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ISSUES AND OPINION

Adding background music as new stimuli of interest to information systems research

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ABSTRACT
Music is a self-evident crucial part of the human experience across cultures, with artefacts dating as far back as the last Ice Age. Music is, as well, an essential aspect of human communication, profoundly influencing the meaning of communication, perception, and behaviour. Music's critical role is recognised in many disciplines, including anthropology, sociology, psychology, neuroscience, medicine, and marketing. The objective of this *Issues and Opinions* paper is to discuss theoretical insights concerning the effects of music stimuli, and to describe how that insight applies to Information and Communication Technology (ICT) contexts. As ICT becomes ever more ubiquitous, and as background music becomes ever more an integral part of ICT interfaces, including music in IS research presents increasing theoretical and practical importance.

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> Music is a higher revelation than all wisdom and philosophy.
>
> Ludwig van Beethoven

1. Introduction: making the case for music in IS research

Music is undeniably a central and crucial aspect of human cultures (Cross, 2001; Huron, 2001; McDermott, 2008). It has even been argued that perceiving sound as music is one of the unique attributes of the human species (Levitin & Tirovolas, 2009), so much so that humans are aware of music even as early as in the womb (Trappe, 2012) where it is reported to reduce heart rate and anxiety (Yang et al., 2009). As early as the last Ice Age (beginning in the Pleistocene Epoch approximately one million years ago), archaeological findings indicate that music may have been an essential part of human culture. In fact, estimates place the first musical instrument found, a flute found in the Geißenklösterle cave in the Danube Corridor in southwest Germany, as far back as 35,000–40,000 years ago (Conard, Malina, & Münzel, 2009).

Despite the recognition that music is inherent to human culture, IS research has all but ignored the possible impact of background music stimuli. This is surprising because music applies to many areas of research that are of interest to IS research. For instance, music can promote products and services in marketing (Alpert & Alpert, 1990; Blood, Zatorre, Bermudez, & Evans, 1999; Bruner, 1990; Coloma & Kleiner, 2005; Gorn, Goldberg, & Basu, 1993; Jacob, 2006; Magnini & Parker, 2009; Milliman, 1982; North, Hargreaves, & McKendrick, 1999; Oakes, 2000; Vida, 2008; Yalch & Spangenberg, 2000). Music also affects emotions (Gosselin, Peretz, Johnsen, & Adolphs, 2007; Krumhansl, 1997), changes behaviour (Keen, 2005), and is prevalent in the workplace (Haake, 2011). Moreover, movies and other forms of entertainment use music extensively to create emotional effects (Bower, 1981; Cohen, 2001; Eschrich, Münte, & Altenmüller, 2008) and medical therapies use music to reduce perceptions of pain and stress (Keen, 2005; Saroyan, 1990). Music also encourages cooperative behaviours (Blood et al., 1999) and may increase interpersonal trust (Juslin & Västfjäll, 2008), both topics of interest to IS.

A possible reason why music has been ignored by IS research is that the study of music in other disciplines has typically been based on its *emotional* aspects. Indeed, music's significance stems predominantly from the fact that it can be used to prime and convey emotions (Freeman, 2000). Levitin and Tirovolas (2009), in a study of the cognitive neuroscience of music, deem it to be "a form of emotional communication" (p. 211).

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Please note that the online version has live links to music from page 10.

This emphasis on emotion stands in contrast to many theories at the core of IS research that do not centre on communicating and manipulating emotions. Using insights from related disciplines, this *Issues and Opinions* (hereafter, I&O) makes a case for the value of adding background music stimuli to IS research.

The inclusion of music stimuli may not have been of much research or practical interest to the types of information and communication technology (ICT) that dominated the 1990s and early 2000s, such as email, enterprise resource planning, and traditional ecommerce. More recently, however, many of the new types of ICT that have emerged – and that have quickly become ubiquitous in everyday life – do use background music as an integral part of their ICT interface (smartphone apps that support virtual communities and gaming being an obvious example). As will be argued in this I&O, understanding this music aspect of the ICT interface is imperative in order to develop a more complete picture of how current ICT are, and can be, used. Importantly, we also demonstrate that including the study of the possible impact of music during ICT *development* promises to deliver new insights.

The sections that follow outline our research ideas in three sample contexts – contexts relating to the effect of background music on (1) influencing social preferences, (2) distracting people while they perform a task, and (3) manipulating stress (see Figure 1). Incorporating background music may also add new dimensions to current IS theory. Those theories are shown with a box bullet in Figure 1, and are discussed in Sections 2 and 3. The I&O discusses insights drawn from anthropology, psychology, and other disciplines. Specific ICT applications to which these insights apply are discussed. Boundary conditions that limit those insights, but that also imply expansions of the insights through mediation and moderation, are also included.

Background music is defined in this I&O as instrumental music. That is, light classical genre music without lyrics. This definition is consistent with most of the literature cited in this I&O. Parentheses throughout the I&O detail the musical pieces applied in previous research to the extent that they were revealed. Studying the effects of music that contains lyrics would inevitably add priming through the words (e.g., Juslin, Liljeström, Västfjäll, & Lundqvist, 2010, p. 641), threatening internal validity. It follows, in principle, that while IS researchers can study the effects of music with and without lyrics, understanding why music leads to specific effects is easier in the case of music without lyrics. The conceptual boundaries are defined as music stimuli played in the background as a person voluntarily uses an ICT for such activities as communicating or playing with other users, personal gaming and online marketing, as well as using the ICT in the software development environment itself. Such ICT usage types are consistent with the literature cited.

The premise underlying this I&O is that the effects music has in brick-and-mortar contexts should apply also in contexts involving an ICT because the effects of music are not claimed in the literature to be context-dependent. Rather, the effects of music are claimed to be generic to people, possibly being the product of long-term evolution (Cross, 2001, 2007). Indeed, music has always been an integral part of the human experience and has often been applied to influence other people (Cross, 2001; Huron, 2001; Levitin & Tirovolas, 2009). Seen that way, studying the effects of music in the context of an ICT may even allow for a better context to study the effects of music because an ICT environment allows the interaction with music to be more controlled

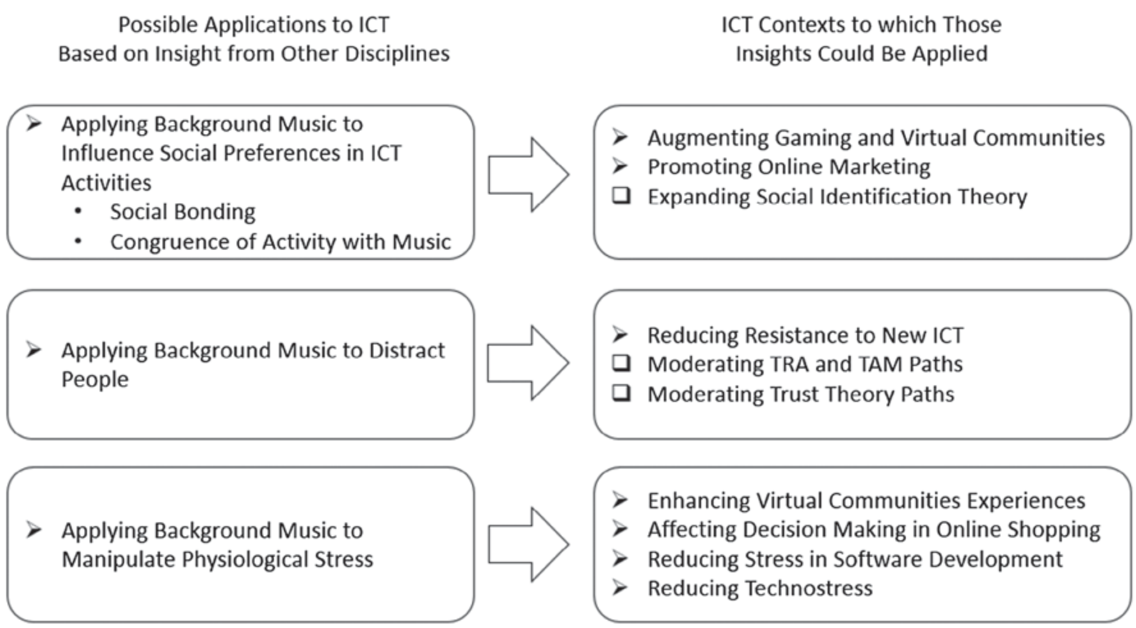

Figure 1. ICT contexts discussed in this I&O.

and more personalised by both the listener and, where relevant, companies controlling the ICT.

This I&O is informed by a recent *EJIS* editorial (Te'eni, 2016) that recognises a need for more "problematization", which is defined as the need "to identify and challenge assumptions that underlie existing theories and, on that basis, generate research questions that lead to the development of more interesting and influential theories" (p. 473). Specifically, we challenge the implied assumption that background music has no role in IS research by suggesting potential applications of music to contexts of interest to IS research and by outlining possibly new directions core theories in IS research could take.

2. Insight about and criteria for applying background music in ICT activities to influence social preferences

2.1. Music and social bonding

Among the many effects that music can generate is the ability of music to create social bonding (Freeman, 2000) and a resulting social cohesion (Abbott, 2002). Hirschi (1969) presented a useful definition of social bonding as an attachment and commitment to the social norms and institutions of a group. When music increases bonding within a group, it also reduces internal aggression, and thus increases that group's success and the likelihood of its propagation and survival (Fitch, 2006). Some researchers attribute social bonding through music to an evolutionary process that begins at the stage of mother–infant bonding (Fitch, 2006). As empirical support for this social bonding hypothesis, music has been shown to regulate and coordinate moods and emotional states of both individuals and groups (Cross, 2001; Juslin & Sloboda, 2001), including bolstering a sense of group identity through coordination (Cross, 2001). Neurologically, music promotes social bonding through synchronisation and release of endorphins (Tarr, Launay, & Dunbar, 2014). Extensive literature reviews provide evidence that background music promotes both interpersonal trust (Juslin & Västfjäll, 2008) and cooperative behaviours (Blood et al., 1999; Juslin & Västfjäll, 2008). Apparently, just listening to music can affect human bonding (e.g., Panksepp, 1995). In fact, adding background music can increase interaction and conversation in groups (e.g., Blood & Ferriss, 1993), and can promote trust behaviour among people who sing together (Anshel & Kipper, 1988). Background music can increase social attraction even when one person simply communicates that he or she likes the same genre of music as another person does (Boer et al., 2011).

2.1.1. Applying the insight to ICT contexts

Allowing that the human response to music is at least partly a matter of evolution, and therefore applies across contexts, and allowing that ICT can be applied to introduce music as never before, the research above suggests several possible avenues of research dealing with applications of music in ICT contexts.

2.1.1.1. The role of background music in augmenting gaming and virtual communities. One possible research and application avenue is that of adding music to increase social bonding in the contexts of online communities, multiplayer online games, and chat rooms. Indeed, background music is already an integral part of online gaming, where it is applied to create emotions and to provide game cues (much as it is used in movies). However, background music can also be used to create a sense of community – leading to the hypothesis that the sense of community, and through it the length of time and investment people make in the community, will be increased by the inclusion of music representing that community. Such a result is anticipated because social bonds are essential for retaining virtual community members (Bock, Ahuja, Suh, & Yap, 2015; Ren, Kraut, & Kiesler, 2007) and, as the research above indicates, music can be manipulated to increase social bonding. As Panksepp (1995) shows through observation of students listening to music, as Anshel and Kipper (1988) conclude from research on group singing, and as Blood and Ferriss (1993) determine from study of conversations that take place when background music is played, adding background music increases social bonding and increases the liveliness and enjoyment of the participants' interaction. If these effects also apply to online contexts such as gaming communities or people in chat rooms – and there is no reason to assume otherwise, considering that on the basis of human evolution people can be expected to behave this way (Cross, 2001), so that the effects should apply across contexts – then adding music should strengthen these ICT-enabled communities as well, prolonging their longevity and adding value to their members.

A sample application of this idea – following the logic in Boer et al. (2011) that even just knowing that another person likes the same genre of music creates an attraction – would be that in the environment of an online community (such as a gaming community, a chat room, and even a newspaper blog), playing a culturally identifiable melody will increase the sense of community, and will induce people who identify with a specific nationality or culture to stay longer and to be more committed. An example of this tactic would be playing the traditional song *Auld Lang Syne* in the background of online community sites during the New Year's Eve season. (The song, literally "Old Long Since", is a traditional Scottish song pledging friendship, and is traditionally and nostalgically sung at New Year's Eve celebrations by people of Scottish or British descent.) Previous IS research did touch on the importance of social bonding for successful ICT adoption (e.g., Gefen & Ridings, 2003; Ifinedo, 2014;

Jung & Sundar, 2016; Lawrence & Tar, 2010), but the idea that such bonding can be induced through music is new. The next section presents one theoretical track that was previously used to elucidate the importance of perceived social grouping, and suggests that the sense of social grouping can be expanded to allow an explication of the importance and consequences of adding background music in virtual communities through ICT.

2.1.2. Expanding social identification theory

On a theoretical basis, the importance of social bonding can be explained through Social Identification Theory (Tajfel, 1978). Social identification is important in human relations because people tend to classify themselves and others into "us" vs. "them" or, in the terminology of Social Identification Theory, as the "in-group" and the "out-group". People then bolster their own sense of value by identifying with their assumed in-group, treating its successes and failures as if they were their own. That in-group identification can be based on shared nationality, social class, vocation, or even preferred soccer club. People tend to adopt what they think are the values, attitudes, typical behaviour, and even attire of their in-group (soccer fans are a prime example of this). Importantly, because such identifications subjectively reflect on their own sense of worth, people tend to over-value their own in-group, and degrade out-groups (Hogg, 1996; Hogg & Terry, 2000; Tajfel, 1978). Simply believing another person to be member of the same in-group can elicit a positive bias towards that person (Tajfel, 1978).

As Gefen and Ridings (2003) show, Social Identification Theory also applies to ICT deployment: companies can increase the successful release of a new ICT by de-emphasising the boundaries between in-groups and out-groups – the boundaries between users and developers, in that case. Gefen and Ridings added that de-emphasising those boundaries reduced the users' resistance to that new ICT because the users then treat the success of the new ICT and its new processes as partly their own project, rather than resenting the new ICT as an external system imposed on them. Conversely, when social identification promotes a sense of being an out-group member, the outcome can be detrimental to a successful ICT deployment, as shown in the context of e-government ICT adoption in South Africa (Gefen, Rose, Pavlou, & Warkentin, 2004). Specifically, Gefen et al. found that perceptions of sociocultural similarity (measured through items such as "The election agency is made up of people like me") had a stronger effect on trust in the national agency managing a new e-voting system in South Africa than in the USA because, they concluded, of the greater and more contentious racial divide in South Africa. That hypothesis is in agreement with Zucker (1986) who studied the development of trust in US banking in the nineteenth and early twentieth centuries and who determined that the sense of belonging to the same social group was a key drive in building initial trust in the US banking industry. Indeed, additional detailed analysis in Gefen et al. showed that the difference between the US and South Africa in levels of both trust and sociocultural similarity was primarily among people who identified themselves as white. As the data were collected only several years after apartheid was dismantled and with it Afrikaans (spoken by 25.6% of their sample) delegated from one of the two primary languages (together with English) to just another one of the 11 spoken languages, it might not be surprising that Afrikaans speakers felt disenfranchised and had less trust in the government. Subsequent research on IT implementation showed that such a sense of belonging to the same social group was a key drive in building trust also in contexts involving IT implementation (Gefen, 2004). Applying those findings to the context of music and IT management implies that when specific music is a cultural identifier, and possibly also a social divider, that music could be applied to amplify social rifts and emphasise social identity, or, alternatively, to emphasise joint social identity and so reduce social tensions. Such an emphasis could both bolster the success of an IT, by broadcasting that it is made by "one of us" and therefore its shortcomings should be deemphasised as in Gefen and Ridings, or hinder it, by broadcasting that it is made by "one of them" and therefore its shortcomings should be emphasised, as in Gefen et al.

Put into perspective, research has recognised that social identification can be manipulated by various behavioural stimuli, such as playing sports together. Social Identification Theory does not address music. However, experiments conducted by Anshel and Kipper (1988), showing that singing together promotes a sense of being part of a cohesive group, could be interpreted as support for the idea that music could promote social identification. Such an idea of music promoting social identification would be consistent with observations indicating that background music can lead to, or amplify, social grouping (Cross, 2001). On this basis, adding background music to an ICT that supports a gaming or a virtual community could increase the sense of community, which would – as predicted by Social Identification Theory – create greater approval and enthusiasm for the value and importance of the community.

2.2. Congruence of activity with music

The effects of background music on behaviour have been shown to apply even when no actual community is involved, and therefore where social bonding is immaterial. The mechanism involved in such a case, as claimed by North et al. (1999), is the human tendency to try to maintain congruence across stimuli. In their study, the preference for congruence resulted in customers preferring either German or French wine depending on whether German or French stereotypical music was being played at the time they were selecting the wine (North et al., 1999). Replicating the concept of congruence, Guéguen and Jacob (2010) report that people spent more money purchasing flowers in a florist's shop when they heard "congruent music" such as love songs and romantic music than when they heard "incongruent music" such as pop music or no music at all. Other research shows that accommodation choice for a fictitious seaside resort was affected by the type of instrumental music played at the website (musical details not specified), such that subjects preferred camping when they heard music played on a West African djembe (a goblet-shaped skin drum), but preferred a hotel room when they heard jazz (Guéguen & Jacob, 2012) (In survey research, an equivalent tendency is known as demand characteristics: subjects impose a shared meaning across survey items, even when no shared meaning was intended by the researcher, and respond accordingly, showing congruence across their answers (Cook & Campbell, 1979; Shadish, Cook, & Campbell, 2002)).

2.2.1. Applying the insight to ICT contexts

The studies of relationships between music and wine choice, music and shopping, and music and resort preference are informative. However, those studies present little substantive theory to suggest reasons for those results. To conclude based on those studies alone that such congruence between the music and the product or service automatically applies to any combination of music with products or services in any situation is clearly a conclusion that reaches beyond what can be supported by the original studies. Nonetheless, the need for congruence that North et al. (1999) suggest is not limited to brick-and-mortar shops, and by logical extension tentatively applies to other scenarios too. Specifically, North et al. (1999) argue that because people prefer "congruency", then when they select a product "typical exemplars of a given category should be preferred to a less typical exemplar" (p. 272). Along those lines, Guéguen and Jacob (2012) interpret North et al. (1999) as suggesting that "[b]ackground music is considered to be congruent with a product if rational or symbolic information is connected with the product being offered", and that "the music played could have oriented this choice by priming knowledge about a country that produces wine" (p. 30). Guéguen and Jacob's (2012) logic about music priming the subjects, when applied to marketing through an ICT, suggests that preference for products or services congruent with background music can also be expected in the case of targeted marketing enabled by an ICT. The next section discusses such an option.

2.2.1.1. The case of background music in promoting online marketing. By the same logic of people seeking congruence between the music they hear and the activity they perform, and therefore preferring French wine to German wine when they hear French music (North et al., 1999), buyers should prefer a French app to a German one if the background music they hear at the time is French. North et al. suggest that a possible process behind such preferences is that people categorise stimuli into cognitive groupings, and that these groupings then form knowledge associations that prime the person into thinking about what is associated with that knowledge association. In the case of music, that mechanism, suggest North et al., might result in stereotypically French music eliciting thoughts about French things, and such thoughts should, hypothesise North et al., create a preference for French wines because the person is thinking about French things at that moment. That hypothesised seeking of congruence logic resonates with framing theory (Goffman, 1974). According to framing theory, the way people process information is related to the context in which it is presented, i.e., the "frame". A common application of the theory is in the way journalists choose to present the news to structure the message they want people to take from it. Many things can create a frame, including metaphors and stories, and, importantly in the case of music, also artefacts that remind the person of intrinsic symbolic cultural meaning. Accordingly, viewing the North et al. experiment through the lens of framing theory can be interpreted as the French background music setting the frame of a French cultural context, and that frame then serving as the context through which the choice of wine is made. Viewed that way, people should also prefer one virtual community or gaming site over another based on cultural associations with the background music at the site. Such priming-based preference setting could be manipulated by introducing background music to increase membership in and time spent at an ICT-enabled community. As indicated in the Introduction, if the effects of music are based on evolution (Cross, 2001), then they should apply across contexts. Likewise, drawing a direct parallel between traditional stores in North et al. (1999) and in Guéguen and Jacob (2010) to ecommerce sites implies that choosing background music congruent with the assumed nationality of the product (as in the case of wine) or an association with a product (such as flowers with love songs) should increase sales carried out through an ICT.

2.3. Boundary limitations

To the best of our knowledge, no research has studied either social bonding or congruence in relation to music in ICT contexts. The limited research on music and ecommerce, however, suggests that it may be difficult to isolate the effects of music on social bonding from its effects on emotion or arousal. The reason for that difficultly is that social bonding – because it deals with perceiving others as "being like me" (Hogg & Terry, 2000; Hogg, 1996) – might elicit a possible emotional response too (Tajfel, 1978). As a result, adding background music to online shopping sites, as well as to gaming and virtual communities, may create an effect not only through social bonding, as suggested, but also through emotional and arousal responses from interacting with people "like me".

The well-established relationship between music and emotion demonstrates that difficulty. Some recent studies on that relationship in ICT contexts include the following. Wu, Cheng, and Yen's (2008) laboratory experiment shows that both music (unspecified instrumental music) and colour may exert significant influence on participants' self-reported emotional response which, in turn, may influence behavioural intention. On the subject of arousal, Lai and Chiang (2012) in another experiment also found that background music (Vivaldi, *The Four Seasons: Spring*) increased pleasure, arousal, and approach behaviour intention. Xu and Sundar (2014) likewise found that arousal can be manipulated by varying the background music (Schubert, *Ava Maria*, and Rossini, *William Tell Overture*). In another experiment, Lorenzo-Romero, Gómez-Borja, and Mollá-Descals (2011) showed that adding pop music to a website can lengthen the time subjects spend at a site, indicating that music may also affect online behaviour in other ways.

Adding difficulty to the problem of isolating the effects of music on social bonding from its effects on emotion or arousal, none of the studies above considered social bonding or congruence in their design. And so, while those studies are revealing, it is impossible to find support for social bonding or congruence in their results. Indeed, the lack of a comprehensive theory on how music affects social behaviour is a serious drawback in the study of the topic. Moreover, even the literature discussed in this section – including the notion of congruence (North et al., 1999) and Social Identification Theory (Tajfel, 1978) – does not make an explicit distinction between the emotional and cognitive sides of decision-making. This lack of distinction presents researchers with a methodological challenge in studying the effects of background music on behaviour as viewed from the perspective of congruence or social identification in isolating its emotional and cognitive effects. The next section will suggest another approach to studying the effects of the cognitive side only.

3. Insight about and criteria for applying background music to distract people

3.1. Music and distraction

Music can be distracting. This was shown in driving performance tests (Shek and Schubert, 2009; van der Zwaag et al., 2012), as well as in self-reported mental effort across driving tasks (Ünal, Steg, & Epstude, 2012). A possible reason for this distraction is that hearing music, because it takes up cognitive resources, lessens the amount of cognitive resources left available for other tasks (Balogun, Monteiro, & Teseletso, 2013). That is, people have limited cognitive attention abilities, and hearing music captures part of that attention. Supporting the view that music can be a source of distraction, Brodsky (2002), Beh and Hirst (1999), and North and Hargreaves (1999) suggest that the more arousing the music is (predominantly manipulated by tempo and loudness, with more beats per minute and increased volume resulting in greater arousal), the more cognitive capacity it consumes. By implication, such musical distraction could weaken the effects of many exogenous variables that are of interest to IS, such as assessments of ICT usefulness and social norms. This does not mean that people become less rational or show less consideration for the social context but, rather, it means that when people become distracted, they pay less attention to such important considerations than they would otherwise. This "paying less attention" on the behavioural level may have a neurological root cause – namely, that hearing background music utilises some of the brain's processing capacity that would otherwise be used to assess the ICT and to retrieve memory about beliefs, attitudes, and behaviours of other actors.

Distraction can also be positive, which is confirmed by research indicating that background music also affects decision-making by increasing people's pleasure (Blood & Zatorre, 2001). Conversations taking place in the presence of background music are perceived as more satisfying (Blood & Ferriss, 1993). Similarly, adding background music when telephone customers are put on hold results in lower levels of dissatisfaction, and less awareness of how long they have been waiting (Peevers, McInnes, Morton, Matthews, & Jack, 2009). Including background music as pleasant stimuli also explains why adding music in advertising increases the attention given to an advertising message (Allan, 2006). It seems that people make a gestalt assessment of the situation, considering all aspects of the situation together whether relevant or not, so that incorporating pleasant stimuli in the form of music may add to an overall positive assessment.

3.1.1. Applying the insight to ICT contexts

Background music can also be manipulated to distract users who oppose a new ICT. It may also have manifest implications for some of the leading theories in IS. The next section will discuss some of those theories, and in doing so provides additional rationale for the reasons why distraction may be manipulated to play a crucial role in ICT deployment and acceptance.

3.1.1.1. The case of background music in reducing resistance to new ICT. Employee resistance to new unwelcome ICT could be reduced by introducing background music into the ICT training process. Reduced resistance may come about through both distraction that hampers the employees' assessment process against the ICT, and through inducing a positive mood through the background music to counterbalance the negative feeling towards the ICT. Moreover, considering that background music is prevalent in computer-based office environments, desired distraction could be programmed into many workplace activities through the ICT itself. When negative issues become critical (such as problems with the ICT), background music could be programmed to promote constructive employee behaviour through distraction. Background music could also be applied in such cases to induce positive mood. Showing how prevalent background music is, a recent study in the UK showed that in computer-based office environments, on average, employees listened to music 36% of their working time (e.g., while "doing word processing tasks" or "surfing internet/e-mailing" (Haake, 2011, p. 115)). In theory, such distraction can be explained through the moderating effects distraction should have on assessments. The next section explicates that distraction effect in the context of two leading theories that deal with reasoned and usefulness assessments.

3.1.2. Moderating the effects suggested in the theory of reasoned action and the technology acceptance model

A considerable amount of IS research has its roots in the theory of reasoned action (TRA) (Ajzen, 1985; Ajzen & Fishbein, 1980) and in the assessments of perceived usefulness and perceived ease of use in the technology acceptance model (TAM) (Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003). Research based on those theories assumes that before people choose to use an ICT or decide how to use it, they evaluate the ICT and the potential utility of their actions through its. If background music affects people through distraction, then distraction through music should apply also to the TRA and TAM assessments. Accordingly, distracting people with background music should moderate the importance of the TRA and TAM behavioural antecedents of intended behaviour. Adding this to TRA and TAM constitutes a potentially important extension of both theories, as neither TRA nor TAM considers distraction, and especially not distraction brought about by background music. If, as postulated by TRA, people consider their beliefs about the expected outcome and consider what others think about their behaviour before forming their own attitudes and subjective norms (serving as antecedents to their behavioural intentions), then it follows that distraction brought about by background music should impair this process. Background music should, accordingly, moderate the effect of those belief and norm antecedents on behavioural intentions. Regarding TAM, similarly, both the assessments of perceived usefulness and perceived ease of use and their subsequent effect on behavioural intentions could be moderated through distraction caused by background music, thereby reducing both the strength of those assessments and their importance in determining behavioural intentions towards an ICT.

3.1.3. Moderating the effects suggested in trust theory

Another theory context for which such distraction may be of importance is in the area of trust. Trust is a core theory in IS, especially as it applies to virtual communities, ecommerce, and ICT adoption (Benbasat, Gefen, & Pavlou, 2010). Deciding whether to trust another person is, in part, a rational process of assessing the past and the expected behaviour of others (Gefen, Karahanna, & Straub, 2003; Mayer, Davis, & Schoorman, 1995; McKnight, Choudhury, & Kacmar, 2002; McKnight, Cummings, & Chervany, 1998; Pavlou & Gefen, 2005). The rational side of trust has also been confirmed by cognitive neuroscience research. For reviews, see Dimoka (2010), Riedl, Hubert, and Kenning (2010), Riedl and Javor (2012), and Riedl, Mohr, Kenning, Davis, and Heekeren (2014). The distraction brought about by background music should be at play in the context of trust too. If people are distracted by background music when deciding whether and how much to trust other people, they are likely to pay less attention to the past behaviours, or to the possible current behaviours, of others when deciding to what degree to trust them.

To demonstrate the consequences of such a distraction consider the frequently cited integrative model of organisational trust by Mayer et al. (1995). In their theory, trusting behaviour is the result of trustworthiness assessments, with trustworthiness being understood as a combination of the assessments of ability, benevolence, and integrity. Trustworthiness itself is determined by assessments of previous outcomes. Implied in that theory is that people invest cognitive energy in assessing other people and in assessing their own previous behavioural outcomes. If adding background music can distract people during this cognitive assessment process, then it follows that the weight of previous outcomes in determining trustworthiness will be reduced. In other words, the process of deciding whether and how much to trust others could be moderated by the introduction of background music as a distraction. Integrating trust and TAM, as in Gefen et al. (2003), suggests that background music may actually concurrently distract both the TAM and the trust theory paths.

3.2. Boundary limitations

Distraction, as discussed in the previous section, is a mostly negative consequence of listening to music. However, distraction also has a positive side. In essence, listening to music *prior* to executing a task may have the potential to increase attention and performance (Dalton & Behm, 2007) – perhaps because listening to sedative music prior to executing a task is relaxing. This was demonstrated in a well-known study by Borling (1981) that objectively measured attention through electroencephalography (for a description of this neuroscience tool from an IS perspective, see Müller-Putz, Riedl, and

Wriessnegger (2015)). In Borling (1981), subjects were instructed to close their eyes while a musical piece was played for five minutes. After that, the subjects were asked to open their eyes and were immediately administered a Maze Tracing Speed Test (MTST). The results showed that sedative music (Debussy, *G minor String Quartet*) positively affected performance. The positive effects of distraction that result from listening to music, and not only the negative ones, have practical implication for ICT users. The ability to distract ICT users from their anxiety is one such application. Anxiety is known to have detrimental effects on users and their use of an ICT (Riedl, 2013). More on how music can reduce anxiety, in that case physiological rather than psychological, appears in the next section.

4. Insight about and criteria for applying background music to manipulate physiological stress

4.1. Music and physiological stress

Background music also moderates physiological stress. Depending on the specific musical piece, music can either lower or increase the physiological stress that results from the perception of a stressor. Being physiologically stressed often results in deficient decision-making, such as not taking all available relevant information into account (Keinan, 1987), and being more biased (Porcelli & Delgado, 2009). Basically, when people are physiologically stressed, their behaviour is less calculated and not as carefully thought out (Starcke & Brand, 2012).

Background music has been shown to reduce physiological stress symptoms such as galvanic skin response, vasoconstriction, muscle tension, respiration rate, heart rate variability, pulse rate, and blood pressure, and to lower levels of the stress hormones adrenaline, noradrenaline, and cortisol. For reviews, see McCraty, Barrios-Choplin, Atkinson, and Tomasino (1998), Koelsch and Siebel (2005), Lea Wolf and Wolf (2011), and Chanda and Levitin (2013). Research suggests two major mechanisms through which background music may reduce physiological stress (e.g., Wiesenthal, Hennessy, and Totten (2000)). First, music may *distract* people from the stressful stimuli, and thereby draw their attention away from the cause of their physiological stress. Unlike the previous discussion about cognitive distraction, this distraction has physiological consequences. Second, music may facilitate *relaxation* through the release of reward-related substances such as dopamine and opioids (Creutzfeldt & Ojemann, 1989; Koelsch, 2010; Koelsch, Fritz, Cramon, Müller, & Friederici, 2006; Koelsch & Siebel, 2005; Menon & Levitin, 2005). It is important to note that both mechanisms may act in concert. The neurochemical changes resulting from these mechanisms may explain why the application of music therapy after surgery is effective in reducing pain (Nilsson, 2009). Another aspect of the diminished physiological stress that results from listening to music is the release of oxytocin (Nilsson, 2009), making people more trusting (Zak, 2008) and thereby reducing social anxiety (Bartz, Zaki, Bolger, & Ochsner, 2011).

Listening to music, especially listening to music that has a slow tempo, that has no lyrics, and that is set in a low pitch (e.g., Pachelbel, *Canon in D major*) is also related to reducing signs of physiological stress, including reduced heart rate, blood pressure, and stress hormones, as well as increased salivary IgA (Immunoglobulin A), thereby making music an effective anxiolytic (Knight & Rickard, 2001). In a similar context, Khalfa, Bella, Roy, Peretz, and Lupien (2003) found that among healthy subjects who listened to music after being exposed to the Trier Social Stress Test (a major paradigm used to induce stress experimentally), levels of the stress hormone cortisol were reduced. Related studies have found that patients who listened to music (self-selected from among unspecified pieces in nine pre-selected genres) before and after surgery had reduced systolic blood pressure readings after surgery, and showed no post-surgical increase in cortisol levels. In contrast, patients who did not hear music retained their high systolic blood pressure levels and showed an increase in cortisol levels after surgery. As well, a significant correlation between cortisol levels and self-reported anxiety was reported (Schneider, Schedlowski, Schürmeyer, & Becker, 2001). These results are consistent with Pelletier's (2004) review of 22 studies on the potential of music to decrease the arousal caused by physiological stress. That review concluded that "music alone and music assisted relaxation techniques significantly decreased arousal" (Pelletier, 2004, p. 192). That conclusion was demonstrated through the reduction of physiological stress that was related to medical procedures, such as surgery and labour, as well as to the reduction of physiological stress that was related to occupational-related stress. Music was found to be most beneficial in reducing physiological stress when it was familiar music, when the method was applied to musicians and to people under 18, and when the music was in a slower tempo with regular rhythms (such as Bach) and with no lyrics (Pelletier, 2004).

Physiological stress reduction achieved through music may, however, be less pronounced if people are familiar with the stressful task. This was shown in a study by Lesiuk (2008) who examined the effect of preferred music listening on work stress among 33 air traffic controllers. Air traffic controllers' work is characterised by a significantly high level of stress and by intensive interaction with ICT. In this two-week field-setting longitudinal study, the treatment group listened to their preferred music (freely chosen from six genres such as jazz and classical) in four work breaks of 15 to 20 min each, while the control group sat in silence during these breaks. Dependent variables included, among others, heart rate, mean arterial pressure, and self-reported work stress. From a stress perspective, the most important result is that *no* significant difference in physiological activation was found between the groups. Thus, in that specialised condition of highly experienced employees, music had no stress-reducing effect on biological markers, suggesting that experience with the stressful task is a moderator. The treatment group, however, did report lower levels of self-reported stress.

Another important aspect of the influence of music is how the tempo affects decision-making. It has been established that music tempo is positively correlated with arousal and physiological stress, as well as with the cognitive capacity needed to process music (e.g., Brodsky (2002)). Based on eye-tracking data, Day, Lin, Huang, and Chuang (2009) found that information search patterns in multi-attribute decision-making are affected by the tempo of music played in the background. Specifically, that study found that with increasing tempo, search patterns shifted from option-wise processing to attribute-wise processing. In option-wise processing, the attribute values of a single option are considered before information about the next option is processed; in attribute-wise processing, the values of several options on a single attribute are processed before information about another attribute is processed. Research indicates that, compared to option-wise processing search, attribute-wise search processing has multiple effects, two of which are that people process information that is less potentially relevant, and that people make decisions faster (Payne, Bettman, & Johnson, 1993; Riedl, Brandstätter, & Roithmayr, 2008).

4.1.1. Applying the insight to ICT contexts

Based on the research cited above, by dynamically changing the levels of physiological stress that people experience, music could play an even broader role in many ICT contexts than those presented in Sections 2 and 3. Some of those applications are discussed next. On the basis of the value that people give to assessments related to TRA, TAM, and Trust Theory (as presented in Sections 3.1.2 and 3.1.3), the implications of reducing physiological stress through the introduction of background music strengthen the argument in support of the proposed moderating effects of adding background music. While those sections present support from behavioural research, this section adds a physiological aspect.

4.1.1.1. The case of background music in enhancing virtual community experiences. Physiological stress reduction through music may play an important role in virtual communities. Among the many reasons that such communities exist, a primary purpose is providing emotional support to persons who are experiencing distress (when a family member is gravely ill, for example) (Ridings, Gefen, & Arinze, 2002). As mechanisms for emotional support, *distracting* and facilitating *relaxation* could be applied to improve the quality of interaction and of service provided to people visiting such sites. Using music to instigate the release of oxytocin (Nilsson, 2009) could be another important consequence of adding music to such sites. (Note that oxytocin is a major trust hormone; for a review of related literature, see Riedl and Javor (2012)). In virtual communities that serve other purposes, the addition of music could facilitate both increased and decreased physiological stress, as may be relevant for the specific virtual community. For example, a virtual community dedicated to replaying great moments in football could add background music to increase physiological stress at desired moments, thus creating a physiological experience that is more comparable to a real game. In the case of virtual communities that facilitate discussions and social interactions, the addition of music could conceivably be applied to reduce social anxiety. As in other social settings (Bartz et al., 2011), the addition of music could be applied to reduce social anxiety, thereby promoting more sincere and valuable discourse. In such cases of discussions and social interaction through a virtual community, the tempo of the added background music could be manipulated to influence thought processes that members apply, as in Payne et al. (1993) and Riedl et al. (2008), and in this way influence what they pay attention to. To the best of our knowledge, research has not yet studied these topics.

4.1.1.2. The case of background music affecting decision-making in online shopping. Adding background music to reduce physiological stress could be applied to online shopping as well, which could be especially important for shoppers who are naturally stressful or in stressful circumstances, such as selecting among crucially important products and services. Moreover, as Day et al. (2009) show in other contexts, faster tempo music can be added to induce attribute-wise searching rather than option-wise searching. Considering that many online retailers, including Amazon.com, present product information in a matrix format (particularly with technical products), background music could be applied to manipulate how customers assess the information presented to them. To the best of our knowledge, research has not yet studied these possibilities. Selectively distracting or manipulating customers may not be what Amazon is about, and would almost certainly create a backlash and legal action, but in other contexts, such as training, it could be an option. It may also be that to commercially apply such insight requires additional research into the specific effects of specific genres on specific people under specific conditions. Indeed, music does not automatically always increase oxytocin (Riedl, Javor, Gefen, Felten, & Reuter, 2017).

4.1.1.3. The case of background music in reducing stress for software developers. Another IS area where music has an impact on physiological stress is that of reducing stress among software developers. Software development is often very stressful (e.g., Glass (1997)). That music can reduce physiological stress levels among software developers has been shown by research. Lesiuk (2000) investigated the influence of music on programmer anxiety (a stress proxy) and software error identification. Seventy-two students enrolled in an "Introduction to Programming" course at a North American university were randomly assigned to one of the three experimental conditions: (i) no music, (ii) 11 min of music before conducting tasks, or (iii) 11 min of music before conducting tasks and continuing throughout the tasks (Brahms, *Symphony #1*, https://www.youtube.com/watch?v=EGRqIGOAPcE&t=87s; Respighi, *I pini del Gianicola from Pines of Rome*, https://www.youtube.com/watch?v=62V-ALlLZSg; Haydn, *Concerto for Cello and Orchestra No. 1 in C, Adagio*, https://www.youtube.com/watch?v=LlnmKv_Nt0I; Sibelius, *Swan of Tuonely*, https://www.youtube.com/watch?v=FXS2DabqBI8; Villa Lobos, *Bachianas Brasileiras, No. 5*). The first task lasted 15 min and required subjects to locate and correct programming language syntax errors; the second task lasted 20 min and required subjects to locate and correct logic errors in a given C language program. Anxiety was measured with STAI (State Anxiety Inventory Form). Error identification performance was evaluated by the professor and the teaching assistants (scale: 1 to 5; 5 awarded to subjects whose corrected program could be executed with complete success). The group presented with the most music (i.e., prior to and during the tasks) experienced significantly lower levels of anxiety. (There was no statistically significant difference in task performance between the three groups; however, the group with the most music had the highest mean scores, both in the syntax error and the logic error correction tasks.)

In a subsequent longitudinal field study, Lesiuk (2005) investigated the effects that listening to music imposes on software developers' positive affect, work quality, and time-on-task. Lesiuk (2005) collected data from 56 programmers at four North American software companies, during weeks when the programmers did and did not listen to music (self-selected). Results indicate that positive affect and work quality were lowest in the weeks that had no music. In another study, Lesiuk, Polak, Stutz, and Hummer (2011) examined the effect that 10 min of music listening before task completion would have on work performance. Sixty-two professional database modellers (from North America, Australia, England, and Germany) participated in an online study in which half of the modellers were randomly assigned to the treatment group (self-selected music prior to the task) and half to the control that did not listen to music before the task. The task required participants to create an Entity Relationship Diagram (ERD) for a business problem. The task required approximately one hour to complete. Participants also completed an online survey on demographics, personality, prior modelling knowledge, and mood. Results indicate that objective measures of work performance (i.e., ERD quality) were *not* affected by the experimental treatment of music listening. However, music had a significant effect on decreasing nervousness and increasing relaxation.

4.1.1.4. The case of background music in reducing technostress. Reducing physiological stress through music could play a major role also in reducing technostress. Technostress is a form of stress that results from direct human interaction with an ICT, as well as from perceptions, emotions, and thoughts regarding the implementation of such technologies in organisations and society at large (Riedl, 2013). Technostress can cause physiological stress too. Research has shown that a computer system breakdown, presented visually in the form of a pop-up error message, significantly increases the stress hormone cortisol (Riedl, Kindermann, Auinger, & Javor, 2012), as well as electrodermal activity (Riedl, Kindermann, Auinger, & Javor, 2013). Likewise, long and variable system response times may result in the activation of sympathetic division of the autonomic nervous system (ANS), including elevated blood pressure and increased heart rate and electrodermal activity (Boucsein, 2009). Those effects are usually relatively independent of expertise, which indicates that long-term habituation seldom takes place (Trimmel, Meixner-Pendleton, & Haring, 2003). Reducing technostress is also important because it is related to health issues (Anderson, 1985; Brod, 1984; Weil & Rosen, 1997) and may result in detrimental biological consequences—among other effects, technostress increases blood pressure, heart rate, electrodermal activity, muscle tension, and release of stress hormones such as adrenaline and cortisol (see Riedl (2013) for a review). Technostress and human health, in turn, significantly affect user satisfaction, as well as user work performance and productivity (Tams, Hill, Ortiz de Guinea, Thatcher, & Grover, 2014; Turner & Karasek, 1984).

Practically, adding background music when people are biologically stressed from their interaction with an ICT can be a major technostress countermeasure. Research indicates that salivary Immunoglobulin A (IgA) increases immediately after a brief exposure to stress factors (immediate stress effect, which is an adaptive reaction of the body), and usually decreases several days after the stress ends (delayed stress effect) (e.g., Nomura, 2006; Tsujita & Morimoto, 1999). IgA is an important substance in the immune system (Jemmott & McClelland, 1989; Woff & Kerr, 2006). In consideration of these IgA effects, Nomura, Tanaka, and Nagashima

(2005) experimentally examined whether engagement in a human–computer interaction task affects salivary IgA levels, and, if so, whether exposure to *pleasant music* ("slow tempo, instrumental, and not too much inflexion", p. 132) can alter this effect. In a within-subjects design, participants were asked to perform a cognitively demanding human–computer interaction task (calculation and inputting data), and were instructed to perform the task as fast as possible (the task lasted 30 minutes). After that, each subject was exposed to seven minutes of (i) pleasant music, (ii) noise, or (iii) silence while resting in a dark room. IgA measurements were taken before the task, after the task was completed, and after the exposure to one of the treatments. Results indicate that IgA levels significantly increased from the first to the second measurement point, confirming prior evidence that human–computer interaction is indeed biologically stressful. Supporting the implied role of music in reducing technostress, the results show that the levels of IgA decreased significantly more in the music condition than in the other two conditions (noise, rest in a silent dark room). Even more importantly, IgA decreased nearly to baseline levels within seven minutes in the music condition. These results confirm prior results from non-IS domains that demonstrated music's potential to decrease salivary IgA levels (Charnetski, Brennan, & Harrison, 1998; Kuhn, 2002; McCraty, Atkinson, Rein, Creek, & Watkins, 1996), and thereby to contribute to "a first line of defence against bacterial and viral infections" (Chanda & Levitin, 2013, p. 179).

By extension, these results suggest that adding background music could become an important aspect of using an ICT. Software trainers could include relaxing background music during breaks when they are instructing stressed trainees. Online income tax preparation programmes could also add relaxing music between data-entry sections (such as when showing a progress bar as the data are being compiled into the tax report) to reduce the physiological stress levels. Likewise, applications that take a long time to complete, such as building complicated statistical models, could play relaxing background music as they churn the data.

4.2. Boundary limitations

Music has been shown to reduce physiological stress, but it is noteworthy that in Lesiuk et al. (2011) the significant reduction in stress and the increased relaxation brought about by music was stronger among women and developers who had higher levels of IT experience. Thus, it may be necessary to account for gender and experience when studying the effects of music on physiological stress. Indeed, even for purely behavioural aspects, men and women use and perceive ICTs differently, even a simple ICT such as work-related email (Gefen & Straub, 1997). Additional empirical support for the expectation that men and women might respond differently to musical stimuli comes from Nater, Abbruzzese, Krebs, and Ehlert (2006), who exposed subjects (26 men and 27 women) to relaxing, pleasant Renaissance music in one experimental condition, and to arousing, unpleasant heavy metal in the other condition. Responses to psychological measures of stress as administered through a survey did not differ significantly between the men and the women. However, the physiological measures (heart rate, electrodermal activity, skin temperature, salivary cortisol, salivary alpha-amylase) differed significantly. Only female participants demonstrated an increase in heart rate, electrodermal activity, and skin temperature in response to the unpleasant music stimuli. Nater et al. concluded that

> women tend to show hypersensitivity to aversive musical stimuli. This finding is in accordance with previous literature on sex differences in emotion research. Furthermore, our study indicates that the confounding effects of sex differences have to be considered when using musical stimuli for emotion induction. (p. 300)

It is also important to add that there are good reasons to believe that varied genres of background music reduce or induce physiological stress differently. While there is no comprehensive theory to explain why different music genres have different effects, the few studies on the topic to date reveal noteworthy results. A major observation is that different genres do indeed have different effects. Classical music, especially Bach and Mozart but apparently not Beethoven, is most effective in therapy to reduce physiological stress. This is likely because the harmonics in Classical music represent mathematical series, so that "sudden changes" in the musical piece are avoided (Trappe, 2012). In contrast, Heavy Metal and Techno genres are not only ineffective for therapy, but may actually be dangerous, as they encourage anger, aggression, and stress. While Classical music reduces blood pressure and heart rate, Heavy Metal and Techno genres actually increase blood pressure and heart rate (Trappe, 2012). Higher blood pressure and heart rate are, as discussed above, indicative of physiological stress. McCraty et al. (1998) also show that Classical music (Mozart, *Six German Dances, Numbers 1–3, K. 509*, https://www.youtube.com/watch?v=vHiUiypIgc8 and *Piano Concerto in D minor, K. 466*, https://www.youtube.com/watch?v=yM8CFR01KwQ) reduced self-reported tension. New Age music (including "How Can I Keep From Singing?", *Marble Halls*, and others from Enya's *Shepherd Moon*) also increased self-reported relaxation and reduced hostility and tension, but also resulted in reduced mental clarity and vigour. In contrast, McCraty et al. show that Grunge Rock music ("Last Exit", "Spin the Black Circle", https://www.youtube.com/watch?v=7P9nt-dIM5v0 and others from Paul Jam's *Vitalogy*, https://www.youtube.com/watch?v=Q0tklHS5bN8) increased hostility, fatigue, sadness, and tension, resulting in a reduction in self-reported caring, relaxation, mental clarity, and vigour. As Trappe (2012) writes: "The most benefit from music on health is seen in classical and in mediation music, whereas heavy metal or techno are ineffective or even dangerous" (p. 140).

The ability to both induce and reduce physiological stress through choice of genre and tempo constitutes an important intervention in ICT contexts for which background music can be applied. For example, in gaming contexts, music can be used to increase physiological stress, thereby giving gamers a heightened sense of thrill. In the technostress context, in contrast, music can be used to reduce physiological stress, thereby contributing to users' well-being.

Another important boundary aspect is the tempo of the music (see Appendix 1). A slower tempo usually reduces physiological stress, and a faster tempo increases it (e.g., Bernardi et al., 2009). A faster tempo of Classical music increases heart rate, blood pressure, and breathing rate, while slower Classical music reduces heart rate, blood pressure, and breathing rate (Trappe, 2009). This effect may occur because Classical music, especially at a rhythm of six cycles a minute, can synchronise a person's inherent cardiovascular rhythm (Grewe, Nagel, Kopiez, & Altenmüller, 2005).

5. Conclusion

When Ludwig van Beethoven stated that "Music is a higher revelation than all wisdom and philosophy", he may have been saying that music adds new dimensions to the human experience, and that without music life would be far more bland. Taking that view, the objective of this I&O was to suggest the importance of adding music into IS research. The insights we provide have barely scratched the surface of the vast potential of deliberately adding music to ICTs to influence users, but even this preliminary investigation suggests that adding music could open new avenues for research, and that at least some of the theories at the core of much IS research could be extended to include music.

Arguably, the need for this change has always existed, but now that music can easily be incorporated into ICT-supported activities, including those activities involved in the development of new ICT, it is time for music to make its way into mainstream IS research. As society becomes ever more dependent on ICT, and, through ICT, is increasingly exposed to the easy and ubiquitous insertion of background music into ICT interfaces, the importance of understanding how music changes human behaviour and experience only grows. One need only look around, walk the streets, or ride the Metro to realise how ICT and the music that has become an integral part of it have, in tandem, become almost an umbilical cord of daily existence. That being said, studying music in the context of ICT does present unique challenges, some of those have been discussed above such as the realisation that music comes in many styles and genres and that it is not a monolithic construct. That is a challenge, but also an opportunity. The addition of music into IS research is a promising direction, we urge researchers to rise to the challenge. The theoretical contexts presented in this I&O, such as framing theory (Goffman, 1974) and Social Identification Theory (Tajfel, 1978), could be good starting points. Researchers should also realise that music is listened to in many contexts and is understood and appreciated differently by different people. It is multidimensional stimuli (in plural) and is closely tied to culture. That is a methodological challenge, but it should not detract from studying this promising realm.

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Appendix 1. Attributes of music.

Attribute	Definition	Reaction Time
Pitch	A property that allows the ordering of sounds (resulting from a vibrating body that produces sound pressure waves) on a frequency scale (usually the number of cycles of the wave form per second, measured in Hertz [Hz]). "Higher" pitches (i.e., higher frequencies) are distinguished from "lower" pitches (i.e., lower frequencies). The fundamental frequency of musical instrument tones is within a range of approximately 25–4000 Hz. (Note that humans can hear frequencies up to 15,000 Hz, and sometimes even higher.)	10–100 ms
Timbre	A property of a sound that distinguishes it from a different sound, even though both sounds may have the same pitch and loudness (e.g., trombone versus violin). The physical features of a sound that determine timbre perception are spectrum and envelope.	10–100 ms
Loudness	A property of an auditory sensation that can be ordered on a scale ranging from "very loud" to "very soft". Even though this sensation is typically correlated with intensity of a sound as objectively measured in decibels, loudness refers to subjective evaluation.	10–100 ms
Rhythm	A property of an acoustic signal that describes the time between the onsets of successive events – in other words, the acoustic pattern in time. If the time between events (e.g., brief tones) is less than 100 ms, humans typically hear the sequence as a continuous, single event. If the time between events is greater than 1500 ms (1.5 s), humans often have difficulty grouping these events.	100–400 ms
Meter	A property that describes the rhythmic structure of sounds. In other words, the pattern of accents in the presentation of music.	180–400 ms
Tempo	A property that describes the speed of a given musical presentation. Tempo is usually measured in beats per minute (bpm). Specifically, a particular note value (e.g., crotchet) is specified as the beat, and the time between successive beats is a specified fraction of a minute. Thus, the smaller the number of bpm, the larger the amount of time between successive beats (and hence the musical piece is played more slowly). Generally, fewer than 60 bpm is considered a slow tempo, 60–120 bpm is a medium tempo, and more than 120 bpm is fast. (Note: Small deviations from this rule can be found in the literature.)	Depends on bpm

Notes: Research in musciology describes attributes of music. These attributes can be varied independently (Gomez & Danuser, 2007; Kolb & Wishaw, 2009; Krumhansl, 2000; Levitin & Tirovolas, 2009; Pierce, 1983) and generally. With increasing musicality, an individual is better able to perceive the individual attributes of music, and hence does not perceive music only as a monolithic acoustic stimulus (Zatorre, 2005). Thus, experts are able to rate the attribute values on survey scales with high accuracy (benchmark: ratings of other experts such as high interrater reliability or objective measures such as frequency measured in Hz (Gomez & Danuser, 2007)). The time from stimulus onset to human perception in the brain (i.e., reaction time) varies across the different attributes of music (Koelsch & Siebel, 2005).