapsody no. 2, part 1, "Friska"*) included a transition where a pause could technically go. As in the conducting experiment, *Audacity 2.0.6* was used to select the excerpts and prepare them with the appropriate fade-outs etc.

To make multiple excerpts with a variety of pause durations, each of the excerpts were duplicated twice and the pause between them altered. For those excerpts that already included an original pause, the altered versions included a shorter *Cut* (C) version of the track, which removed the pause totally, and a longer *Double* (D) version of the track, which doubled the pause to be was twice as long as the original. These were included in the experiment alongside the *Original* (O) duration. Excerpts with no pause between phrases were named *Short* (S) to distinguish them from C excerpts. S excerpts were altered by embedding a pause between the phrases of both one and two beats, naming those excerpts *Medium* (M) and *Long*

(L) respectively. This was done in an effort to create seemingly equivalent excerpts as a comparative measure. However, due to the complicatedness of the idea these excerpts will not be used in the manner originally intended, but will still be included in some of the analysis.

In an effort to ensure that each of these excerpts were comparable, all locations with a pause were cut, removing any potential background noise, and replaced with silence of 0 dB (i.e., so that no audio signal could be detected). The removal of background static was done as subtly as possible, and longer fade-outs were added in track where necessary to ease the listener to absolute silence as best as possible. Only in the track, *Take me out*, was an actual gasp removed because its inclusion confused the return of the phrase in relation to the beat.

Table 2: List of tracks used in critiquing experiment. * indicates those tracks with no original pause.

Composer / Artist	**Title**
Yngwie Malmsteen	*Braveheart*
H. Duparc, sung by Kiri Te Kanawa	*La vie Antérieure*
Whitney Houston	*I Will Always Love you*
X-press 2 ft. David Byrne	*Lazy*
King Crimson	*21st Century Schizoid man*
F. Liszt performed by György Cziffra	*Hungarian Rhapsody no. 2, Part 1, "Friska"**
L. V. Beethoven, performed by Alfred Brendel	*Piano Sonata no. 21, op.53, "Waldstein"*
MeNaiset	*Kuulin Äänen*
The Doors	*People are Strange*
C. Debussy, performed by Orchestre National De L'O.R.T.F. Conducted by Jean Martinon	*Prelude to the Afternoon of a Faun*
Flogging Molly	*Black Friday Rule**

As in the conducting experiment, excerpts were analysed to select the most appropriate BPM, which again caused agreement and scaling problems resolvable only through compromise. For example, while *21st Century Schizoid man* appears in online sources as 142 BPM, whereas raters marked as 72 and 74 BPM. Therefore, the final selection was 71 BPM.

Excerpts were then labelled based on the previous tempi and pulse clarity categories. Finally, the silence in beats was again calculated for each of the excerpts using Equation 1.

3.2.2 Experiment design

The experiment consisted of the 33 excerpts (each containing varying degrees of pause durations), which played only once each in a random order. To proceed through the excerpts, participants had to rate on 5-point Likert scales, how musical they considered the excerpt (1 = not musical; 5 = very musical), and how familiar they were with the music from which the excerpt was taken before hearing it in the experiment (1 = not familiar; 5 = very familiar). The experiment took approximately 30 minutes to complete, and was followed by the TIPI.

4 RESULTS

Data were extracted using scripts, created in *Matlab 2014a*, written to convert the collected data into tables. These were then imported to *R* (in conjunction with libraries *circular*, *lmtest*, *pracma*, *psych*, and *stats*) for analysis (see appendix 2 for track details).

4.1 Conducting experiment results

4.1.1 Duration

First measured was an average duration for the *splits*, i.e., the pauses created by the participants. Splits were divided into groups of *approved* and *unapproved*, respectively denoting those splits with which participants were "happy" or "unhappy".[3] This was chiefly done in an effort to remove any potential error caused by the online platform (e.g., lag).

Using only approved conducting data (n = 166), the average split was found to be 0.87 seconds (sd = 0.63; range = 0.060–3.80), or 1.37 beats (sd = 1.05; range = 0.083–6.59). Figure 1 and Figure 2 display both the approved and unapproved splits in seconds (s) and beats (b) respectively (each bin is equal to a quarter of a measure). It can be seen that the mode of approved splits occurs at 0.50 s or 0.75 b, while the bulk of the splits occurs between 0.25 and 1.25 s, or 0.50–1.50 b, which could be viewed as one to three beats, depending on how the pulse was perceived. However, based on these measures of BPM, it was noted that 75% of approved splits did not exceed 2 b, while 92% did not exceed 3 b.

Both Figure 1 and Figure 2 also indicate that the majority of unapproved pauses occur within the same bulk of the approved splits. In fact, although more unapproved splits were longer than approved ones, nearly 75% of the unapproved splits also occur within the first two beats, and 90% were fewer than three beats. Additionally, more unapproved pauses occurred in the first quarter of a second or half a beat. The average unapproved pause lasted 1.02 s (sd = 1.17, range = 0.010–7.76), or 1.58 b (sd = 1.78, range = 0.013–13.5); although, these data have a positive skew, because the mode actually occurs at approximately 0.25 s, or 0.50 b.

[3] The median and mode musicality rating on "happy" approved splits were both 4, while the median and mode rating on "unhappy" unapproved splits were both 2.

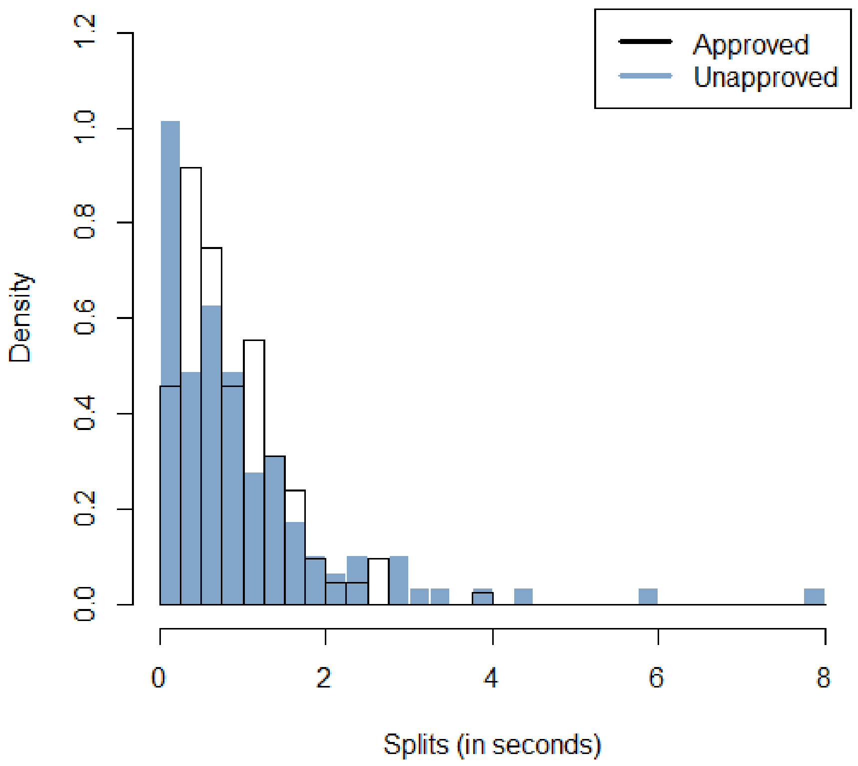

Figure 1: Density plot, in seconds, displaying all approved and unapproved splits (bins = 0.25).

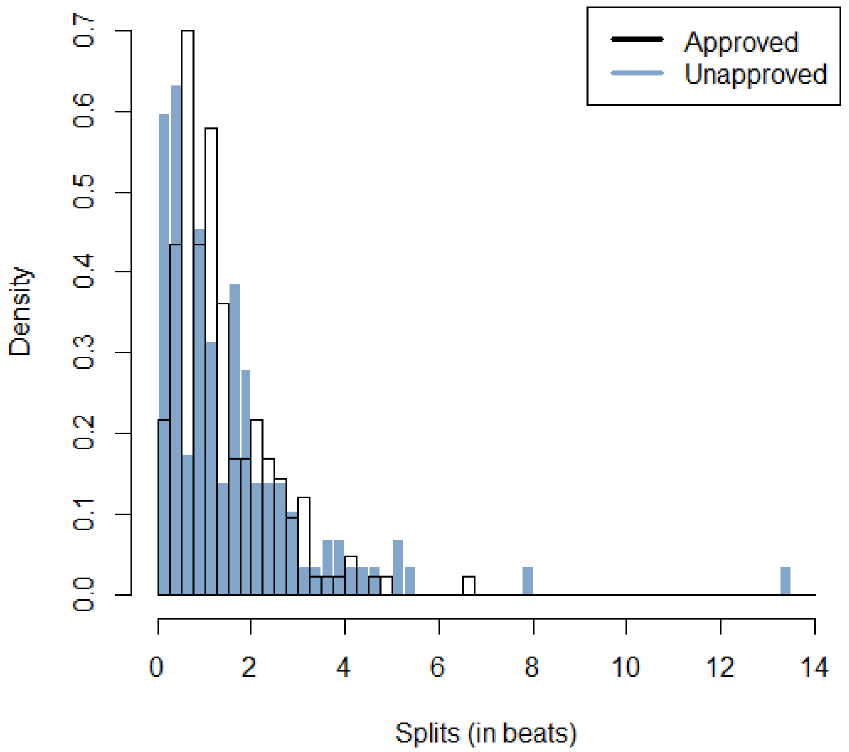

Figure 2: Density plot, in beats, displaying all approved and unapproved splits (bins = 0.25).

4.1.2 Low-level features

To find if splits showed any relationship to the stronger beats, a circular analysis was done by mapping the splits as beats around a single beat using modulo one. Figure 3 displays the results for both the approved and unapproved splits: Data are split into eights and points closest to 0, 1, or .50 may be considered as coinciding with a strong beat. What is most notable is the distribution of the splits: Although some agreement occurs at certain points, the data spread quite uniformly across the beat. There is no clear indication that splits were made to occur on the stronger beats, as the data occurring around 1 is more often unapproved than approved. Furthermore, the peak of both approved and unapproved splits occurs at .20 b (one-fifth of a beat).

Instead, to gauge an internal relationship the peaks from Figure 3 were considered in relation to one another. It appeared that approved phrases returns primarily .25 b (one-quarter of a beat) apart (or three-quarters, depending on the direction), whereas the unapproved peaks are roughly .55 b (eleven-twentieth of a beat) apart (or nine-twentieths depending on the direction). A Rayleigh Test of Uniformity was done to find if there was any regularity in the splits, however it did not reach significance ($z = .080$, $p = .35$), meaning there were no points of agreement regarding the use of metre as a reference for the duration of a pause.

To consider if the actual length of the splits may have altered the relationship to the metre, the peaks from a density estimate of the data were plotted. As can be seen in Figure 4, it appears there was some regularity between the splits, as they do often occur quite close to the half beat. By using this approach, the average of the difference amongst beats was found to be .67 b ($sd = .46$) and the median to be .55 b (mad[4] = .07), suggesting some effort was perhaps made to relate to the beat or half beat, but that the relationship deviated over time. This may explain why the circular analysis gave no clear results.

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[4] Median absolute deviation

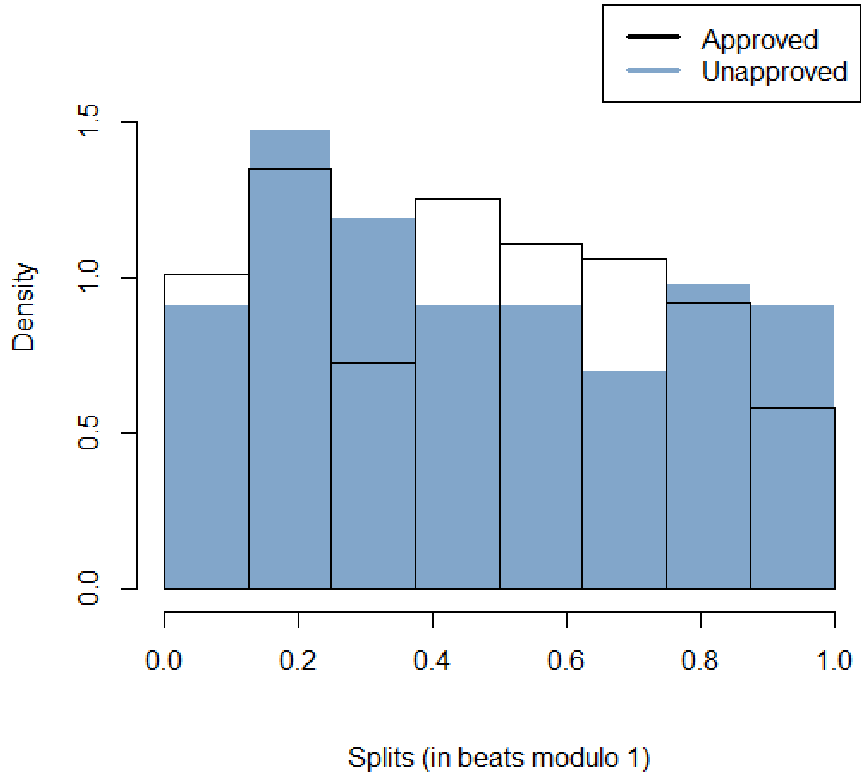

Figure 3: Density plot, in beats, displaying all approved and unapproved splits in relation to a single beat (bins = 0.80). The points 0 and 1 along the X-axis represent the strong beat.

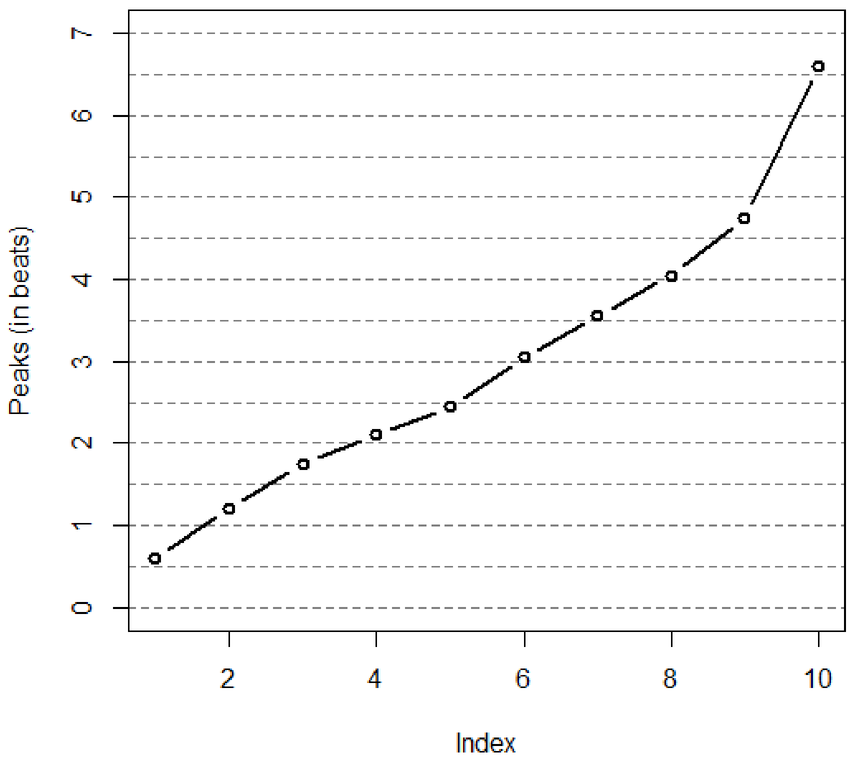

Figure 4: Plot displaying peaks taken from the density estimate, in beats, denoting points of agreement for splits from all participants (bandwidth = 0.20; temporal resolution = 0.050 b).

Next, to examine if the clarity of metre had any influence on participants' splits, the data were separated into groups of those with *clear* (n = 109) and *unclear* (n = 57) pulse clarity. It could be expected that excerpts with unclear pulse clarity would result in a greater variance of splits than those with clear pulse clarity. This was tested by first using a Wilcoxon signed-rank test with continuity correction, finding that the means of these two groups were similar (V = 3234, p = .67). Therefore, a Kolmogorov-Smirnov test was done to check if there was a difference between the distributions; however, no significant difference was found (D = .10, p = .89).

These results are visible in Figure 5, which shows that the cumulative density of splits from both groups to be roughly the same; the primary difference is that excerpts with unclear pulse clarity included an insignificant number of slightly longer splits. However, to test if there was a relationship between variance of the durations and the pulse clarity, a non-parametric test was also done on the data (because grouping data to test differences does not assume a linear relationship). A Breusch-Pagan test on the approved uncategorized data similarly found no significant relationship, $X^2_{BP}(1, N = 166) = 2.72$, p = .10.

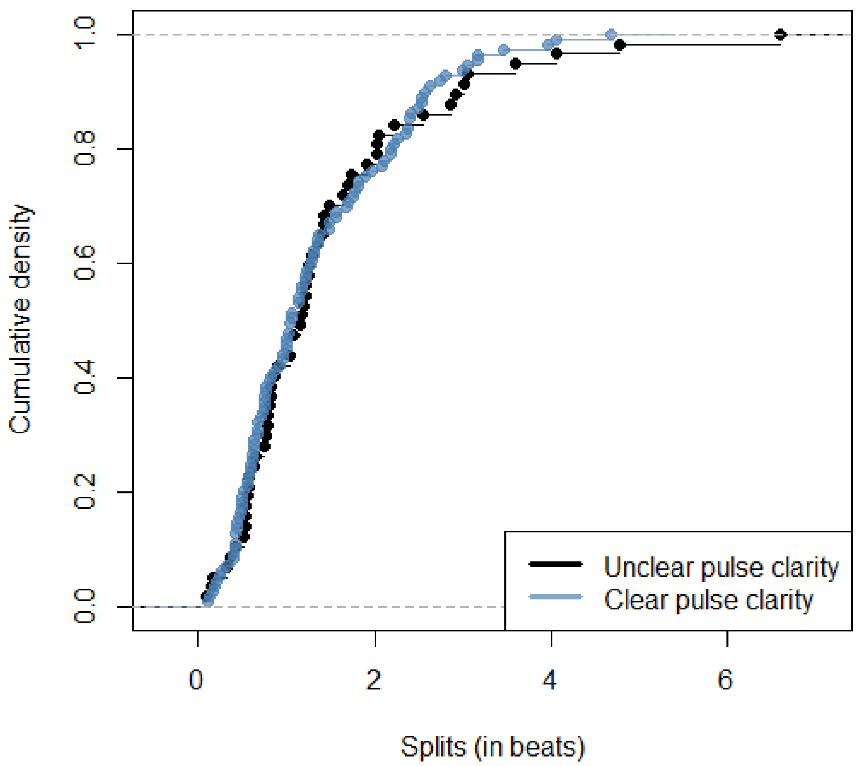

Figure 5: Cumulative density plot, in beats, displaying the association between pulse clarity and splits for all approved and unapproved data.

Next, it was considered how tempo might have influenced the data: It was expected that excerpts with faster tempi would result in shorter splits in seconds but in equal splits in beats. To test this, the data were grouped into slow and moderate tempi and analysed using the measure of absolute seconds. A Wilcoxon rank sum test with continuity correction was done, which found a small, but not significant, negative shift in location between the slow and moderate tempo groups, $W = 2605$, $p = .36$, 95% CI [-0.25, 0.090]. Likewise, a Spearman's rank correlation revealed a small negative, but not significant, correlation between tempo and duration in seconds, $r_s(164) = -.11$, $p = .15$.

The same tests were done on both groups but this time using the measurement of beats. A Wilcoxon rank sum test with continuity correction on slow excerpts ($n = 49$) and moderate excerpts ($n = 117$) revealed that tempo had a significant effect on the choice of splits, $W = 3467$, $p = .034$, 95% CI [0.021, 0.55], suggesting that the moderate tempo group had longer splits in beats. A Spearman's rank correlation, found a small negative, but not significant, correlation, $r_s(164) = .14$, $p = .067$.

Finally, a Kolmogorov-Smirnov test was also done to check the difference of the distributions, which would indicate the consistency of splits given to each group: It was anticipated that excerpts with slower tempi might result in a greater variety of split deviations. As seen in Figure 6, excerpts with moderate tempi received splits with longer durations than excerpts with slow tempi. However, while there appears to be more observations in the right tail of excerpts with a moderate tempo, there was no significant difference found in the distribution between the splits of each tempo groups ($D = .23$, $p = .056$).

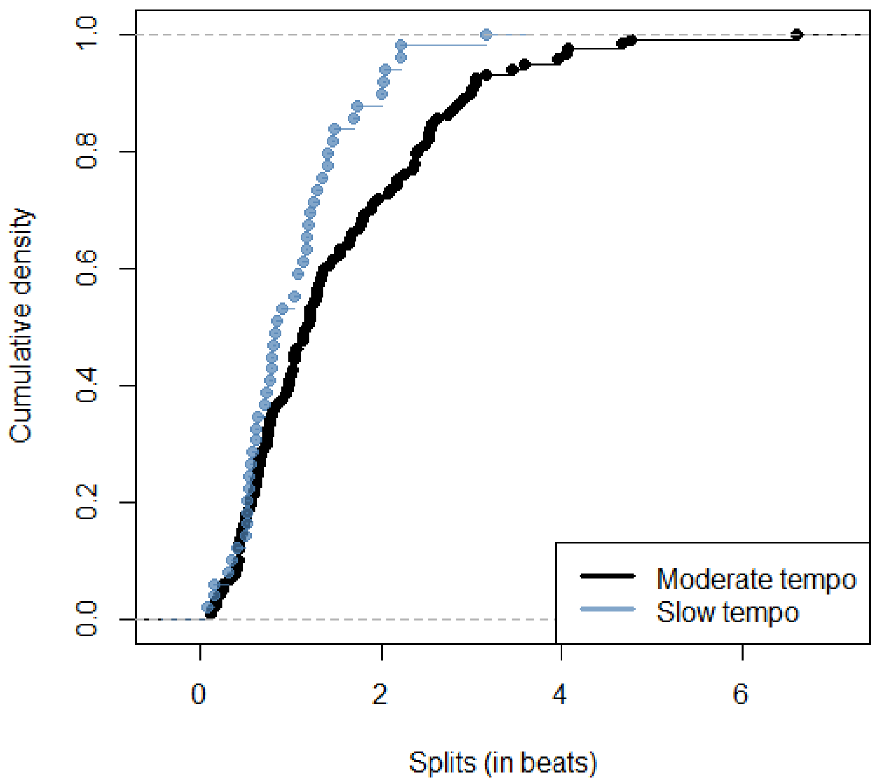

Figure 6: Cumulative density plot, in beats, displaying the association between tempo and splits for all approved and unapproved data.

4.1.3 Familiarity

If LT expectations were to have any impact on splits, it could be expected that those most familiar with a given track would create splits more similar to the original, whereas individuals unfamiliar with the track will be less likely to recreate the original pause duration. To compare these groups, familiar and unfamiliar categories were created for each excerpt (a rating of 4 or 5 was considered as familiar, while a rating of 1 or 2 was considered unfamiliar)[5]. Then the averages of the splits from each group were compared to each of the corresponding excerpts. It was soon noticed however that further analysis would be fruitless since the filtering into groups meant that not enough data were left for a coherent analysis: In many instances, only one participant represented the average in the familiar group (see appendix 3).

[5] Ideally data included would have only been from the extreme ends of the scale (ratings of 1 and 5), however data were grouped in an effort to gain enough data points for a stronger analysis.

Instead of considering the excerpts separately, the overall variance of each groups' deviations (i.e., the splits minus the original) were compared. To do this, the differences were found between all approved splits and the original pauses for each track (*n* = 166). These were then categorized for each rating of familiarity and plotted. Figure 7 displays how with each stage of familiarity the data vary less from the original value (as indicated by 0 on the y-axis). Hence, it appeared that an increase of familiarity leads to an increase in the agreement of participant splits as the deviation from the original duration lessens. Several negative outliers resulted from *Tangerine*, which is perhaps no surprise since the pause actually lasts nearly 7 s (9 b), and no one indicated a familiarity rating of 5.

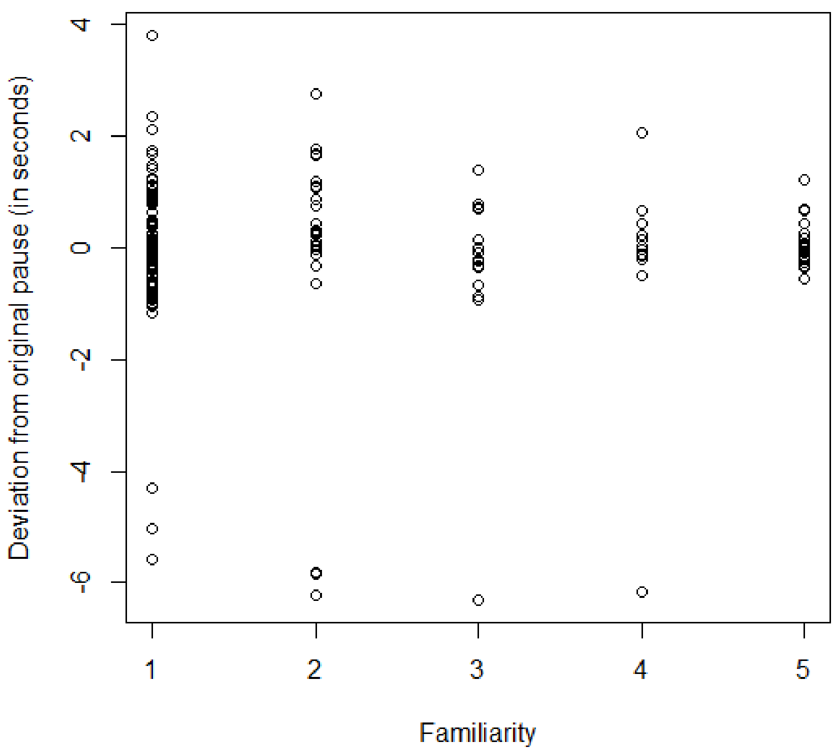

Figure 7: Deviations, in seconds, of the approved splits from the original pause, which is represented by 0 on the y-axis. It can be seen that each stage of familiarity, as indicated on the x-axis, the splits deviate less from the original value.

To find if the accuracy of the splits differed significantly between levels of familiarity, two groups were created from the most extreme familiarity ratings (i.e., 1 and 5). Since *Tangerine* produced only negative outliers, and *Etude op. 21, no. 10* and *Brian Boru's March* (with no actual original pause) could produce only positive deviations, they were removed from the dataset. First a Wilcoxon rank sum test was done on both the highly familiar and highly unfamiliar groups, finding that the central tendency did not differ ($W = 731$, $p = .65$). Because the data were not normally distributed, a Fligner-Killeen test[6] was then done to check the homogeneity of variance between the groups. It was found that there was a significant difference within the variance, med $X^2(1) = 7.65$, $p = .006$, indicating that high familiarity resulted in more similar splits than those given to unfamiliar excerpts.

Finally, it was tested if the deviation tended to be more positive or negative for those who gave the excerpts the most extreme familiarity ratings. A Wilcoxon signed-rank test was done only on the extreme ratings of 1 and 5 to find if the central tendency differs greatly from 0 to either negative or positive differences in splits. No significant difference was found in the familiar group, $V = 105$, $p = .50$, 95% CI [-0.17, 0.10]; or the unfamiliar group, V = 1161, $p = .50$, 95% CI [-0.23, 0.11]. Hence, in neither group did splits tend to be more often earlier or later than the original duration.[7]

[6] This test is the "most robust against departures from normality" ("Fligner-Killeen test", n.d.).
[7] For comparisons sake the same tests were done on the full dataset (now including *Tangerine*, *Etude op. 21, no. 10* and *Brian Boru's March*) finding similar results. The Fligner-Killeen test found a significant amount of variance between the two groups, med $X^2(1) = 10.64$, $p < .001$; and the Wilcoxon signed-rank test found no significant difference in direction (longer or shorter than original) between the familiar and unfamiliar groups ($V = 106$, $p = .93$).

4.1.4 Musicianship

To examine if musicianship had any effect on the length and accuracy of the splits, the approved data were sorted between musicians (n = 85) and non-musicians (n = 81). It was found that the average split given by musicians was 0.80 s (sd = 0.55) or 1.27 b (sd = 0.95), but the median was 1.02 b (mad = 0.74); while the average split given by non-musicians was 0.94 s (sd = 0.70) or 1.45 b (sd = 1.14), and the median was 1.18 b (mad = 0.86). To compare the groups' splits in beats, firstly a Kolmogorov-Smirnov test was performed, which found a significant deviation from normality in both the musicians' (D = .55, p < .001), and the non-musician (D = .61, p < .001). Therefore, a Wilcoxon rank sum test with continuity correction was preformed, finding a significant difference between the groups, W = 2715, p = .035, 95% CI [-0.52, -0.022]. Thus, the location of the splits did differ significantly between groups, and non-musicians' splits were longer than musicians'.

To explore the variance of the splits in beats from both groups, the density estimates, plotted in Figure 8, were calculated using a bandwidth of 0.10. A Pearson's product-moment correlation[8] revealed the groups to be highly similar, r(8.25) = .90, t = 5.06, p < .001, 95% CI [.54, .98]. This suggests that both musicians' and non-musicians' splits were equally as varied. This can be seen more clearly in Figure 9, which displays the peaks of the density estimates from each group: the density of the splits from each group peak in roughly the same places; only deviating where musicians attempt more splits from approximately the sixth beat onwards.

[8] The effective degrees of freedom were calculated using the method as described by Pyper & Peterman (1998).

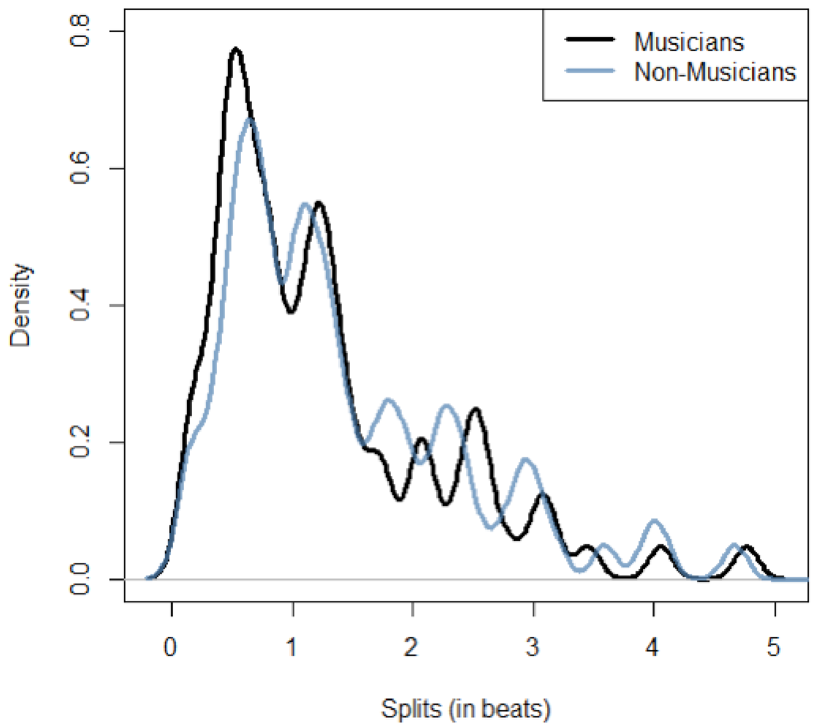

Figure 8: Density estimate of splits, in beats, given by both musicians and non-musicians (bandwidth = 0.10).

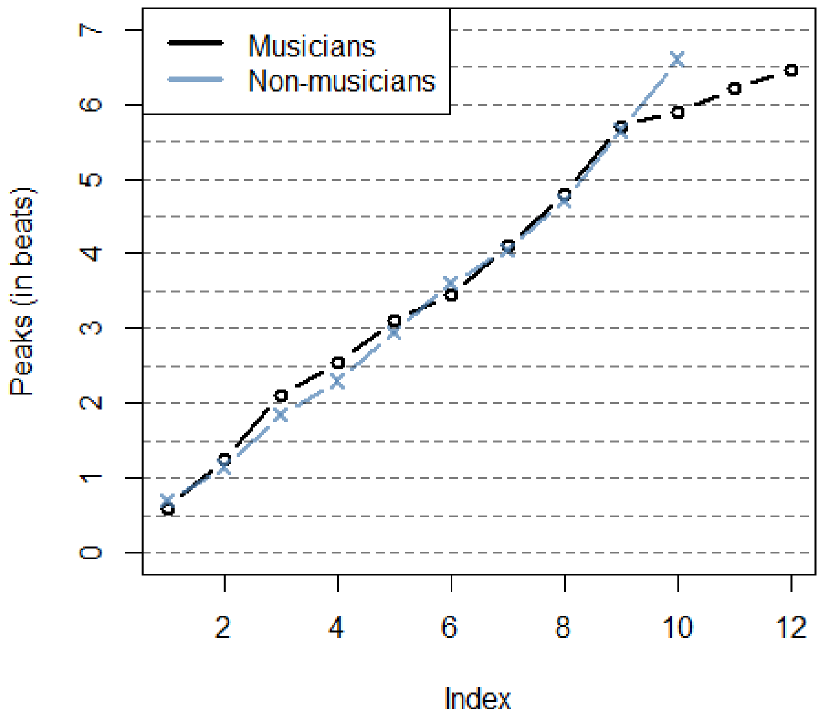

Figure 9: Plot displaying peaks taken from the density estimate, in beats, denoting points of agreement for splits from both musicians' and non-musicians' (bandwidth = 0.10; temporal resolution = 0.050 b).

4.1.5 Personality

To examine if extraversion had any effect on the length and consistency of the splits, the approved splits created by extraverts (n = 33) and introverts (n = 45) were compared. It was found that, on average, extraverts created splits of 0.96 s (sd = 0.57) or 1.53 b (sd = 1.02), while introverts' created splits of 0.99 s (sd = 0.73) or 1.58 b (sd = 1.22). A Shapiro-Wilk normality test was done on the observations of splits, finding the distribution to be non-normal in both the slow (W = 0.93, p = .005) and moderate (W = 0.88, p < .001) group. Hence, a Wilcoxon rank sum test was performed on the groups, which found that the groups did not differ significantly (W = 777, p = .73).

Although the location differences of the splits did not reach significance, Figure 10 reflects perhaps some difference in the regularity of the splits from each group. To find if the datasets contained any periodicity, the peaks of each set were found from the density estimate (bandwidth = 0.10 and using a temporal resolution of 0.050 b). The groups' periodicity, as seen in Figure 11, shows how for the first two beats, introverts appear to make splits consistently longer than extraverts do, although not by much. The average distance between peaks for introverts is 0.84 b (0.78), with a median of 0.60 b (mad = 0.30), whereas the average distance for extraverts' peaks is slightly shorter 0.79 b (sd = 0.65), and so too was the median, at 0.55 b (mad = 0.22). However, what may be more notable is that both groups are consistent in their choices until about 2.50–3 b, after which time the durations become less accurate in relation to the beat, and occur less often.

To explore the variance of the splits in beats from both groups, the density estimates, plotted in Figure 10, were calculated using a bandwidth of 0.10. A Pearson's product-moment correlation[9] revealed the groups to be significantly correlated, r(8.85) = .72, t =2.74, p = .023, 95% CI [.10, .94]. This indicates that both introverts' and extraverts' splits had high similarity, but (as indicated by the confidence interval) also moments of high dissimilarity.

[9] The effective degrees of freedom were again calculated using the method as described by Pyper & Peterman (1998).

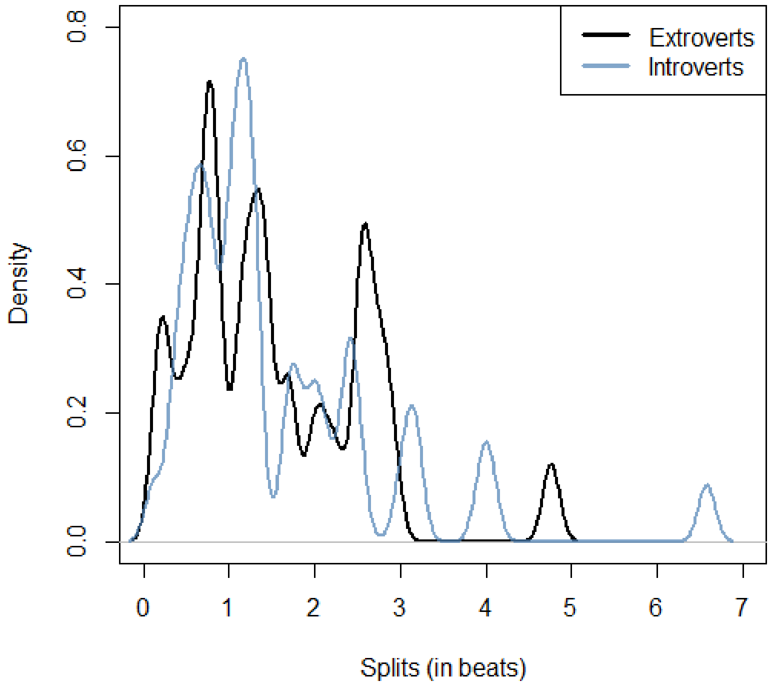

Figure 10: Density estimate of splits, in beats, given by both extraverts and introverts (bandwidth = 0.10).

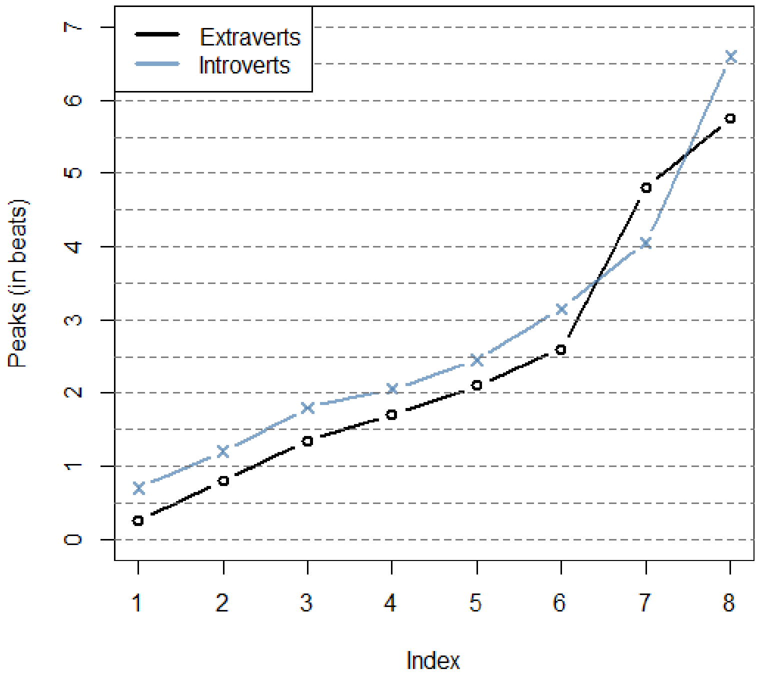

Figure 11: Plot displaying peaks taken from the density estimate, in beats, denoting points of agreement for splits from both extraverts and from introverts (bandwidth = 0.10; temporal resolution = 0.050 b).

4.2 Critiquing experiment results

4.2.1 Duration

To examine if there was a general preference towards excerpts of a certain length an analysis was done on the excerpts with the best comparability, which were the D, O, and C excerpts (*N* = 756). Table 3 shows the frequency of each musicality rating given to each type of track. As can be seen, C excerpts actually received the highest frequency of preferred ratings, while D received the lowest.

Table 3: Frequency of the musicality ratings for each excerpt category: Double (D), Original (O), and Cut (C), with row and column sums.

	1	**2**	**3**	**4**	**5**	**Row sums**
D	53	**54**	**54**	53	38	252
O	34	37	52	**73**	56	252
C	13	35	44	76	**84**	252
Column sums	100	126	150	202	178	

Because these data are ordinal, the categories were then ranked to allow for a correlation (see Howell, 2001): This approach quantifies a monotonic relationship allowing for the testing of statistical significance. A Spearman's rank correlation revealed a significant negative correlation between musicality and duration, $r_s(754) = -.26$, $p < .001$. This indicates that the longer the pause, the less musical the excerpts were considered.

The categories of D, O, and C do not fully account for the actual duration of the pauses: For instance, durations of D excerpts range from approximately one to 13 beats. Hence, to better assess the perception of absolute duration (rather than relative duration), all D and O data were ordered from shortest to longest pause (range = 0.46, 12.8) and the sum of the ratings were found per excerpt. A linear regression model was fitted to the data, as seen in Figure 12, revealing that the duration in beats significantly predicted a decrease in musicality rating, $\beta = -5.38$, $t(15) = -3.69$, $p = .002$; and that the duration also explained a significant proportion of variance in musicality ratings, $R^2 = .48$, $F(1, 15) = 13.6$, $p = .002$. This result supports the negative correlation found with the D, O, and C, excerpts.

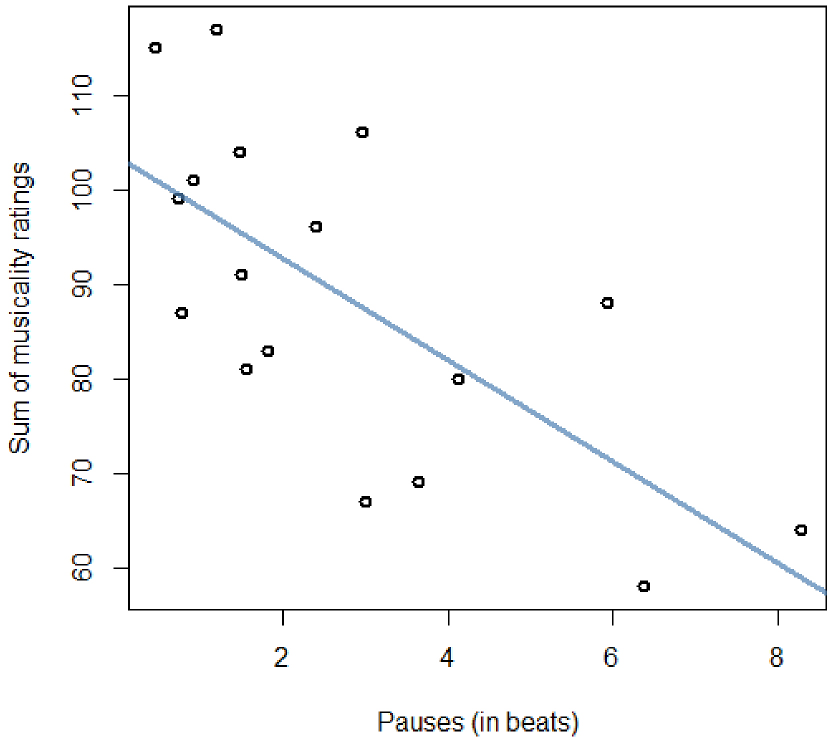

Figure 12: Linear regression model predicting musicality ratings by how long the pause is, in beats.

Next, it was tested if participants perceived pauses differently depending on the type of task—i.e., did results from the critiquing experiment reflect the results found in the conducting experiment. The duration of the pauses in the excerpts used in all D, O, and C excerpts were categorized based on the findings from the conducting experiments: Any D, O, or C, excerpt that was three beats or fewer was categorized as *short* (n = 588) while those longer than three beats were considered *long* (n = 168). The proportions of ratings given to these excerpts, presented as percentages in Table 4, show that the majority ratings given to short excerpts was 5, while the majority of ratings given to long tracks was 1. Additionally, 1 and 5 received the least amount of agreement for short and long excerpts respectively. These findings are consistent with preferences expressed in the conducting experiment.

Table 4: Musicality ratings expressed as percentages given to each short or long pause category. Short pauses are any D, O, or C excerpt, which were three beats or fewer; long pauses are any D, or O, excerpt, which exceeded three beats.

	1	**2**	**3**	**4**	**5**
Short	7.65	15.6	19.0	29.6	**38.1**
Long	**32.7**	20.2	22.6	16.7	7.74

4.2.2 Low-level features

To examine if pulse clarity had an effect on the measure of musicality for each category D, O, and C, the track data were subset into groups of those with clear and unclear pulse clarity. The correlation coefficients were calculated using Spearman's rank correlation, finding a negative correlation between musicality and duration in both the clear group, $r_s(250) = -.25$, $p < .001$; and in the unclear group, $r_s(502) = -.26$, $p < .001$. The correlation coefficients between these two groups were then compared using a Z-test, finding no significant difference ($z = 0.040$, $p = .96$). This implies that pulse clarity did not affect participants' musicality preference when rating the different categories.

Next, the musicality ratings given to each category D, O, and C were subset into three tempo groups (slow, moderate, and fast). Using Spearman's rank correlation, the correlation coefficient was found for each group, finding a negative correlation between musicality and duration for slow excerpts, $r_s(418) = -.28$, $p < .001$; moderate excerpts, $r_s(166) = -.11$, $p = .15$; and fast excerpts, $r_s(166) = -.34$, $p < .001$). The correlation coefficients from each of the three groups were compared against one another. A Z-test found no significant difference of the musicality ratings between excerpts with slow and fast tempi (z = 0.65, $p = .52$), and a small significant correlation of the musicality ratings between excerpts with slow and moderate tempi (z = 1.93, $p = .050$), and moderate and fast tempi (z = 2.16, $p = .030$). To account for multiple comparisons, the Benjamini-Hochberg correction was applied to the *p*-values of each group finding no significant correlation between tempo groups of slow and fast ($p = .52$), slow and moderate ($p = .075$), or moderate and fast ($p = .075$). Hence, it appeared that tempo had no clear significant impact on how musical each category of a pause was rated.

4.2.3 Familiarity

It was examined whether track familiarity had any effect on the perception of musicality ratings given to each group. A Spearman's rank correlation was done between musicality and familiarity for set of D, O, and C excerpts, finding small but non-significant positive correlations in group D, $r_S(250) = .12$, $p = .066$; group O, $r_S(250) = .079$, $p = .21$; and group C, $r_S(250) = .079$, $p = .21$. Although not reaching significance, this result still implies that as familiarity increased with the excerpts so too did musicality rating, regardless of the pause duration difference. Using a Z-test, the difference between these unpaired correlations were checked, finding that the null hypothesis was met between D and O (z = 0.42, $p = .68$), O and C (z = 0, p = 1)[10], and D and C (z = 0.41, $p = .68$). These results generally imply that track familiarity had no effect on the perceptual musicality of different pause durations.

4.2.4 Musicianship

To find if musical training had an influence on the preference for different pause durations, the median for ratings from each group was found. Table 5 displays the ratings from both musicians (M) and non-musicians (~~M~~) expressed as a percentage per category (e.g., all M ratings given to D excerpts will amount to 100%). It can be seen that the highest ratings from both musicians and non-musicians were given to the C excerpts, and generally, there was more dislike from both groups for D excerpts.

A spearman's rank correlation was performed on each group finding a significant negative correlation between musicality and duration for musicians, $r_S(376) = -0.25$, $p < .001$; and non-musicians, $r_s(376) = -0.26$, $p < .001$. To test for significance, a Z-test was performed, finding no statistically significant difference between the correlation coefficients (z = 0.062, $p = .95$). This indicates that both musician and non-musicians rated the excerpts similarly.

[10] *P*-value here is perhaps not exactly 1 but close eough to be rounded up in the calculation.

Table 5: Musicality ratings expressed as percentages given by Musician (M) and Non-musician (~~M~~) to each excerpt category: Double (D), original (O), and cut (C).

Rating	**1**		**2**		**3**		**4**		**5**	
Group	**M**	**~~M~~**	**M**	**~~M~~**	**M**	**~~M~~**	**M**	**~~M~~**	**M**	**~~M~~**
D	19.8	22.2	**27.0**	15.9	19.1	23.8	15.9	**26.2**	18.3	11.9
O	11.9	15.1	15.9	13.5	21.4	19.8	24.6	**33.3**	**26.2**	18.3
C	3.97	6.35	15.1	12.7	19.1	15.9	28.6	31.8	**33.3**	**33.3**

4.2.5 Personality

Finally, to explore if personality traits could result in different preferences towards longer or shorter pauses, the musicality ratings for D, O, and C excerpts were sub-divided between those categorized as introverts (*n* = 264) and those categorized as extraverts (*n* = 165). From these data, a frequency table was created from which the median rating given to each category by each group could be obtained.

Table 6 displays this as a percentage of the ratings given to each track by each group, so that the total 100% comprises of the ratings given by a personality group to a durational group. Generally, it appeared that groups agreed upon the distribution of the ratings, although introverts showed stronger opinions towards D excerpts, rating highly with 1 and 4, while extraverts shared most ratings around 2, 3, and 4. O excerpts were preferred to D as both groups tended towards 4 or 5 ratings. C however appeared to be favoured by both groups: To extraverts C excerpts appeared to be most liked, receiving mostly fives compared with O or C excerpts, while to introverts C was most least disliked, receiving the least amount of ones compared with O or C excerpts.

Table 6: Frequency of musicality ratings given by extraverts (E) and introverts (I) to each excerpt category: Double (D), original (O), and cut (C).

Rating	**1**		**2**		**3**		**4**		**5**	
Groups	**E**	**I**	**E**	**I**	**E**	**I**	**E**	**I**	**E**	**I**
D	4.44	23.6	24.4	12.5	**28.9**	19.4	22.2	**27.8**	20.0	16.7
O	6.67	9.72	6.67	8.33	17.8	25.0	**35.6**	**34.7**	33.3	22.2
C	4.44	1.39	11.1	13.9	8.89	19.4	22.2	**33.3**	**53.3**	31.9

To examine the variance of the splits given, a Spearman's rank correlation was performed, revealing that a significant negative correlation between musicality and duration with extraverts, $r_s(133) = -0.29$, p < .001; and introverts, $r_s(214) = -0.23$, $p < .001$. However, a Z-test revealed no significant difference between the correlation coefficients of each group (z = 0.63, $p = .53$). This indicates that introverts and extraverts rated the excerpts similarly.

5 DISCUSSION

The findings of each experiment shall be first discussed separately, before being considered in relation to one another. Additionally, any problems encountered will also be discussed, alongside ideas for future experiments.

5.1 Conducting experiment findings

5.1.1 Duration and low-level features

It was found that the majority of approved splits did not exceed two seconds: Splits tended to be no more than two beats (75%), and only a small percentage exceeded three beats (8%). This indicates that the *length*[11] of the split affected the participants' choices. However, roughly the same majority of unapproved splits (90%) were within the first three beats indicating that the metre was an important factor. Yet, despite the splits indicating a relationship with the beat, the circular analysis revealed that the relationship was neither focused towards a strong beat, nor consistent between tracks. At most, it could be said that phrases were often returned slightly after a clear beat division.

Lag is a factor here, however it would be considered a greater issue had the participants not had a chance to approve their data: Even if lag occurred, it did not stop the pauses from sounding musical or reflecting the participants' intentions. Furthermore, that the splits did not adhere directly to a beat is actually consistent with the expectation that pauses do not take up a full exclusive beat, as was pointed out by Margulis (2007). Margulis described that pauses were often heard in recordings despite not being notated in the score: If pauses were expected to take a specific duration of beats then perhaps they would then be notated, or on the contrary, because they are not always notated, they are not expected to last an exact duration in beats.

[11] *length* here is to refer to the abstract concept of the general time frame in which pauses primarily exists and holds no indication of any relationship to low-level features; it is to distinguish the concept from the word *duration*, which references time in a more concrete manner, as it could also be interpreted to include a relationship to the metre.

Conversely, classical music often includes playing instructions that indicate methods of subjective interpretation (e.g., *adagio* means *slowly* or *leisurely*, and *andante* is often synonymous with *at walking pace*), whereas modern music more often utilises available technology to ensure a certain metric consistency (as was found with many of the excerpts in the current study). Hence, further study could examine whether different genres included unique expectations surrounding the pause.

Irrespective, findings indicated that the length of a split might have actually influenced individual's internal perception of the metre. It could be seen that some inter-beat regularity did occur, but also eventually deviated with time, again indicating a relationship with a perceived metre. This point may also explain why splits did not tend to last longer than two or three beats: The longer participants waited to create the splits, the less clear the metre became, and perhaps for this reason, why longer splits were avoided.

Pulse clarity did not appear to make a significant impact on splits. Tempo did not show any significant influence to the variance of spits; however, it did have a small impact on duration of splits. It was found that excerpts with slower tempi received longer split durations in seconds. Despite that only the slow and moderate excerpts were compared, this finding would make sense because the beats are further apart in excerpts with slow tempi, therefore taking longer to pass. However, it was also found that when the tempo was moderate, that more beats occurred in the splits. This suggests that while slower pauses may last longer, splits were not as many beats as what was included in moderate excerpts.

The fact that a certain amount of time had to pass before splits were made could again be due to the limitations of the experiment. A couple of the comments did mention an unfulfilled desire to cut phrase *A* short during the conducting experiment. Yet, while some of the results may reflect experimental restrictions, it is also arguable that those less favoured splits would not have been approved. Thus, it can be assumed that at least some of the approved splits reflected participants' true intentions. In this case, one potential reason (that the splits always contained some duration of absolute time, rather than beats) could adhere to the musical aesthetics established from mimicking speech, which requires the pause for thought (Marler, 2000) and breath. Pauses are used in speech and music for indicating phrase boundaries (Doctor, 2007; Knösche et al., 2005; Margulis, 2007, 2007a; Saville-Troike, 1985; Steinhauer et al., 1999), and so too it may be that they are treated with the same sets of expectations. Therefore, if the musical pause were to act as an equivalent of catching a breath between spoken phrases, the pause would have to last at least that duration in actual time. Hence, more beats will pass in faster excerpts than in slower excerpts. However, to truly test this hypothesis another experiment should be performed wherein participants are allowed to cut *A* short if so desired.

5.1.2 Effects of track familiarity

A positive correlation was found between familiarity and the similarity in splits compared to the original pause, i.e., that the tendency and accuracy of recreating the original pause increased with the familiarity. This result perhaps seems somewhat obvious; however, it is important since it strongly suggests that LT familiarity was a more dominant guiding factor than the ST expectancies. For those participants most familiar with the stimulus, it may be that LT familiarity potentially overrides expectations induced by any localized information.

Moreover, it was not fully clear what guided the choices made by those unfamiliar with the excerpts. The fact that those unfamiliar with the stimulus—and therefore who could not rely on the LT knowledge of a specific track—created a greater range of splits, might mean there was no specific localized aspect in the stimulus predominantly governing their choices for a split. Conversely, these data reflect what has been found in previous studies: that while individuals may become entrained to a stimulus, those individuals each experience and express the effects differently (Burger et al., 2014; Haas et al., 1986). Hence, it is also possible the ST expectancies were guiding the participants unfamiliar with the excerpts, but that those effects manifested themselves differently in how the participants responded.

Additionally, it was found that neither the familiar nor the unfamiliar group showed a significant direction of deviation in split choices (i.e., both groups' splits were equally as early or as late compared to the original). Therefore, participants unfamiliar with a given track both deviated greatly from the original duration, and equally under- and over- estimated the original durations in their choice for a split. This further suggests that those unfamiliar with the stimulus did not rely only on ST expectancies to decide the split, or their splits would have been more similar.

5.1.3 Individual factors: musicianship and personality

Splits were found to differ significantly between musicians and non-musicians: Non-musicians created longer splits. Yet it is still difficult to interpret this result since the medians were so close in value. This difference between the groups may reflect musicians' accuracy, because it was also found that musicians' responded .16 b more accurately in relation to the beat, as their median was 1.02 b, whereas the median of non-musicians splits was 1.18 b. The standard deviations also indicated a greater variance from the beat from non-musicians, which again suggests a greater inaccuracy locating the beat.

The findings generally imply that musicians were more aware of the beat when making their decision, and/or that they were physically better at tapping to it. The fact that musicians quite closely followed the beat may indicate that actually, entrainment and ST expectancies were present in the participants' choices, but when considered altogether, the inability to respond accurately diminished the finding. Alternatively, this finding could also support LT learning, as perhaps musicians are more familiar with awareness to the beat than are non-musicians, and therefore have learned to notice it while non-musicians focus on other aspects of the music.

Although it was suspected that introverts would create longer splits, no significant difference was established. Nevertheless, it was found that extraverts and introverts appeared to focus on a different relationship with the beat, and that the average of these beats created by introverts was actually a marginal .05 b shorter than those created by extraverts. There was also an indication that extraverts were more consistent in splits durations, always arriving just after the beat; albeit, this is impossible to gauge, since a seemingly short late arrival could in fact be a very early arrival. However, what was clear was that splits from both groups were affected by length, as the regularity of split lengths diminishes in each group after approximately 2.5 b. Again, this finding indicates that individuals eventually tend to deviate from the original metre as time progresses.

5.2 Critiquing experiment findings

5.2.1 Duration and low-level features

The critiquing experiment revealed that there was a negative correlation between duration and musicality: that the longer the pause (which lengthened in relation to the beat) the less musical it was perceived. This correlation between relative durations of the excerpts somewhat relied on the assumption that the original pause was the most appropriate duration. Regardless, the finding (that longer durations were less preferred) was confirmed with a linear regression model fitted to the data when ordered into the exact lengths of the pauses from short to long, which could predict a decline in musicality ratings by the duration in beats.

The slope of the line ($\beta = -5.38$) in the linear regression model (Figure 12) indicated that, with each beat it could be predicted that the overall musicality ratings would decrease by approximately five points. The model only predicts a specific range of durations: It would be worth developing to test more extreme cases. It may be that the relationship does not continue in a linear fashion, or even begin in a linear manner: The y-intercept is arbitrary because no data without any pauses were included in the model. Furthermore, this model was based on the assumption that the musicality ratings accumulate in value when added together, when in fact the relationship between each level of musicality may not be equal.

Yet, despite the exclusion of the extreme situations from the model—viz., no silences, and exceptionally long silences—it was apparent that the data reflected a preference for shorter pauses. One potential cause for this may be that the pause durations were always marked to be on the beat: This result could reflect what was suggested from the conducting experiment—that longer pauses need not be on the beat, and that the on-the-beat arrival of a phrase after a long duration is actually considered less musical. It would be interesting to test whether this model remains true even when the duration of the pause also deviate from the beat as it lengthens. Based on the gradual inaccuracy found in the conducting data, it could be expected that actually longer pauses may be preferred when they result in the phrase not returning on a simple division of the beat.

Of course, it is also probable that these results simply arose from the excerpts unnatural nature of the silence: Indeed, several of the comments left by participants mentioned that the silences and fade-outs occasionally sounded unnatural. Therefore, a preference for shorter durations may simply result from a preference for less absolute silence. Arguably, while fading out to 0 dB may have impacted upon perception (as indeed C were favoured), it may not have been the primary cause of such results or the O and D excerpts would have been equally disfavoured. However, since this cannot be stated conclusively, it would be beneficial to repeat this experiment using different variants of the stimuli.

Generally, it appeared that low-level features did not have an impact on how participants rated the musicality of the excerpts. Neither pulse clarity nor tempo showed any clear effect on the ratings, and variations from the metre were not included in this experiment because all variations of the pauses were created as a ratio from the original. Future experiments could also improve upon this approach by creating excerpts with a great variation of phrase returns on fewer musical excerpts (by repeating this experiment with a variety of pauses in excerpts of real music, the results could then be compared against the goodness of fit model proposed by Palmer & Krumhansl, 1990).

5.2.2 Effects of track familiarity

A small positive correlation for musicality and familiarity was found in each group (D, O, and C), and while this did not reach significance, it might imply that, regardless of the pause durations, participants tended to prefer any stimulus with which they were more familiar. However, comparing the differences between groups, the musicality in relation to familiarity was not significantly affected by the durations. Although not significance, these results still hint towards a preference for the familiar, again alluding to preference for LT expectancies: A finding that may be better understood with more data gathered through further experiments (the effects are likely to be subtle and so not enough data were collected in the current research).

5.2.3 Individual factors: musicianship and personality

No significant conclusions were reached regarding the perception of musicianship on the musicality of different duration of pauses. This could be because the variation in pauses was so limited, because pauses were timed in such a manner as to comply with the metre. Hence, perception of the metre could not be tested between the two groups. Nonetheless, it was somewhat anticipated that musicians may have preferred D when compared to non-musicians, since it was previously found that musicians may be better at tracking rhythms on larger time scales (McAuley & Semple, 1999). In fact, it appeared the majority of musicians rated the musicality of D excerpts as 2, whereas the majority of non-musicians gave D excerpts a rating of 4. This finding does not necessarily mean that musicians and non-musicians experience different metric time-scales, and the actual cause is unclear in the current context; however, it does imply that non-musicians may favour longer silences than do musicians.

By comparing the distribution of the musicality ratings from extraverts and introverts, it was established that both groups tended to agree upon preferences. Nonetheless, it was interesting to find that introverts did express stronger opinions (be it positive or negative) when rating D excerpts, while extraverts' ratings tended to be more neutral. Similarly, extraverts showed higher agreement in preference for C excerpts when compared to O or C excerpts, whereas introverts found C to be the least disliked when compared with O or C excerpts. While these findings do not indicate clearly that levels of extraversion can predict a preference for pause duration, it reflects how the two groups' opinions may differ: Introverts may have clearer indications of what they like and dislike, whereas extraverts may be more flexible and therefore may even appear impartial. Though this verdict is beyond the scope of this thesis, it would make for an interesting future area of study.

5.3 General discussion

5.3.1 Duration and low-level features

Both the conducting and critiquing experiment revealed that pauses were preferred when they were shorter, and were generally not expected to exceed the duration of three beats. The conducting experiment indicated that participants' internalisation of the metre deviates over longer spans of time, and this could explain why there was a negative correlation found between preference and duration for pauses in the critiquing experiment. The pauses in the critiquing experiment maintained a strong relationship with the beat. Therefore, the negative effect duration showed on musicality could be a result of the gradual decline of the sense of metre as perceived by the participant. This finding further indicates that, although stimulus entrainment was weak, the pulse did have an effect on the participants. However, future studies could consider the hypothesis that, because participants eventually swayed away from the metre during a silence, then they expect or prefer that same quality when listening to music with longer pauses.

Of the low-level features, only tempo appeared to influence how participants' created pauses. It may be that tempo did not influence the critiquing results in the same way because either, tempo is a more important factor if the pause fluctuates from the metre (which was not a factor in the critiquing experiment), or differences arise from types of listening. It is difficult to assess, because while splits were approved, there is still the potential flaws from experimental, and even human, error: even musicians, who may practice timing the entry of sounds more often than non-musicians, would not normally do so with a spacebar.

From the current study, what can be stated is that the length of the pause was important (results from both experiments indicated that a pause should not exceed a certain duration), and so too was the relationship between the pause and the pulse. However, the findings did not strongly support that low-level features are a strong guiding factor for participants' perception of the pause. However, this does not necessarily mean participants did not reference the metre when selecting the pause duration, but may have varied so greatly between individuals it was not clear: Much like the temporal goodness of fit model proposed by Palmer and Krumhansl (1990), individuals may perceive different hierarchies of metre. Furthermore, it appeared that other factors dominated participants' choices, and so the overall results were not consistently directed towards low-level features. As noted, this could be due to the nature of the experiment; however, based on the rest of the results, it is quite probable that LT familiarity superseded ST observations and low-level entrainment.

5.3.2 Effects of track familiarity

It was conjectured that familiarity could result in participants preferring unexpected silences as it breaks their preconditioned expectations. This was tested by asking participants to rate a variety of (original and altered) musical excerpts based on their musicality and level of familiarity. Track familiarity was not found to significantly influence the musicality choices of the different D, O, C excerpts by participants in the critiquing experiment. Only in the conducting experiment did track familiarity have any significant impact on the duration of the pauses. One reason why familiarity did not greatly influence the perception of pause durations may result from the experimental framework: The pauses did not particularly deviate greatly from the original, and so perhaps not enough data were collected to measure the subtle effects. Furthermore, the study specifically asked participants to reflect on the musicality of the silence, and therefore, “surprising” silences were to be expected.

Nevertheless, results from conducting experiment supported a reliance on LT expectancies, as it found that participants familiar with a track would endeavour to recreate the original pause. Results from participants who were unfamiliar with the excerpts did not clearly prove or disprove that their choices were influenced by either LT or ST expectations, although the variability of the responses did imply that ST features were less consistently influential. It is also interesting to note that when conducting familiar music, individuals preferred and sought to recreate the original version; yet when listening to and rating familiar excerpts it was indicated that individuals generally preferred any version of music with which they were more familiar. This contrast may allude to different sets of expectations when individuals are actively involved in the creation of music compared to when they are the audience simply observing the music. Since ITPRA framework relies on surprise, it would be more likely for individuals to find enjoyment from surprises when listening to music because the conscious act of creating music eliminates many possibilities for a surprise.

Future studies, regarding the effects of familiarity on the preference for a pause, may also wish to focus on linguistic and cultural background of the participants. Many cultural stereotypes exist that mean cultures may be comparatively perceived as using more silence during communication. The “threshold of tolerance [for conversational silence] varies from culture to culture and from language to language” (Lehtonen & Sajavaara, 1985, 194), which includes standards for pauses between speakers and between phrases. R. Murray Schafer (as cited in Cox & Warner, 2004, p. 37) suggests, “in the West, silence has for many centuries been unfashionable”, as it is seen as a failure in communication, considered “unnatural” or “intimidating” (Styhre, 2013, p. 24). Likewise, in the English/Scottish ballad canon, silence has been described as, “a problem to overcome” (Kallen, 1997, p. 174). Accordingly, in countries where silence is undesirable, such as Western and North American societies, it has been found that to uphold fluent conversations, inter-turn silences should not exceed 1.5 seconds, or the conversation becomes dysfluent (Watts, 1997). However, in societies that esteem silence, such as with American and Canadian Athabaskan Indians, conversational fluency is best maintained when speaking-turns are always followed by two-second silence (Scallon, 1981). Although this would have made for an interesting study, not enough data were collected to create clear differences between groups for such an analysis. Furthermore, it can be expected that such differences are subtle and may even require specific isolated cultures that have less experience of each other's customs.

5.3.3 Individual factors: musicianship and personality

It was suspected that musical training could influence pause duration preferences. Previous research indicated that musical ability might be correlated with a greater awareness of the beat, and that musicians showed greater accuracy when pertaining to the metre (Doggett & Repp, 2007; Jongsma et al., 2005; McAuley & Semple, 1999; Palmer & Krumhansl, 1990). Indeed the conducting experiment found, that while both musicians and non-musicians were aware of some metrical structure, that musicians displayed more accuracy at responding to the beat. This finding does not actually indicate whether musicians were closer to the beat because of physical skill, LTM, and preference for the beat, or if non-musicians actually relied on some other factor. The critiquing experiment indicates that each group has similar preference for the beat since there was no significant difference found between how musically they rated the excerpts (if non-musicians preferred phrases to return off beat, then they would have rated these excerpts as less musical sounding). Therefore, it is quite likely that both groups were aware of the metrical connections within the pause, but that musicians were better able to synchronize with it or detect it.

Both musicianship and personality are factors pertaining to the individual, which could equally change how individuals perceive LT or ST expectancies. The fact that musicians more often created splits closer to the beat could result from LT training to do so. However, it is equally as likely that musicians, having better motor skills resulting from training, were better able to respond to the ST expectancies. Similarly, personality did not seem to drastically affect the results. The contrast between extraverts and introverts, regarding the perception of the metre, could reflect a difference of the individuals' temporal mapping and perception of time scale. Yet, it is unclear if those perceptions are relating to ST or LT information.

It was further posited that personality could affect the perception of silence, which was based on previous evidence that introverts are associated with being quieter for longer times, and that during conversation will say less (Crown & Feldstein, 1985). However, no clear difference was found between groups, which may be because the groups were not well represented. Future studies may better consider the effects of personality by only recruiting participants who represent the extreme ends of the extraversion scale. It was interesting that introverts appeared more opinionated in the critiquing experiment, but data from the conducting experiment was unable to support an equally strong opinion regarding the preference for specific pause durations.

Finally, age was another important individual factor that was not included in the analysis due to a lack of data. However, it would be interesting to focus a study on the effects of age on perception of a silence. It has been proposed that, compared to adults, children show a preference and a natural tendency towards faster tapping and speech rates (Drake et al., 2000; Holland & Fletcher, 2000; Sutton, et al., 1995; Wingfield & Du-charme, 1999; Provasi & Bobin-Bègue, 2003). Therefore, responses to timed events are reliant on an individual's dynamic attunement to the structure of the events, which also changes with age (McAuley et al., 2006). Future studies could explore the deviation in threshold for tolerating silence between younger and older groups: Those more with a higher threshold for longer silences may also prefer longer pauses in music.

6 CONCLUSION

Findings from the present study indicate that the optimal duration for a musical pause is no more than three beats, and that it is not required to uphold a precise metric relationship with the metre. Findings further indicated that these guidelines were not clearly affected by pulse clarity, but were partially affected by tempo. However, the impact of tempo may warrant further study since the comparison was only between tracks with slow and moderate tempi, and the results could have been transformed by the restrictive nature of the experimental framework, which may have interfered with participants' response times. Regardless, the general lack of conformity between participant results regarding the influence of low-level features indicates that other more dominant causes may have been guiding participants' choices.

Future studies could focus on the significance of pauses rarely exceeding three beats. The reason could reflect the individual's eventual loss of the actual metre, and hence may prefer a time span in which the metre is more apparent. However, since pauses did not resemble a clear direct relationship with the metre makes this hypothesis slightly unlikely. Alternatively, the finding may result from LT schemata learned through speech: Individuals may expect pauses to resemble those found in speech, and therefore expect them to require the same duration of a breath between statements. Future consideration could be given to physiological aspects of the individual in relation to the pause in both music perception and speech usage to assess if the duration of the pause is equal to a breath.

Familiarity was shown to influence the treatment of pauses in both experiments: In the conducting experiment participants recreated the pauses with which they were familiar, while in the critiquing experiment, participants tended to prefer any track with which they were familiar. However, the impact of low-level features was less consistently displayed. Thus, in the current research it appears that listeners more often rely upon LT expectancies when comprehending the musical pause. That is not to say that an awareness of low-level influences was not present: The fact that listeners eventually lost a clear sense of the pulse during longer pauses in the conducting experiment indicates that some level of entrainment occurred when listening to a stimulus, which then declined upon its removal. In fact, the role of ST expectancies may have diminished since their presence is difficult to assess: Using natural stimuli may be too complex; many studies examining the DAT involve very controlled stimuli, altering specifically only pitch or duration.

The differences in LT and ST expectancies could also depend on the situation: By comparing listening experiments it could be seen that not all factors had the same impact: Tempo and familiarity did not affect critiquing results as they did conducting results. Hence, it is quite possible that different responses to expectation vary depending on the goal of the listener. Thus, the creator of the music, e.g., the performer, will hear the music differently than the listener, e.g., an audience: where a performer may not like surprise, the audience may appreciate it. Another additional important factor when understanding the interpretation of silence in music, and language, is that it relies heavily on the context and circumstances (Saville-Troike, 1985). The awareness and preference for a pause may differ between listening alone from home compared to listening as a group in a social setting. Even visually perceiving the performers will influence what is expected from a silence, or sound, in music (Mortillaro, Camurri, Volpe, Scherer, & Castellano, 2008; Thompson & Luck, 2008), and in conversation, as they share some underlying cognitive content (Loehr, 2012).

However, even in simple DAT studies, it seems quite difficult to assess whether responses were built on ST expectances, or if indeed they reflect LT expectancies. One problem when assessing the importance of ST knowledge is that it shares many of the same preferences as LT knowledge. For example, standard Western familiarity has shown that preference tended towards tones that fell on strongest beat, then on lesser beats, on half beat divisions, and lastly favoured those which did not coincide with any beat (Palmer & Krumhansl, 1990), which would be consistent with potential ST responses to a beat, which entrain individuals to maintain the pulse. Furthermore, how can it clearly be stated that ST expectancies are not based on LT expectancies?

For instance, when a pattern, that has been created locally, deviates, then could what appears as unexpected ST information actually be derived from unexpectancies in LT learning? In normal life from whence LT patterns are learned, it is rare to experience sounds that randomly fluctuate, and it is rarer still that a continuously loud rhythm simply stops. Most rhythmic sounds may come from footsteps, or something dropping to the ground and bouncing: In many ubiquitous instances, it may be more likely that the audio source gradually diminishes as it moves away or loses energy. Therefore, deviations in local information may actually be deviations from LT expectancies of what local information is expected to contain. Even the gambler’s fallacy phenomenon actually indicates a stronger reliance on LT learning, because it reflects how, as an interactive species, humans expect actions to result in consequences: In typical life, it may be less usual to encounter a multitude of independent events.

Yet, what is clear from the present study is that individuals use LT knowledge (i.e. LTM), but do also rely on low-level features and ST knowledge (i.e., WM) to understand auditory stimuli. It may well be that ST expectancies present in the DAT could be the foundation for developing LT schematic knowledge—as a provider of statistical information to the higher cognitive functions that yield responses for making future predictions. Perhaps when a participant is able to focus on a single feature, such as in tapping experiments used for DAT, they are better able to track the stimulus and respond directly to its changes. Similarly, entrainment may be more apparent when they are directly involved with the stimulus (composing or dancing). However, it would seem that during reflective music listening, it is impossible to track all the low-level features at once, and while individuals may focus attention and respond to certain audio features, the focus will not always be the same for everyone, or for each time a stimulus is heard. In such situations, it is likely that individuals share ST and LT expectancies, and use LT for all the features on which they are not focused at that moment. In conclusion, it is likely that the responses to a stimulus are shared out among a dynamic network of LT and ST knowledge that is simultaneously developing and governing individuals’ actions, which in turn develops the expectancies and preferences for all auditory stimuli, including the musical pause.

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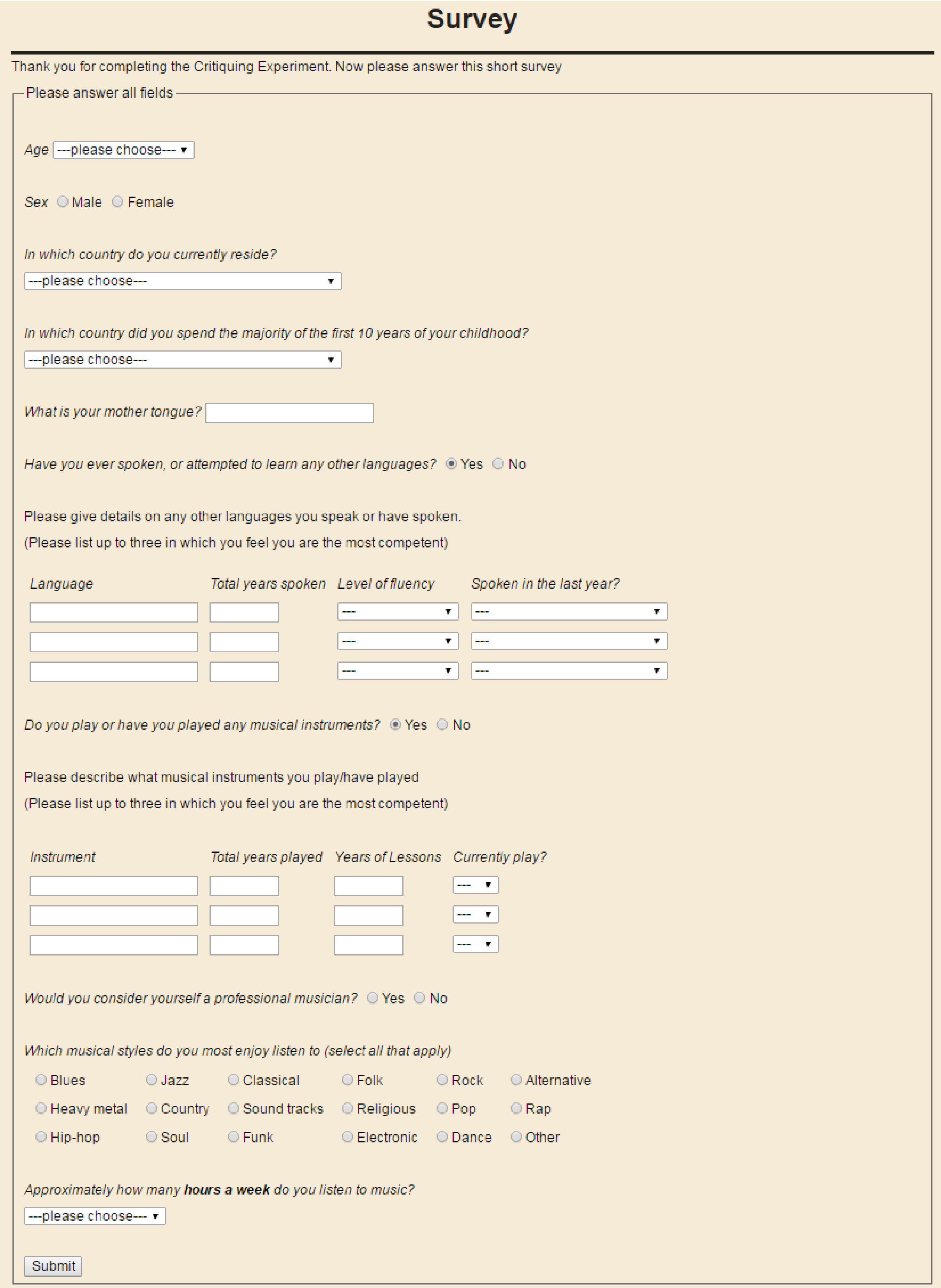
List of tables, figures, and equations

TABLES

FIGURES

EQUATIONS

APPENDIX 1: Survey and TIPI as used in the online platform



Survey

Thank you for completing the Critiquing Experiment. Now please answer this short survey

Please answer all fields

Age ---please choose---

Sex Male Female

In which country do you currently reside?

---please choose---

In which country did you spend the majority of the first 10 years of your childhood?

---please choose---

What is your mother tongue?

Have you ever spoken, or attempted to learn any other languages? Yes No

Please give details on any other languages you speak or have spoken.

(Please list up to three in which you feel you are the most competent)

Language	*Total years spoken*	*Level of fluency*	*Spoken in the last year?*
		---	---
		---	---
		---	---

Do you play or have you played any musical instruments? Yes No

Please describe what musical instruments you play/have played

(Please list up to three in which you feel you are the most competent)

Instrument	*Total years played*	*Years of Lessons*	*Currently play?*

Would you consider yourself a professional musician? Yes No

Which musical styles do you most enjoy listen to (select all that apply)

Blues	Jazz	Classical	Folk	Rock	Alternative
Heavy metal	Country	Sound tracks	Religious	Pop	Rap
Hip-hop	Soul	Funk	Electronic	Dance	Other

Approximately how many ***hours a week*** *do you listen to music?*

---please choose---

Submit

Ten Item Personality Index

Thank you for completing the Conducting Experiement. Finally, complete this short Ten Item Personality Index.

Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.
You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

1 = Disagree strongly
2 = Disagree moderately
3 = Disagree a little
4 = Neither agree nor disagree
5 = Agree a little
6 = Agree moderately
7 = Agree strongly

I see myself as

	Extraverted, enthusiastic.
	Critical, quarrelsome.
	Dependable, self-disciplined.
	Anxious, easily upset.
	Open to new experiences, complex.
	Reserved, quiet.
	Sympathetic, warm.
	Disorganized, careless.
	Calm, emotionally stable.
	Conventional, uncreative.

SUBMIT

APPENDIX 2: Details of all tracks for analysis

Title	Pulse Clarity	BPM	Excerpt length (s)	Length of silence removed	
				(s)	(b)
Take me out	.27	103	0.25	0.61	1.04
Strange Days	.57	120	0.22	0.60	1.20
Black Friday Rule	.52	143	0.21	0	0
All I Really Want	.56	93	0.26	1.43	2.22
Prelude to the Afternoon of a Faun	.084	73	0.45	5.24	6.38
Kuulin Äänen	.20	106	0.24	0.44	0.78
Be My Lover	.82	127	0.29	0.34	0.72
Polka from Ballet Suite no.2	.41	90	0.15	0.45	0.68
La vie Antérieure	.10	78	0.17	0.57	0.74
Piano Sonata no. 21, op.53, "Waldstein"	.19	140	0.25	1.27	2.96
21st Century Schizoid man	.46	71	0.28	1.27	1.50
Hungarian Rhapsody no. 2, part 1, "Friska"	.40	170	0.15	0	0
Nosferatu	.056	62	0.29	1.02	1.05
Tangerine	.46	80	0.27	6.69	8.92
Lazy	.15	65	0.29	0.42	0.46
Le Manoir de Rosamonde	.10	93	0.25	1.29	2.00
Ugh! We Come in Peace	.64	115	0.16	0.23	0.71
Braveheart	.53	160	0.27	1.55	4.13
I Will Always Love you	.22	68	0.27	1.61	1.83
Brian Boru's March	.33	106	0.18	0	0
Etude op. 21, no. 10	.16	104	0.36	0	0

APPENDIX 3: Average splits given by participants categorized as familiar or unfamiliar with the excerpts

Table 7: Comparing the original to average approved splits from familiar and unfamiliar ratings in beats

Title	O (s)	Average familiar split (s)	Average unfamiliar split (s)
Take me out	0.61	1.13 (*n* = 16, *sd* = 0.66)	1.56 (*n* = 6, *sd* = 1.63)
Be my Lover	0.34	0.68 (*n* = 5, *sd* = 0.44)	1.40 (*n* = 10, *sd* = 0.74)
Tangerine	6.69	0.72 (*n*= 1, *sd* = NA)	1.64 (*n* = 6, *sd* = 0.92)
Polka From Ballet Suite no.2	0.45	0.95 (*n* = 2, *sd* = 0.50)	1.12 (*n* = 7, *sd* = 0.78)
Nosferatu	1.02	0.72 (*n* = 2, *sd* = 0.26)	0.94 (*n* = 20, *sd* = 0.52)
All I Really Want	1.43	1.88 (*n* = 5, *sd* = 0.37)	1.61 (*n* = 11, *sd* = 1.28)
Le Manoir de Rosamonde	0.57	1.70 (*n* = 1, *sd* = NA)	1.12 (*n* = 14, *sd* = 0.62)
Brian Boru's March	0.00	0.41 (*n* = 1, *sd* = NA)	1.19 (*n* = 10, *sd* = 1.04)
Ugh! We Come in Peace	0.37	1.97 (*n* = 1, *sd* = NA)	1.56 (*n* = 17, *sd* = 1.02)
Etude op. 21, no. 10	0.00	1.98 (*n* = 3, *sd* = 1.39)	2.96 (*n* = 12, *sd* = 1.59)

Table 8: Comparing the original (O) to average approved splits from familiar and unfamiliar ratings in seconds

Title	O (s)	Average familiar split (s)	Average unfamiliar split (s)
Take me out	0.61	0.66 (*n* = 16, *sd* = 0.38)	0.91 (*n* = 6, *sd* = 0.95)
Be my Lover	0.34	0.32 (*n* = 5, *sd* = 0.21)	0.66 (*n* = 10, *sd* = 0.35)
Tangerine	6.69	0.54 (*n* = 1, *sd* = NA)	1.23 (*n* = 6, *sd* = 0.69)
Polka from Ballet Suite no.2	0.45	0.64 (*n* = 2, *sd* = 0.33)	0.75 (*n* = 7, *sd* = 0.52)
Nosferatu	1.02	0.70 (*n* = 2, *sd* = 0.26)	0.91 (*n* = 20, *sd* = 0.50)
All I Really Want	1.43	1.21 (*n* = 5, *sd* = 0.24)	1.04 (*n* = 11, *sd* = 0.83)
Le Manoir de Rosamonde	0.57	1.31 (*n* = 1, *sd* = NA)	0.86 (*n* = 14, *sd* = 0.48)
Brian Boru's March	0.00	0.23 (*n* = 1, *sd* = NA)	0.67 (*n* = 10, *sd* = 0.59)
Ugh! We Come in Peace	0.37	1.03 (*n* = 1, *sd* = NA)	0.81 (*n* = 17, *sd* = 0.53)
Etude op. 21, no. 10	0.00	1.14 (*n* = 3, *sd* = 0.80)	1.71 (*n* = 12, *sd* = 0.92)