THE EFFECTS OF MUSIC AROUSAL LEVEL AND TEMPO ON CARD GAME PLAYERS' RISK-TAKING AND EEG MENTAL STATE AMONG INTROVERTS AND EXTROVERTS

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DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER IN PERFORMING ARTS (MUSIC)

CULTURAL CENTRE
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UNIVERSITY OF MALAYA

ORIGINAL LITERARY WORK DECLARATION

Name of Candidate	:	Ho Hao Yi [redacted]
Matric No.	:	ROA180008
Name of Degree	:	Master in Performing Arts (Music)
Title of Thesis	:	The Effects of Music Arousal Level and Tempo on Card Game Players' Risk-Taking and EEG Mental State Among Introverts and Extroverts
Field of Study	:	Musicology (Music Psychology)

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THE EFFECTS OF MUSIC AROUSAL LEVEL AND TEMPO ON CARD GAME PLAYERS' RISK-TAKING AND EEG MENTAL STATE AMONG INTROVERTS AND EXTROVERTS

ABSTRACT

This is an experimental quantitative study which examined the effects of music arousal level and tempo on card game players' risk-taking and EEG mental state among introverts and extroverts. A total of 20 male participants (through selection of 10 introverts and 10 extroverts) aged between 18 – 29 voluntarily participated by playing the card game *In-Between*. All participants put on the NeuroSky® MindWave™ Mobile EEG device and played the game while being exposed to various music conditions. The conditions were no-music (control) condition, and a set of both high-arousal (hereafter HA) and low-arousal (hereafter LA) music manipulated to three different tempi, which are 100% (normal tempo), 175% (faster tempo), and 75% (slower tempo). In terms of gameplay risk-taking among the arousal level conditions, findings showed that there were only significant differences between HA and LA music conditions, but insignificant between the music and no-music conditions. Among the tempo conditions, overall risk taken were highest during the highly-arousing and extremely-fast music tempo condition, while overall risk taken were lowest during the lowly-arousing and original music tempo condition. In terms of gameplay EEG mental state, attention and meditation levels were highest when the music stimuli were optimally-arousing, in which the optimal arousal level of extroverts is generally higher than introverts, in accordance with the optimal arousal hypothesis. However, over-arousal impairs mental state and task performance, in which its effects will be much more detrimental among introverts.

Keywords: Music Arousal Level, Music Tempo, Extroversion-Introversion (E/I), Risk-taking, EEG Mental State.

KESAN TAHAP RANGSANGAN DAN TEMPO MUZIK TERHADAP PENGAMBILAN RISIKO DAN KEADAAN MENTAL EEG PEMAIN KAD DALAM KALANGAN INTROVERT DAN EKSTROVERT

ABSTRAK

Kajian eksperimental kuantitatif ini menyiasati kesan-kesan tahap rangsangan dan tempo muzik terhadap pengambilan risiko dan keadaan mental EEG pemain kad dalam kalangan introvert dan ekstrovert. Sejumlah 20 orang peserta jantina lelaki (melalui pemilihan 10 orang introvert dan 10 orang ekstrovert) dalam lingkungan umur 18 – 29 mengambil bahagian dalam kajian ini secara sukarela untuk bermain permainan kad *In-Between*. Setiap peserta memakai alat EEG NeuroSky® MindWave™ Mobile lalu bermain permainan kad tersebut semasa terdedah kepada beberapa keadaan muzik. Keadaan tahap rangsangan muzik dibahagikan kepada keadaan tiada muzik (terkawal), muzik rangsangan tinggi (HA) dan rendah (LA), kemudian dibahagikan kepada tiga jenis tempo, iaitu 100% (biasa), 175% (dipercepatkan), dan 75% (diperlahankan). Dari segi pengambilan risiko antara keadaan tahap rangsangan muzik, keputusan kajian menunjukkan bahawa terdapat perbezaan yang ketara hanya antara keadaan muzik HA dan LA, tetapi tiada perbezaan yang ketara antara keadaan muzik dan tiada muzik. Antara keadaan tempo muzik, pengambilan risiko secara keseluruhan adalah tertinggi semasa keadaan muzik rangsangan tinggi dalam tempo yang terlampau tinggi, manakala pengambilan risiko secara keseluruhan adalah terendah semasa keadaan muzik rangsangan rendah dalam tempo biasa. Dari segi keadaan mental EEG dalam permainan, tahap perhatian dan meditasi adalah tertinggi semasa keadaan muzik rangsangan optimum, di mana tahap rangsangan optimum ekstrovert akan lebih tinggi secara umum berbanding dengan introvert, selaras dengan hipotesis rangsangan optimum. Malah, tahap rangsangan terlampau tinggi akan menjejaskan prestasi mental dan tugas, maka penjejasan tersebut akan lebih memudaratkan dalam kalangan introvert.

Kata Kunci: Tahap Rangsangan Muzik, Tempo Muzik, Ekstroversi-Introversi (E/I), Pengambilan Risiko, Keadaan Mental EEG.

ACKNOWLEDGEMENTS

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I would also like to specially acknowledge my teacher Anne Tham, who is the founder of ACE EdVenture (M) Sdn Bhd (an English language and personal development centre in Subang Jaya which I have attended from Standard 1 up to Form 5); and also the founder and CEO of Sri Emas and Dwi Emas International Schools located in Petaling Jaya and Shah Alam, Selangor, respectively. Tchr. Anne Tham has not only been my English teacher since I was seven years old, but also a remarkable mentor in self-development, leadership, and entrepreneurship throughout my formative years. Tchr. Anne was the main reason behind the field that I have chosen to research in, as we had met up for "yumcha" one day about nine months prior to the commencement of this study, in which she had introduced me the NeuroSky® MindWave™ Mobile, which immediately sparked my amazement. I specially thank Tchr. Anne for allowing me to use the school premises and use 20 sets of the MindWave™ devices which belonged to the school (Dwi Emas) to carry out my research. At the same time, I would also like to acknowledge one of

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I believe there are still many more people around me who have directly or indirectly contributed towards my journey in this research, in which I am unable to fully list out here, but all of your contributions have been vital to this research and I am grateful to each and every one of you. Lastly, to you, as while you are coincidentally reading this, I humbly hope that this dissertation is able to contribute any information or as a reference to your paper should you be also in the process of writing out a relevant dissertation as well; or contribute some beneficial knowledge to you in your career if you are in the field of music psychology or in any related areas; or if you are here for leisure reading or just so happen you coincidentally came across this, I hope that this dissertation will be an enjoyable ride for you throughout as I share some two-cents knowledge with you here.

I thank all of you from the bottom of my heart.

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LIST OF SYMBOLS AND ABBREVIATIONS

ANOVA	:	Analysis of variance
Att/Med	:	Attention/Meditation
BPM	:	Beats per minute
EEG	:	Electroencephalography
E/I	:	Extroversion-introversion
H0 (H)	:	Null hypothesis (Alternative hypothesis)
HA	:	High-arousal
LA	:	Low-arousal
RO	:	Research Objective
RQ	:	Research Question
A	:	An event whereby the value of *z* is between *x* and *y*
B	:	An event whereby the value of *z* is either below *x* or above *y*
C	:	An event whereby the value of *z* is equal to either *x* or *y*
EV	:	Expected Value
P(X)	:	Probability of event, *X* represents either event *A*, *B*, or *C*
Q(X)	:	Payoff of event, *X* represents either event *A*, *B*, or *C*
x	:	Value of the first card in the *In-Between* game
y	:	Value of the second card in the *In-Between* game
z	:	Available gap between *x* and *y* in the *In-Between* game
$	:	Betting amount
M	:	Mean
N	:	Total number
SD	:	Standard deviation
SE(M)	:	Standard error (mean)
t	:	Test statistic for paired samples t-test
df	:	Degrees of freedom
F	:	Test statistic for one-way ANOVA
p	:	Significance value (threshold significance value at $p < .05$)

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CHAPTER 1

INTRODUCTION

1.1 Overview

This is a music psychology study on the effects of music arousal level and tempo on party card game players' risk-taking and electroencephalographical (EEG) mental state among introverts and extroverts. The task for this study is to play a card game called *In-Between* which betting and risk-taking using play money. This is a quantitative study, in which the results obtained will be based on two aspects: gameplay risk-taking among the game players, and gameplay EEG mental state of the game players while playing the card game, in terms of attention and meditation levels.

This dissertation consists of five chapters. The current chapter, introduces the study which includes a brief background of study which covers the overview and positioning of the current study in the knowledge field, problem statement, significance of study, conceptual framework, research objectives, research questions, null hypotheses, and limitations of study. Chapter 2 provides a thorough review on past relevant academic literature in various related fields, hence forming the vast knowledge groundwork which underpins the formation of the current study. Chapter 3 describes the methodology of this study in detail. Findings of the study are reported and discussed in Chapter 4. Lastly, Chapter 5 concludes the research and its findings.

1.2 Background of Study

Music psychology is the inter-relational branch of both the fields of psychology and musicology, studying on how the perception and response to music stimuli affects the listeners' behaviour and experience (Tan, Pfordresher, & Harrę 2010). This field plays an integral part in the society, as of today, music is all around us, particularly with the advent of technology and mass media (Evano, 2013). Through time, music not only serves as a form of culture and art, but has evolved into becoming a vital facilitation for various psychophysiological functions. Thus, a huge body of literature in this field has addressed the effects of music on various responses including psychophysiological, cognitive, behavioural, and emotional (Cassidy & MacDonald, 2007). However, measurements of these effects may be rather difficult to judge, as all humans are uniquely different from one another and that everyone has a different encounters and perceptions to each music, therefore the interactions of listeners and the context of the music has to be taken into consideration in order to obtain more valid and accurate measurements (Furnham & Bradley, 1997; Cassidy & MacDonald, 2007).

This study focuses on the relationship between music and three inter-relatable psychophysiological aspects, which are arousal, emotion, and decision-making. Arousal is a psychophysiological state that occurs when an individual is psychophysiologically (or emotionally) triggered by a stimulus, which causes adrenaline production and increase in heart rate (Patel, 2015). Emotion is known as the individuals' psychophysiological responses (or feelings) towards the arousal, based on their interpretation of the response or situation (Roeckelein, 2006, p. 187). Decision-making is a cognitive process of an individual producing a resolution within a number of possibilities, in which the decision-making process and selections are greatly impacted by the arousal and emotional state of the individual (O'Sullivan, 2011, pp. 2-3; Juneja, 2019). Risk-taking is one of the two conditions of decision-making (the other being intertemporal choice), which involves the act of making decisions with uncertainty of its consequential outcomes (Foo, 2011).

This study focuses on two types of personality traits: introverts and extroverts (or extraverts). Simply defining, introverts are people who are on the "more-reserved, self-contained" personality spectrum and tend to perform better in insolation; while extroverts are people who are "outgoing, outspoken, and gregarious" (MacDonald, 2016; Surbhi, 2016; Dasgupta, 2018, p. 57). Psychophysiological arousal plays a huge role in affecting the behaviour and performance of introverts and extroverts while carrying out a task. This study placed basis on the optimal arousal hypothesis based on the Yerkes-Dodson law, which shows the empirical relationship between psychophysiological arousal and task performance (Yerkes & Dodson, 1908). The original Yerkes-Dodson law compared arousal and performance based on task difficulty, but the later Hebbian version simplified the relationship to only find out the optimal arousal point with the assumption that the difficulty of the task remains constant. Figure 1.1 shows the original Yerkes-Dodson law, while Figure 1.2 shows the Hebbian version of the law, which is also known as the optimal arousal hypothesis (Diamond, Campbell, Park, Halonen, & Zoladz, 2007).

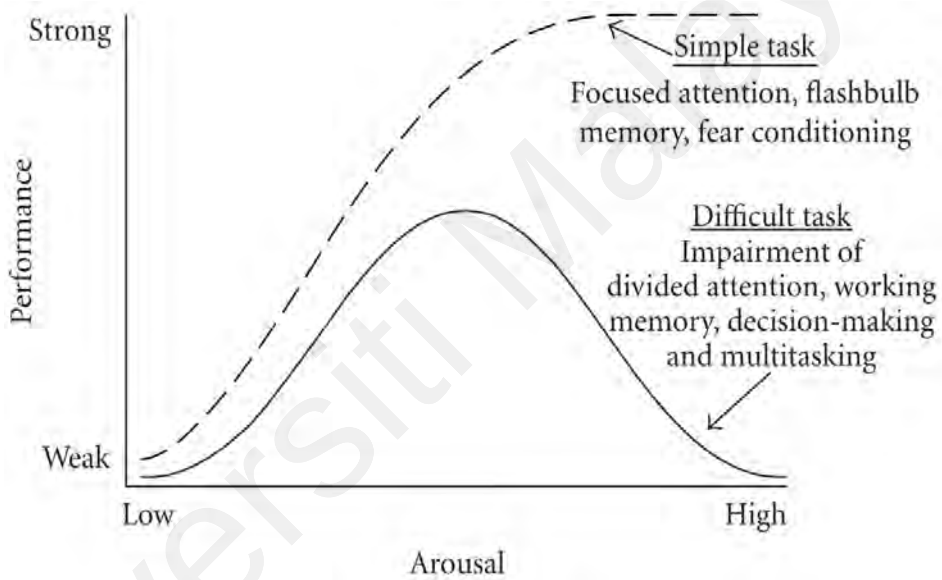

Figure 1.1 Yerkes-Dodson Law (Diamond et al., 2007, p. 3).

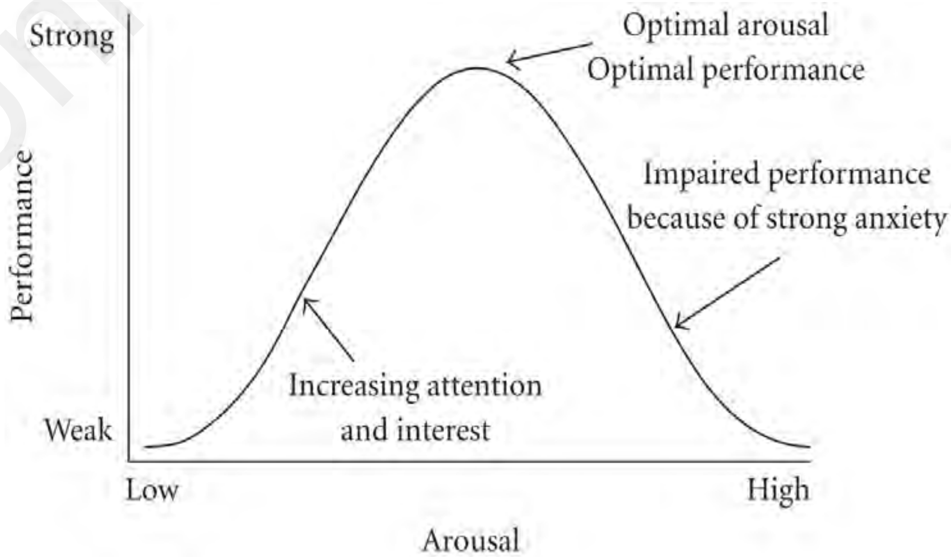

Figure 1.2 Hebbian version “Optimal Arousal Hypothesis” (Diamond et al., 2007, p. 3).

Based on the figures above, the Hebbian version of the law and its optimal arousal hypothesis will be most suitable for this study, as the task for this study remained constant for all participants, thus disregarding the comparison of task difficulty. In Figure 1.2, the optimal arousal hypothesis states that task performance is at its best at the optimal arousal level, in which under-arousal causes inertness while over-arousal detriments performance due to anxiety. However, a task that is too difficult may overwhelm the individual, thus over-inducing arousal and in turn, hinders task performance of the individual as well (Salamé & Baddeley, 1982; Hallam, Price, & Katsarou, 2002).

The optimal arousal level also differs between introverts and extroverts. The optimal arousal level for introverts is lower, while the optimal arousal level for extroverts is higher (Mistry, 2015). Figure 1.3 shows an originally-formed graph of the assumed depiction of the law differentiated between introverts and extroverts as stated by Mistry (2015). The figure shows that during exposure to an optimally high-arousal stimulus, performance of introverts will be weakened, but will be stronger for extroverts; while on the contrary, during exposure to an optimally low-arousal stimulus, performance of introverts will be stronger, but will be weakened for extroverts.

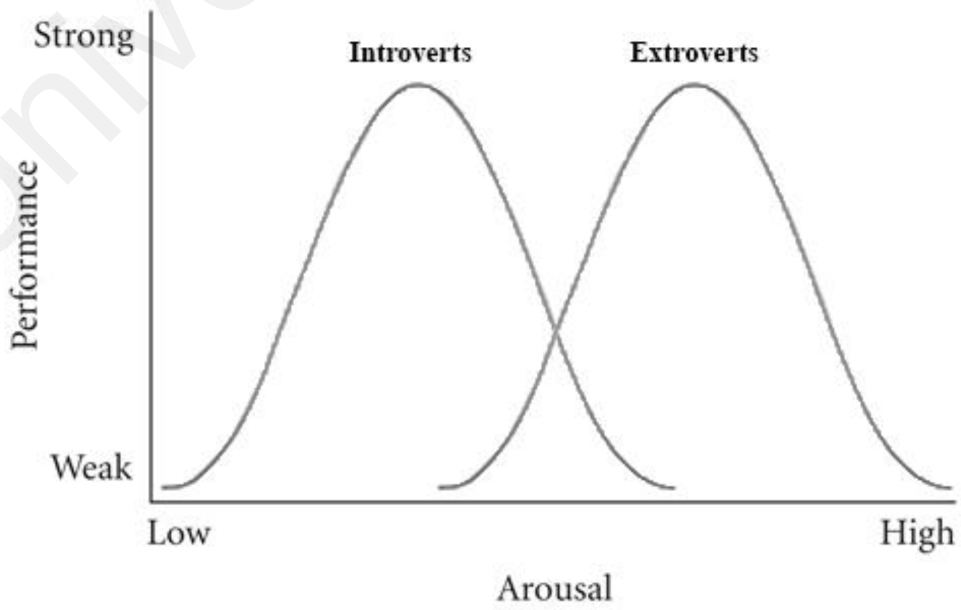

Figure 1.3 Optimal Arousal Level between Introverts and Extroverts (Mistry, 2015).

As mentioned, there is already a vast amount of literature in the field of music psychology, in terms of how different music aspects are able to show significant effects on psychophysiological arousal. Among the musical aspects, music tempo has been widely used to observe how music affects human behaviour (Griffiths, 2015). “Tempo” is an Italian loanword which means “velocity”, simply defined as the “speed of a passage of music” measured by the number of beats per minute (BPM) (Erskine, 2002, p. 17; Mazzola, 2002; Miller, 2012), hence “tempo manipulation” will be the act of altering the BPM of music (Riley, 2020). Berlyne (1971) stated that faster tempo music induces arousal (and excitement), while slower music decreases arousal and induces relaxation. Berlyne’s (1971) theory has been widely observed by later studies, with many whom carried out studies relevant to the theory and successfully supported it (Wulfert, Roland, Hartley, Wang, & Franco, 2005). Fast tempo music was also found to be able to show significant impacts on both risk-taking and intertemporal choice, as compared to slower tempo music or without music condition (Fujikawa & Kobayashi, 2010). This is mostly applied to situations such as playing games (or “gameplay”), in which fast tempo music is able to boost hype and excitement of the game players (Levy, 2015; Shepard, 2017). However, findings of the psychological effects of music tempo was not always consistent. There were findings that did not support music tempo being the sole factor on affecting arousal, thus stating that the manipulation of music tempo alone is insufficient to prove how music affects human behaviour (Bramley, Dibben, & Rowe, 2016).

The current study took note on the insufficiency of having only one musical aspect to be manipulated, thus manipulated two music aspects, which are music tempo and music arousal level. The categorization of the terms “high-arousal” (hereafter HA) and “low-arousal” (hereafter LA) music was based on Bartlett’s (1996) assumptions of both terms, whereby HA music is generally defined as music which are “percussive, fast in tempo, highly rhythmic, and loud in dynamics”, and is able to increase heart rate and muscle tension; while LA music is generally defined as music which are "melodic, slow in tempo, generally legato, and soft in dynamics", and is able to decrease heart rate and music tension (Lundqvist, Carlsson, Hilmersson, & Juslin, 2009, p. 63; Griffiths, 2015). This assumption by Bartlett (1996) were applied to the current study. After referring to a number of studies regarding HA/LA music, the current study perceived "music arousal level" as the tendency of the music to psychophysiologically arouse listeners based on the intensity (rhythm, tempo, timbre: acoustic/electric and sound effects, etc.), and the emotional level (happiness/sadness, pleasant/unpleasant, preference, etc.) in the music.

In terms of the relationship between tempo and arousal level, fast tempo music is able to increase arousal, while slow tempo music is able to decrease arousal (Husain et al., 2002). In terms of how HA and LA music affects task performance of introverts and extroverts, it is found that performance of introverts will be good during silent or LA music conditions, but will detriment during HA music conditions; whereas extroverts will show greater performance during HA music conditions as compared to introverts (Cassidy & MacDonald, 2007). Mistry (2015) also supported this claim, as the study found that extroverts perform much better when exposed to HA background music, and vice versa. It was also noted that the greater the arousal produced by the music, the more pleasurable it will be, hence a greater probability for the listeners to like and enjoy the music (Griffiths, 2015).

Moreover, arousal also plays a role in affecting emotions, which in turn also affects the quality of decision-making. As music will be the stimulus for this study and tempo manipulation will be done to see its effects on arousal, it has been studied that as music tempo increases, the arousal and excitement level will increase as well, and this will lead to riskier decision-making (Wulfert et al., 2005; Foo, 2011). In a gambling situation, it is found that fast tempo diminishes the awareness of time (Noseworthy & Finlay, 2009), but will cause quicker reactions times, whereas slower music will induce greater betting numbers which represents greater risk-taking (Mentzoni, Laberg, Brunborg, Molde, & Pallesen, 2014).

In terms of emotions as portrayed by the music, previous studies also have compared between "happy" and "sad" music, or known as music of "positive" and "negative" effect as coined by Cassidy & MacDonald (2007). It was found that happy music will result in more selfish decisions than sad music (Tan & Forgas, 2010). Unpleasant music is found to result in a higher probability of rejections than pleasant music (Chung, Lee, Jung, & Kim, 2016), in the contrary, pleasant and highly-arousing music evokes greater desires and interactions than unpleasant music (Dubé, Chebat, & Morin, 1995). Happy music is able to induce better decision-making as compared to sad music (Liebman, Stone, & White, 2016), but it is also found that happy music causes lesser social interaction than sad music (Liebman, Stone, & White, 2018). Liebman et al. (2018) also found that sad music induces more analytical and rational decisions, while happy music induces decisions that are more self-centered, in accordance with the claims of Tan & Forgas (2010). All of these sources are further discussed in Chapter 2, Sections 2.3 to 2.6.

This study aims to see the effects of music based on electroencephalographical (EEG) analyses through brainwave activity measurement which can accurately show the mental and arousal state of the individual. This field, too, has been covered by many studies, but with the majority using traditional EEG electrodes. There are five types of brainwave frequencies, which are delta-, theta-, alpha-, beta-, and gamma-waves. It was found that extroverts perform best during lower alpha-wave levels, which introverts perform best during greater power in the alpha-wave levels (Matthews & Amelang, 1993). Arousal is mainly associated with lower alpha-wave levels and higher beta-wave levels, while in the contrary, relaxation is associated with higher alpha-wave levels and lower beta-wave levels (Siti Ayuni & Wan Mahani Hafizah, 2015; Rogenmoser, 2016). Happy music is seen to be able to induce greater theta-wave levels (Rogenmoser, 2016).

Moreover, previous studies have also noted on how the traditional EEG electrode devices may not be as handy to be used in research due to its complexity in handling the device which will cause disruptions in the results (Matthews & Amelang, 1993; Thiel, 2018). However, there have been recent studies that used simpler commercial EEG devices such as the NeuroSky® MindWave™ Mobile which had greatly minimized complexity difficulties. In terms of the effects of music arousal manipulation on attentiveness during task performances with the application of the NeuroSky® MindWave™ Mobile, one of the most recent studies found that HA music such as heavy metal detriments attention, while the calm and relaxing LA music is able to increase attention levels (Teixeira, Tomé, Roseiro, & Gomes, 2018). The MindWave™ is able to simplify the massive data noise of brainwave power into simpler and more understandable figures through its patented eSense™ algorithms, which are attention and meditation levels. This helps to ease data complexity and fastens data analysis and interpretation processes. This field is further reviewed in Sections 2.7 and 2.8.

Among the pool of the most recent studies relevant to the current study, one of the latest up-to-date study was the mentioned EEG study which confirmed that HA music causes detrimental effects on attention whereas changing over to LA music helps the listener to regain back attention levels (Teixeira et al., 2018). It has also been raised that actual application of music to enhance mood in real-life settings such as workplaces are still unconfirmed, and that suggestions given were to seek more in-depth understanding on the relationship between music and its effects, thus further placing personality traits (introversion/extroversion) to moderate the relationship (Landay & Harms, 2019). In terms of the two aspects to be manipulated in the current study which are music arousal level and tempo, the latest study showed that slower tempo and LA music induced more risk-taking as compared to faster tempo and HA music, as well as during no-music conditions (Israel, Lahav, & Ziv, 2019).

1.3 Problem Statement

The problem statement for this study is to cover the three main research gaps/issues relevant to this study. The first gap seen was that a greater contrast of music tempo is needed to prove the validity of its psychophysiological effects. The second gap was that the psychological effects of music is not able to be validated based on the manipulation of tempo alone. Many of the reviewed studies solely manipulated music tempo without taking other inter-relating musical aspects and personality traits of participants into account, hence the inconsistency of findings due to the indirect influences of the mentioned external factors. Lastly, although most games traditionally adopt exciting music to enhance gameplay performance, this convention still remains debatable on whether the exciting music improves or hinders gameplay performance and its effects differ between introverts and extroverts (Levy, 2015; Shepard, 2017).

As the manipulation of music tempo in previous studies were not contrasting enough, this study attempted to use a greater tempo difference while putting ecological validity of the findings into consideration as suggested by Lawrence (2012). In attempt to address the second and third research gap, the current study takes note on the problems faced by Evano (2013), Rinato (2014), and Levy (2015), including the contradictions between Wulfert et al. (2005), Foo (2011), and Israel et al. (2019) on risk-taking. Thus, variables such as music arousal level and tempo were manipulated in this study. The selected variables were tested on two personality traits: introverts and extroverts, in observance to the optimal arousal hypothesis as shown by the Yerkes-Dodson law (Diamond et al., 2007), and also how optimal arousal level differs between introverts and extroverts (Cassidy & MacDonald, 2007; Mistry, 2015).

Lastly, in terms of measurement tools, majority of previous studies (apart from studies that use EEG devices) obtain their findings mostly based on qualitative methods such as pen-and-paper observations, video recordings, feedback questionnaires, semi-structured interviews, etc. (Nur Syahirah Roslan et al., 2017). Findings of these studies may not be completely valid as there could be possibilities of potential biasness and other unforeseen personality trait implications that will affect their answers of the questionnaire and interviews as noted from various studies pertaining to this issue (Choi & Pak, 2005; Sedgwick, 2013; Alshenqeeti, 2014). Moreover, previous studies that use traditional EEG electrode devices had quoted on the complexity in handling the devices, thus resulted in having unexpected and inconsistent findings, as stated by Matthews and Amelang (1993) and Thiel (2018). Therefore, the current study employed the usage of EEG using the NeuroSky® MindWave™ Mobile device as used by Texeira et al. (2018) and other relevant studies, that is able to accurately measure the mental state and arousal level of participants during the game, which is able to strengthen the validity of the findings and minimize potential biasness without the need to undergo complex technical difficulties. Also as mentioned, the MindWave™ simplifies sophisticated brainwave power into attention and meditation levels, which eases extreme EEG data complexity.

1.4 Significance of Study

The significance of this study is primarily to provide and also strengthen evidences on how music can affect the psychophysiological state of an individual. A majority of previous studies in the relevant field were pen-and-paper and mere observational-based (Nur Syahirah Roslan et al., 2017), or incorporated sophisticated EEG devices (Matthews & Amelang, 1993; Thiel, 2018), hence the inconsistency of the findings and/or contradictions of a study with another similar or duplicated study. Henceforth, this study intended to rectify this inconsistency by incorporating an easy-to-use commercial EEG device, the NeuroSky® MindWave™ Mobile.

Successful completion of this study may be able to proof that the manipulation of music arousal level and tempo is able to show significant beneficial or detrimental effects on human psychophysiology through accurate EEG brainwave monitoring. The field of music psychology has been studied since the nineteenth century (Hallam, 2009), thus played vital inter-relational roles in many other fields of music such as music education, music therapy, music composition, as well as other non-music industries such as marketing and advertising, online gaming, etc. EEG data evidences in music psychology can greatly benefit in these areas and industries, while also further contribute to building a more advanced society.

1.5 Conceptual Framework

The conceptual framework for this study is shown below in Figure 1.4.

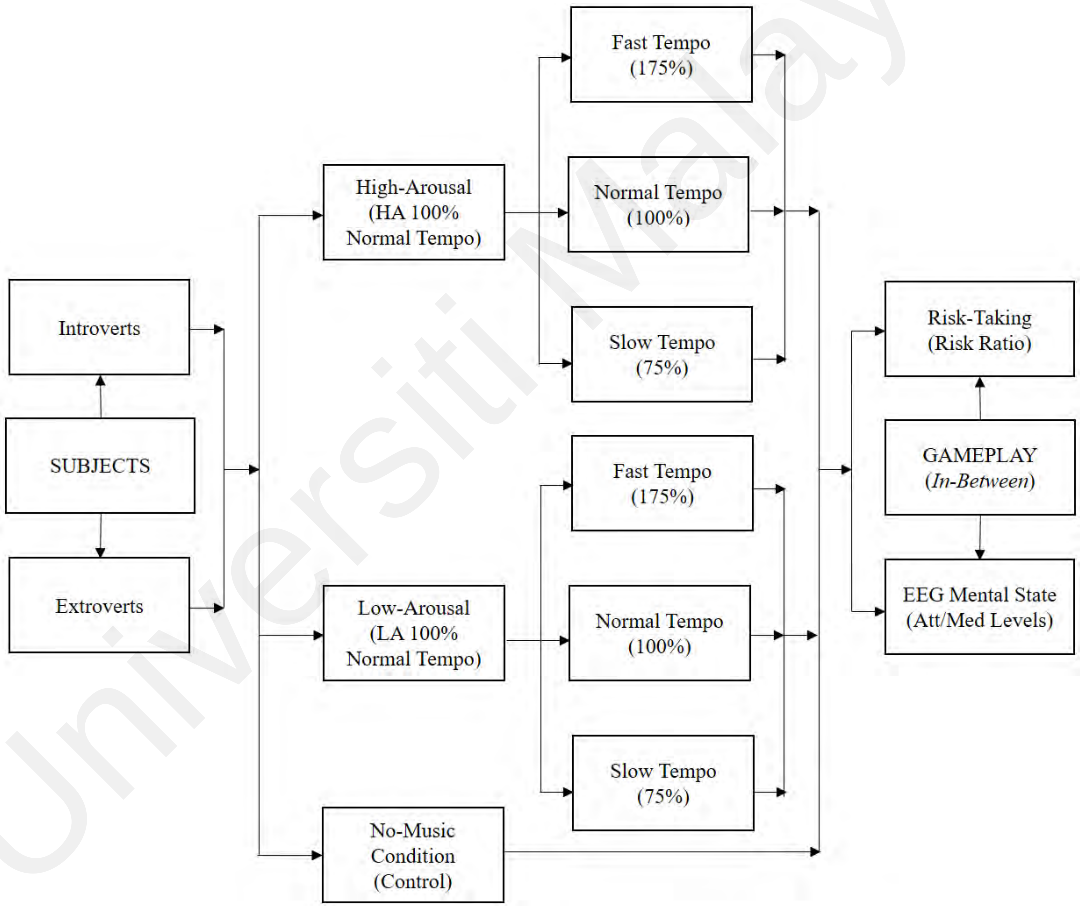

Figure 1.4 Conceptual Framework.

As shown, subjects were evenly divided into introverts and extroverts. Two aspects of music were manipulated, which are arousal level and tempo. There were two types of arousal level (HA and LA music conditions) and a no-music condition, and three tempo manipulations (100%, 175%, and 75%). For music arousal level comparisons, the normal tempo (100%) condition for HA and LA music were used. The task of this study was to play *In-Between*. Two aspects of the game players were measured, which were gameplay risk-taking and EEG mental state. Gameplay risk-taking is based on "risk ratio" of the game players, while gameplay EEG mental state is based on attention and meditation levels (hereafter abbreviated as "Att/Med" levels) of the game players as measured through the NeuroSky® MindWave™ Mobile from a scale of 1 –100.

1.6 Research Objectives

The research objectives for this study are:

RO1: To examine how the manipulation of music arousal level and tempo can affect the degree of risk-taking among introverts and extroverts.

RO2: To examine how the manipulation of music arousal level and tempo can affect the mental state among introverts and extroverts during gameplay (in reference to the optimal arousal hypothesis) based on EEG measurements of attention and meditation through the NeuroSky® MindWave™ Mobile.

1.7 Research Questions

The research questions for this study are:

RQ1: How do the manipulation of music arousal level and tempo of music affect gameplay risk-taking overall and among introverts and extroverts?

RQ2: How do the manipulation of music arousal level and tempo affect gameplay EEG mental state overall and among introverts and extroverts?

RQ3: Will there be any significant differences in the findings of (a) gameplay risk-taking, and (b) gameplay EEG mental state, between introverts and extroverts during the card game among all of the music conditions?

1.8 Null Hypotheses

RO1 and RQ1 were formed based on how arousal and tempo manipulation of music can affect gameplay risk-taking. It has been found that faster tempo music showed great impacts on risk-taking and intertemporal choice, but not much difference during slower tempo music and without music (Foo, 2011). The study found that fast tempo music significantly showed greater extent of risk-taking, and that fast tempo music is able to increase stimulation, which increases arousal level (Wulfert et al., 2005), and also cause riskier behaviours and decisions. However, it is also found out that both slower and faster tempo music can lead to risk-taking, but both showing their effects in different aspects (Mentzoni et al., 2014). The most recent study contradicted to Foo (2011), in which slower tempo and LA music caused more risk-taking than faster tempo and HA music (Israel et al., 2019). As Israel et al. (2019) studied the effects based on quasi-situations on lottery and investments in questionnaire form, the current study intends to re-confirm the claims without prior expectations, by having participants hands-on via playing a card game which involves physical play money (see Chapter 3, Section 3.3).

Additionally, based on RQ3 which questions on how the effects of the music conditions differ between introverts and extroverts, Cassidy and MacDonald (2007) and Mistry (2015) had pointed out that introverts will show performance at its worst during highly-arousing conditions due to distraction and over-arousal and at its best in silent conditions than in the presence of music, and vice versa for extroverts. As previous studies showed that higher arousal levels increases degree of risk-taking, it was expected that both the HA music and fastened tempo manipulation will result in greater risk-taking among introverts than extroverts. Therefore, the current study compared the effects of music arousal level and tempo among card game players, compared among and between introverts and extroverts in reference to RQ3. Three null hypotheses were formed from here, in which the current study intends to reject, which are: -

H01: There will be no significant differences in gameplay risk-taking among the card game players among and between the music arousal level [no-music, HA (100%), and LA (100%) music] conditions overall and among introverts and extroverts.

H02: There will be no significant differences in gameplay risk-taking (risk ratio) among the card game players between normal (100%), faster (175%), and slower (75%) tempi of both (a) HA and (b) LA music conditions overall and among introverts and extroverts.

H03: There will be no significant differences in gameplay risk-taking (risk ratio) among all music arousal levels and tempo manipulation conditions between introverts and extroverts.

RO2 and RQ2 were formed based on how arousal and tempo manipulation of music can affect gameplay EEG mental state of game players. As mentioned, faster tempo music is able to increase arousal levels, whereas slower tempo music is able to decrease arousal levels (Husain et al., 2002). Highly-arousing and fast tempo background music are often employed in various gaming situations as they induce hype and excitement (Shepard, 2017), however, Levy (2015) reported on the lowest flow and engagement of introverts during fast tempo and HA music conditions. Extroverts, on the contrary, are expected to perform well in the more-stimulating HA music conditions (Furnham & Allass, 1999; Mistry, 2015). This study intended to question on whether highly-arousing and faster tempo music are suitable for introverts as well, subsequently in which, aimed to oppose the general convention which assumes that highly-arousing fast tempo music is generally suitable for all.

As mentioned, this study measured EEG mental state based on attention and meditation levels from the NeuroSky® MindWave™ Mobile. Gauged within a scale from 1 – 100, a higher value in the attention and meditation meters indicates a greater mental performance of the user, and that the user is focused and not mentally bothered by the music stimulus; while a lower value indicates a weaker mental performance of the user (see Section 3.7.2). Essentially, this led to the formation of the following three null hypotheses, similarly to be rejected: -

H04: There will be no significant differences in gameplay EEG mental state among the card game players among and between the music arousal level [no-music, HA (100%), and LA (100%) music] conditions overall and among introverts and extroverts.

H05: There will be no significant differences in gameplay EEG mental state (attention and meditation levels) among the card game players between normal (100%), faster (175%), and slower (75%) tempi of both (a) HA and (b) LA music conditions overall and among introverts and extroverts.

H06: There will be no significant differences in gameplay EEG mental state (attention and meditation levels) among all music arousal levels and tempo manipulation conditions between introverts and extroverts.

Therefore, this study intended to execute the research with no prior expectations, solely to find out the effects of the various stimuli conditions towards risk-taking and EEG mental state. Therefore, based on the six null hypotheses which state that the various conditions will not show any significant effects, this study intends to reject all of them.

1.9 Delimitations and Limitations of Study

This study aimed at a general comparison between the psychological effects of HA and LA music and their tempo manipulations, with focus on contemporary pop music which contain English lyrics and of positive emotional effect. However, other musical components such as familiarity, instrumentation, preference, lyrics and instrumental music are not testable variables and are not in control in this study.

Through reviewing the vast amount of relevant literature, it can be seen that arousal, emotion, and decision-making inter-relate with each other. Arousal is able to affect emotions which then affect decision making, and that arousal can also greatly affect the degree of risk-taking as well. This study initially intended to see the inter-relations between the three, however, the second limitation was that measurement of emotions will not be formally taken into consideration in this study in order to not over-complicate the methodological process. The evoked emotions of the music used for the current study will remain constant as “happy” and “pleasant” music.

In terms of sample size, this study used convenient and purposive sampling which was only limited to 20 participants of a particular age group within Klang Valley, Malaysia, as results are based on laboratory experimental findings, and not able to represent the entire population of the region stereotypically. Moreover, this study only used male participants to eliminate gender influences as suggested by Zhang and Fu (2015).

The fourth delimitation is that the study solely collected quantitative data through comparisons of risk-taking and brainwave activity analyses of participants among the various music conditions. It was concerned that the usage of qualitative methods is able to strengthen the validity of the data collected through quantitative methods (Atieno, 2009; Rahman, 2016; Almeida, Faria, & Queirós, 2017) however, in this study, qualitative data collection methods are not covered to avoid over-complexity of data analysis procedures, although qualitative data collection may produce a different set of results.

Lastly, findings of this study were based on an experimental study during a particular period of time, hence results may vary should this study be redone. There could also be chances of “luck” during the game which may have indirectly affected the results, in which further duplication of this study with more participants may strengthen the consistency of the findings of this study. Moreover, the EEG results were solely based on the NeuroSky® MindWave™ Mobile as comfort of players were concern, and the researcher is aware that results of the study may differ when different EEG instruments are used.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

A number of previously-conducted research relevant to this study are reviewed in this chapter. This chapter is significant for this paper as it summarizes past knowledge and findings in the field of music psychology which were derived from previous relevant studies, and also serves as a foundational knowledge groundwork for the current study to be executed. This literature review chapter is divided into various inter-relational areas with music, which are extroversion-introversion, psychophysiological arousal, emotions, decision-making (including risk-taking), gameplay, and electroencephalography (EEG).

2.2 Background of Extroversion-Introversion (E/I)

"Personality trait" is described as a "behavioural/personality characteristic" expressed by an individual (Matthews, 2004, p. 869). Hence, the term "extroversion-introversion" (hereafter abbreviated as E/I), popularized by Swiss psychologist Carl Jung in the 1920s, is defined as a significant "personality dimension" which contrasts the personality traits of "sociability and assertiveness" with "socially-reserved and quietness", or any equivalents belonging to each ends of the contrast (Jung, 1923; Matthews, 2004, p. 869).

The two personality traits on each ends of the E/I spectrum are called "introverts" and "extroverts". According to Jung (1923), "introverts" are individuals whom "allow subjects to determine themselves" in terms of personality, while "extroverts" are individuals whom are "conditioned by the outer object" (p. 33). In addition, Brown (2015) extended Jung's (1923) definition, in which introverts are perceived to be "shy individuals with rich internal worlds", while extroverts are perceived to be "adaptive and happy individuals, with greater risk-taking tendencies" (p. 10). In laymen terms, as mentioned in the previous chapter, introverts are individuals whom their personality traits fall on the "more-reserved, self-contained" personality spectrum and tend to perform better in insolation; whereas extroverts are individuals who are "outgoing, outspoken, and gregarious" (MacDonald, 2016; Surbhi, 2016; Dasgupta, 2018, p. 57). However, Jung (1923) proposed that humans may not be able to be classified as either introverts and extroverts per se as both personality traits coexist within the individual, but depending on which one is more dominant or recessive than the other, and also depending on the four "fundamental functions": "thinking, feeling, sensation, and intuition" (p. 34).

In terms of comparing E/I with arousal stimulation, introverts generally tend to "make efforts to "escape overstimulation", while extroverts tend to "seek stimulation and greater external activity" (Ellis, Abrams, & Abrams, 2009, p. 63). Thus, in comparison with task performance and the optimal arousal hypothesis, introverts have a lower optimal arousal level than extroverts and vice versa (Mistry, 2015). Referring to Figure 1.3 which shows the optimal arousal levels of introverts and extroverts, task performance of introverts will be at best when their lower optimal arousal level is reached, whereas task performance of extroverts will be at best when their higher optimal arousal level is reached.

Hans Jürgen Eysenck (1916-1997), a well-known German-born British psychologist who was widely appreciated for his psychological and intelligence test and theories (Boyle, 2000) and having his works and findings being the most cited in the psychology field at the point of his passing (Rushton, 2001). Eysenck (1967) stated that introversion and extraversion are measured based on the cortical arousal of the individual (Hagemann et al., 1999). Numerous studies have used Eysenck's test models as a guideline framework to find out the personality traits of the selected participants, particularly in terms of how background music affects performance among introverts and extroverts in various tasks, such as memory tests (Furnham & Bradley, 1997; Furnham & Allass, 1999), reasoning tasks (Furnham & Allass, 1999; Cassidy & MacDonald, 2007; Dobbs, Furnham, & McClelland, 2011), and cognitive tasks (Daoussis & McKelvie, 1986; Moradi et al., 2019). Küssner (2017) reported on the adequate evidence on the Eysenck personality tests and theories, however, stated that the tests mainly focus on the detrimental effects of music towards task performance of introverts than its benefits towards task performance of extroverts. Thus, the current study employed the *Eysenck Personality Questionnaire – Revised Short Form* (EPQR-S) (see Appendix 1), but the purpose of this is only to classify the participants as introverts (with the score of "5" out of "12" and below) or extroverts (with a score of "7" out of "12" and above) to find out the differential effects of music stimuli among these two personality traits, and not as a major instrument to measure findings (Eysenck & Eysenck, 1975).

This section is important for the current study as it addressed the derivation of past knowledge regarding extroversion-introversion as this concept plays a significant variable in classifying subjects for the current study. Inter-relations of extroversion-introversion and music are reviewed in the following sections.

2.3 The Effects of Music on Psychophysiological Arousal

Arousal is known as a state of excitement in psychophysiological terms, specifically caused by an individual's response to stimuli triggering the arousal ("Arousal", n.d.), and has been classified as a measurement of "psychophysiological reactivity" by various previous studies (Broadbent, 1971; Eysenck, 1982; Matthews & Amelang, 1993; Coull, 1998). Matthews (2004) connected arousal with "excitement", describing arousal as an "excitation of the brain", which is known to happen within the cerebral cortex (p. 869). Excitement is also a form of arousal; and the arousal occurs when the heart rate, sympathetic nerve activity, and production of adrenaline hormones of an individual begins to increase (Patel, 2015). In this case, music is the stimulus that causes the arousal. Bartlett (1996) reviewed over 130 studies, and concluded that high-arousal (HA) music are generally "percussive, fast in tempo, highly rhythmic, loud in dynamics", which will be able to physically affect a human's body such as increasing heart rate and muscle tension or maintaining heart rate at a steady walking pace; whereas low-arousal (LA) music are generally "melodic (legato), slower in tempo, and soft in dynamics", thus decreasing heart rate and muscle tension (Iwanaga, Ikeda, & Iwaki, 1996; Lundqvist et al., 2009, p. 63; Griffiths, 2015). In terms of music volume, loud music was found to induce more arousal than moderate or no-music conditions (Ünal, Waard, Epstude, & Steg, 2013). A study by North, Hargreaves, and Krause (2009) pointed out three major psychological processes of music, which are the musical effects on psychological arousal, thoughts, and emotions. North et al. (2009) also quoted the Berlyne Theory (Berlyne, 1971), which stated that louder or faster music induces greater arousal, while softer or slower music decreases arousal.

Among the aspects within music, tempo and mode (or tonality) were the aspects of music that were widely used and manipulated by previous studies, considering these two aspects to be factors triggering arousal. Husain et al. (2002) investigated the effects ("Mozart Effect") of music tempo and mode on arousal and mood by using Mozart's Sonata K.448, but altered to fast/slow tempo and major/minor mode. Findings showed that fast tempo music increased arousal and slow tempo music decreased arousal in accordance to the Berlyne Theory; major key resulted in positive mood and minor key resulted in negative mood. However, the findings showed that tempo had no effect on mood, and mode did not affect arousal at all. Although the findings were consistent with previous research, measurements from Husain et al.'s study may not be fully valid, as the manipulation of tempo and mode could have affected other aspects apart from arousal and mood, which may have affected the results.

Gambling was commonly used as a research setting, as gambling involves a lot of excitement and nervousness. Moreover, people usually seek the feeling of excitement in gambling instead of the money, but the expectancy of winning money greatly affects the excitement level of the gambler (Wulfert et al., 2005). Dixon, Trigg, and Griffiths (2007) studied on how background music tempo affects behaviour during a virtual roulette game, having 60 participants randomly distributed to one of the following conditions: no-music, fast tempo music, and slow tempo music. The grand winner was rewarded with a prize gift. Findings showed that faster music tempo resulted in faster betting speed, but no difference in betting amount was seen among all conditions. Noseworthy and Finlay (2009) studied on the effects of music on gambling, and found that listening to music with fast tempo resulted in gamblers to not be aware of the time spent in gambling, while Mentzoni et al. (2014) found that in comparison between fast and slow tempo music, fast tempo music resulted in quicker reaction times of gamblers while slow tempo music resulted gamblers to increase the number of bets. These two studies may have shown that tempo affects arousal and gambling behaviour, which affects the gambling intensity of the gambler. However, Bramley et al. (2016) argued on the lack of solid evidence on the mentioned studies, stating that there could be more external influencing factors of the music, other than tempo, that influences gambling intensity and behaviour. Findings of the study contradicted to previous studies, showing that music tempo does not show any effect on gambling and arousal. Although there were some limitations in the study, for instance, the difference of music tempo used was not contrasting enough, thus the manipulation of music tempo alone is insufficient to prove that music can affect arousal, as there could be more external influencing factors, which lie within or outside of the music itself.

Arousal also affects cognitive task performance. As shown by the Yerkes-Dodson law (Hebbian version, see Figure 1.2) on the empirical relationship between arousal (mental or physiological) and performance, optimal arousal level results in the highest performance level, while too little arousal causes the individual to be inert and too much arousal causes hyperactivity which detriments performance (Diamond et al., 2007). It is shown that the presence of background music is able to improve cognitive task performances as compared to silence (Cockerton, Moore, & Norman, 1997). Apart from music, there are various environmental factors that affect arousal level, such as comfort, temperature, noise levels (including music volume), and personality of the individual, which are introverts and extroverts (Clark, 2010). This can be proven from Mistry's (2015) study on the effects of background music towards the test performance of introverts and extroverts. Due to the contrasting personality traits between introverts and extroverts, extroverts with a higher optimal arousal level perform better in cognitive tasks in the presence of music than in silence, and introverts with a lower optimal arousal level perform better without music than in the presence of music. This study confirms the claims of Furnham and Bradley (1997), which used pop music to see its effects on cognitive task between introverts and extroverts. Findings showed that extroverts had lesser detrimental effects from the music on the comprehension tests as compared to introverts. However, the music for both studies were chosen by the researchers and not the participants, and Mistry (2015) stated that the study should have included the participants' preferred music genres, as music selection could have affected the results.

In terms of how arousal affects memory task performance, Nguyen and Grahn (2017) studied on how background music affects various memory tasks by manipulating music arousal levels (HA/LA) and mood (positive/negative). The music excerpts used were instrumental 90's music of various genres such as blues, jazz, and metal. Findings showed that the background music showed no significant improvements on task performance as compared to no-music conditions, however, severed memory task performances in a few cases. However, findings for recall and recognition memory tasks were consistent with other studies involving memory tasks (Diamond et al., 2007). Findings were also consistent with the Yerkes-Dodson law, whereby the HA music used could have over-induced arousal which distracted the participants and deteriorated task performance, and that the LA music could have induced optimum arousal levels within the participants, which can be considered as the optimal music condition for the memory task.

Hallam and Price (1998) tested on the effects of "mood-calming music" among ten students: eight boys and two girls, with several behavioural difficulties. These students then proceed to complete several mathematical problems with/without listening to the music. To avoid external factors, one of the ways was to execute the experiment during the same time of the day, which was after lunchtime. Results were obtained and interpreted through the video recording of the experiment. Findings showed that all students performed better while listening to the "calming music", therefore it can be seen that the "calming music" can improve performance significantly, decreases any rule-breaking behaviour, and the effects are most apparent for hyperactive individuals. Findings of this study were in-line with the optimal arousal hypothesis, as the "calming music" decreased the arousal level of the hyperactive students (whom are usually highly-aroused) nearer to their optimal arousal level, thus resulting in better task performance.

Moreover, Cassidy and MacDonald (2007) did a similar study on the effects of music on cognitive task performance, but using two types of music: music with high-arousal (HA) and negative effect, and music with low-arousal (LA) and positive effect, and total silence. Similarly, results showed that although introverts generally outperformed extroverts in most tasks, the performance of introverts deteriorated when exposed to HA music. In accordance with the optimal arousal hypothesis, introverts are distracted and lose focus when exposed to HA music and noise, while extroverts with higher optimal arousal level prefer to be in a more engaging environment, hence their better performance when exposed to HA music. However, this study primarily focused on "aggression" instead of "excitement" for the HA music condition, in which the HA music condition was "negative" in effect unlike the LA music which was "positive". The current study will maintain both HA and LA music at positive effect instead. Incidentally, in terms of the differentiation of introverts and extroverts, Cassidy and MacDonald (2007) had acknowledged the proposal of Eysenck (1967) which stated that introversion and extroversion can be differentiated based on the amount of external stimuli which affects the arousal level of the individuals, in accordance with the Yerkes-Dodson's optimal-arousal hypothesis (Diamond et al., 2007).

In a nutshell, from these studies, it can be seen that many researchers tried to study the effects of music on arousal by applying the manipulation of tempo and mode, since tempo generally does indeed affect arousal as stated by Berlyne (1971), and mode may somewhat affect mood. However, findings of the studies may be inconsistent, as there may be other unknown factors ongoing during the experiment which may indirectly affect the results. Despite that, this section of literature review plays an important role to this study as these sources showed that music can affect arousal, but a greater contrast in the manipulation of music has to be used and other limiting or interfering factors have to be identified and rectified in order to get more precise findings.

2.4 The Role of Music in Affecting Emotions

Emotion is known as a sophisticated psychological state of "self-feelings" (Denzin, 1984, p. 3) that involves "an individual's subjective experiences with physiological and behavioural responses" (Cherry, 2019a). Cherry (2019c) identified the six basic emotions based on psychologist Paul Ekman's findings in the 1970s, which are happiness, sadness, fear, anger, disgust, and surprise. Subsequently, psychologist Robert Plutchik's "wheel of emotions" indicated how more-complex secondary emotions can be formed with the combination of two or more basic emotions, such as love, grief, and jealousy (Plutchik, 2001, p. 349). In terms of relations between emotion and arousal, the Schachter-Singer Theory is a cognitive approach theory which stated that the occurrence of arousal comes first with an affecting stimulus, which leads to a response cognitively interpreted by the individual leading to a labelled emotion (Roeckelein, 2006; Cherry, 2019b).

Music is known to affect mood, followed by emotions and behaviour (Hunter & Schellenberg, 2010). Music is also proven to play a huge role in impacting, enhancing, or manipulating human emotions, including human movement as well (Park, Hass, Fawver, Lee, & Janelle, 2019). Previous studies have proven that human emotions will fluctuate and behaviours will start to change when we listen to music (Orr, Myles, & Carlson, 1998), and that the two most significant factors of music affecting emotions are tempo and musical language (Carpentier & Potter, 2007). Ahtisaari and Karanam (2015) stated that in today's globalization era, people spend money on music, particularly subscribing to podcasts such as Spotify. This can be claimed by Salimpoor et al.'s (2013) study on how sound affects activation in the brain and decision-making, which stated that activation in the brain (closely related to optimal arousal level) is a significant factor to an individual's willingness to pay to listen to both familiar and non-familiar music, as the music is found to activate the brain in processing and associating with emotions.

Previous studies also showed neuro-physical effects of music onto emotion and arousal, and that different musical patterns showed different associations with emotional affections. Paquette, Peretz, and Belin (2013) did a study with intention to analyse the expression of basic emotions based on a set of musical excerpts, with the basic emotions being happiness, sadness, and fear, as these and the three most prominent emotions to be found in music. A total of 10 professional violinists and 10 professional clarinettists participated in this study, and performed 10 short improvisations with varied degrees of expression based on the three selected basic emotions. Findings showed that happy stimuli conveyed positive and arousing emotions, sad stimuli conveyed moderate-arousal and negative emotions, fear stimuli conveyed negative and arousing emotions, and a neutral stimulus conveyed neutral emotion with low arousal.

Another finding of the study was that timbre and instrument choice are two significant impacting factors on emotion. Lundqvist et al. (2009) studied on how music induce true emotional responses among listeners, and how listeners perceive emotions that are expressed by the listened music. Findings were taken from 32 participants through self-reporting, and measuring of facial muscle and autonomic activity, based on "happy" and "sad" music emotions. Findings showed that happy music showed greater facial muscle activity and skin conductance, greater happiness and lower sadness levels as compared to sad music. However, the study did not notice on how happy music can induce greater heart rate than sad music, despite quoting how HA music is able to increase heart rate by Bartlett (1996), instead saw a deceleration-acceleration of heart rate for both HA and LA music conditions. Lundqvist et al. (2009) was aware of this predicament, hence acknowledged that it could be due to a shift in attention of the participants known as an orienting response, thus classifying it as a flaw instead of contradicting Bartlett's (1996) statements. The paper eventually stated its intentions to not go against previous claims and theories, but one limitation for this study could be that the emotional expression of the music could have provoked negative emotional responses of listeners towards the music.

In terms of emotions linking to decision-making, Vuoskoski and Eerola (2011) studied on the relation of personality and mood affect emotions represented by music, between extroverts (tendency to be positive) and neurotics (tendency to be negative). Findings showed that extroverts have increased positive future likelihood judgements, while neurotics have increased negative future likelihood judgements, hence concluded that personality and mood significantly affects musical emotional processing, and that music (as a stimulus) affects the interconnection of personality and mood with emotional processing. Liebman, Stone, and White (2015) studied on the effects of music stimuli on emotions which in turn influences decision-making, as they stated that emotion is not just a responding product of music cognitive processing, but also can impact an individual's mental state. The study featured the manipulation of three musical aspects: tempo, tonality, and amplitude. However, findings showed that music had not much significant effects on emotional evaluation, but rather on the favouring of the response options.

There have been studies showed that music familiarity plays a significant role in various mental processes (Hahn & Hwang, 1999; Pereira et al, 2011). In terms of music familiarity and preference with emotions, arousal, and stress, Jiang, Rickson, and Jiang (2016) studied on how music affects the induction of stress by having 200 female students participating in listening to the music with the majority after being stressed-up on an initial mental arithmetic quiz and with some who did not do the quiz. The participants were exposed to 32 different types of music and rate their preference and familiarity with the music, thus the most suitable eight songs were chosen. Findings reported that music preference played the greatest role in reducing stress as it showed significant drop in stress levels of the participants, as compared to music familiarity which did show much differences. This was explained by quoted previous studies that positive emotions will be induced by liked music which leads to relaxation, and that negative emotions will be induced by disliked music which leads to negative feelings such as sadness or anxiety (Montag, Reuter, & Axmacher, 2011; Salimpoor et al., 2013). The study also found that LA music showed greater effect in reducing stress than HA music. Moreover, the study quoted on previous research that showed differential effects of music between music and non-music majors (Smith & Morris, 1977), but this difference was not seen in Jiang et al. (2016). This agrees that emotions felt by the music may not be affected by the listeners' musical training background (Kreutz, Ott, Teichmann, Osawa, & Vaitl, 2008), which strengthens the credibility of music preference being the major manipulating variable of a music in this area, as compared to music familiarity.

In terms of emotions with musical type and preference, Iwanaga and Moroki (1999) studied on how music type and preference affects human emotional responses using music as controlled stimuli. 47 university students participated, and the types of music were labelled as "excitative" (HA) and "sedative" (LA). Findings showed that music type was the main affecting variable towards emotional responses, and that music preference showed no significant differences. In terms of emotions and music familiarity, Park et al. (2019) tested on how forward gait (walking posture) is affected when listening to music, and how this is differentiated between familiar and unfamiliar music. 24 young adults in good health condition were tested using four types of music within the combinations of pleasant and unpleasant, and familiar and unfamiliar music. Findings showed that pleasant music resulted in faster forward gait than unpleasant music, but this only applies to familiar music. There were no differences between familiarity during unpleasant music conditions. Lynar, Cvejic, Schubert, and Vollmer-Conna (2017) studied on how music stimuli affect emotional and physiological response changes by manipulating music and preference through self-selection. Findings showed that songs which are self-selected resulted in the highest levels of joy, and the lower-arousal music induced the most relaxation. Park et al. (2019) thus quoted on neuroscientific validity in the impacts of music on behaviour and emotions, in which pleasant emotions evokes human motor reactions to react with the rhythm of the music, hence in this case, to walk in simultaneous pace with the rhythm of the music (Zentner & Eerola, 2010; Janata, Tomic, & Haberman, 2012; Vuilleumier & Trost, 2015).

Landay and Harms (2019) reviewed on the effects of music in a workplace. The review saw that currently the applications of music in increasing mood in workplaces is still not carried out yet, and that mood is a major aspect alongside emotion, and that it is largely unable to measure only one of them, in accordance with the findings of Vuoskoski and Eerola (2011). Moreover, Landay and Harms (2019) also saw extroversion-introversion as a potential moderating factor in this area, as music with different tempi and arousal levels may have differential effects on both introverts and extroverts. Essentially, this review study pointed out that there are still ample room for research among music with mood and emotions, specifically on its direct relationship moderated within extroversion-introversion.

Therefore, it can be seen from these studies that music greatly affects emotions and the interconnection of emotion with other aspects such as personality, mood, arousal, and decision-making. Unlike arousal, findings of studies on the effect of music on emotion seem rather consistent, solidifying the notion that the manipulation of music show great influences in emotional processing of all kinds of personalities. More studies related to emotional processing in gameplay is further reviewed in Section 2.6.

2.5 The Association of Music with Decision-Making

In psychological context, decision-making is known as a cognitive process of an individual in selecting an action course within a pool of optional possibilities, producing a final resolution (O'Sullivan, 2011, pp. 2-3; Juneja, 2019). There are three major aspects of decision-making, which are consumer, economic (money-related), and personal decision-making; however, this study placed more emphasis on economic and personal decision-making. There are two classifications of decision-making, which are "hot" and "cold" decisions, based on the Hot-Cold Decision Triangle. "Hot" decisions are decisions which are made emotionally and intuitively, while "cold" decisions are made analytically and with rational deliberation (Yang et al., 2012, p. 459). There are two conditions of decision-making: risk (or "risk-taking") and intertemporal choice. Risk-taking is the act of making a decision in a condition of "having uncertainty of its consequential outcomes" (Foo, 2011, p. 1); while intertemporal choice is the act of making decisions at certain points of time with consideration of trade-off efforts, costs, and benefits (Foo, 2011, p. 2; Ericson & Laibson, 2018). Risk-taking is the focused outcome in the current study.

Decision-making has close relations with arousal and emotions, as these two are key factors in influencing an individual's decision-making. The Consequentialist Theory of Decision-Making best describes this relation. In this framework, decision behaviour can directly influence immediate emotions. Moreover, in terms of expected emotions, decision behaviour can affect expected outcomes, while expected emotions is affected by the expected outcomes when any external force influences the expected outcomes. The expected emotions in turn will re-affect the decision behaviour, causing the decision behaviour to change when the expected emotions of the expected outcomes turn negative (Rick & Loewenstein, 2009). Emotions is strongly linked to decision-making, in which sadness is found to have greater demands of fairness (Harlé & Sanfey, 2007).

In terms of the effects of music and emotions on decision-making, Liebman et al. did two studies, one regarding quantitative tasks (2016), and another regarding cooperative tasks (2018). In the quantitative task study (2016), the study investigated on the effects of music on risky decision behaviour in quantitative reasoning, questioning on how analytical decision-making is affected by music exposure. Although there were extensive evidences on arousal and emotion affecting decision behaviour and information processing, not much about the relation between music and risk decision behaviour is studied. Findings of the study showed that despite music affecting decision behaviour, there were no sign of music bias in the processing of decision-making, and that decisions were consistently made better and more rational when listening to happy music as compared to sad music.

In the cooperative task study (2018), decision-making in intersocial tasks are examined to see how it is affected by music exposure. Unlike quantitative tasks which only require analytical reasoning, cooperative tasks require interaction as the tasks are carried out in groups. An experiment was carried out by having participants driving a simulated car at an intersection while listening to different kinds of music, with another computer-controlled car crossing from another direction. It was expected from the previous quantitative task study (2016) that happy music results in more positive decisions and sad music results in more negative decisions. However, results of this cooperative task study (2018) had zero consistence with the previous 2016 study. Findings showed that listening to happier music resulted in lesser social interaction between the participant and the other computer-controlled car driver, hence having a lower probability to allow the other car to cross the intersection first. It was the listening to sad music which made the participants more rational and cautious to their surroundings, making sure that the environment is safe first before proceeding through the interaction.

Therefore, results of Liebman et al.'s cooperative task study in 2018 partially contradict to the quantitative task study in 2016. Although happy music induces positive decisions and sad music induces negative decisions, this is only applicable to solitary tasks. In cooperative tasks which require interaction, happy music induced lesser social behaviour and causes more self-centred decisions with lesser understanding of others; while sad music induced more cautious behaviours that result in an individual being more analytical of the situation before making a decision. The cooperative task study showed that happy music induced more self-centred decisions, while sad music induced more cautious and analytical decisions.

In terms of music familiarity, Fujikawa and Kobayashi (2012) investigated the effects of music familiarity on decision-making in two task situations: intertemporal and lottery choice tasks, questioning on whether music familiarity or unfamiliarity does affect intertemporal decision-making and risk-taking or not. The study was conducted in four conditions: listening to familiar music, unfamiliar music, white noise, and without music, to choose between two situations involving risk: 80% chance of winning 4,000 yen and 20% of winning nothing at all, or a full 100% chance in winning 3,000 yen. Findings showed that participants made the riskiest decision in white noise condition, and that the majority disliked listening to white noise, hence concluding that exposure to noisy conditions will result in riskier decision-making. However, results showed not much of difference between familiar and unfamiliar music in decision-making and risk-taking. Henceforth, findings of this study rejects the claims of music familiarity affecting decision-making and risk-taking.

More research had been done on music tempo, lyrics, and genre in decision-making. Foo's (2011) was similar to Fujikawa and Kobayashi's (2012) study, but by solely manipulating background music tempo instead. Findings showed that fast tempo music showed significant impacts on risk-taking and intertemporal choice, but slow tempo music and no-music condition showed no effects on risk-taking and intertemporal choice. As mentioned earlier by Wulfert et al. (2005), this is due to fast tempo music increasing arousal and excitement, which in turn induced risky decisions. However, it was also found that both slow and fast tempo music can result in riskier behaviours (Mentzoni et al., 2014). Evano (2013) did similar investigation, this time manipulating genre (rock and classical music) and tempo (rock music is generally more upbeat than classical music). Evano hypothesized that rock music induces risker performance in working memory tasks and decisions than classical music. Findings showed that rock music induced more risk-taking than classical music, but the music (played passively) resulted in less risk-taking compared to no-music conditions. Moreover, listening to rock music actively induced more risker decisions and listening passively resulted less risky decisions. However, the results seem rather vague, as the study did not consider the manipulation lyrics in the experiment since rock music had lyrics and classical music did not, and that both "hot" and "cold" decision-making were unable to be properly assessed in this study.

In response to Evano's (2013) study, Rinato (2014) did a similar study, this time manipulating tempo and lyrics, but kept to the two same genres (rock and classical). The experiment was carried out by using music with and without lyrics, music of fast and slow tempo, and two spoken conditions to further validate on how the lyrical words affect decision-making (both "hot" and "cold"). However, findings of the study contradicted to all prior predictions and inconsistent with previous studies. Listening to mid-tempo classical music resulted in riskier decisions than fast-tempo rock music. Music with lyrics induced healthier decisions than music without lyrics, although without much difference between the results. Regarding “hot” and “cold” decisions, findings of Rinato’s (2014) study surprising showed that “hot” decision-making was more associated with the mid-tempo classical music as compared to the fast-tempo rock music. Thus, there could have been various unavoidable flaws and limitations happened in this study which interfered the results contradicting to initial expectations, but despite having the unexpected findings on the effects of music tempo and lyrics, Rinato (2014) also further stated that an individual may be able to show better task performance in emotional-based decision-making and risk-taking in a distractive state, as the decisions made will not need as much conscious considerations.

There were also previous studies on the effects of music on real-life decision-making, or known as consumer behaviour. Caldwell and Hibbert (2002) studied on how music tempo and preference affects restaurant customer behaviour based on four aspects: time spent, money spent, enjoyment, and future intentions. This study noted from Berlyne (1967) whom stated that pleasure is at its highest at moderate arousal level, while unpleasant stimuli occurs when arousal level is too low or too high, hence concluding that people will show greatest preference on moderately-arousing music. Milliman saw how loud music decreased consumer shopping time (1982), and also how fast tempo music decreased restaurant customer dining time (1986). However, Herrington and Capella (1996) found that tempo and volume showed no significant effects on consumer behaviour, but music preference did instead, and that it may be a more valid factor since it was not frequently studied before. Caldwell and Hibbert (2002) carried on the similar research by playing some jazz music by Ella Fitzgerald in the restaurant. Music preference was gauged by having the customers rate their preference of the music. Findings were parallel to Herrington and Capella (1996), in which music preference showed better influence of time spent in the restaurant and future intentions than tempo.

Moreover, Dubé et al. (1995) studied on how background music affects desires of consumers on buyer-seller interactions in banking services by manipulating pleasure and arousal levels of music set in three different levels: low, moderate, and high. Findings showed that the greatest desires were seen in both higher-pleasure and higher-arousal levels. In terms of interactions between pleasure and arousal, pleasure had its greatest impacts during low and high arousal conditions as compared to moderate arousal level, while similarly, arousal had its strongest effects during low and high pleasure as compared to moderate pleasure level music condition. This study showed that high-pleasure and high-arousal level conditions are best for evoking desires and interactions, and additionally, saw high-pleasure music (pleasant music) condition as a great enhancer to evoke desires.

Hussain and Ali (2015) did a causal study on the atmospheric effects on consumer purchase intentions in retail outlets based on a number of variables. It was proven that positive and satisfying atmospheric stimuli are able to increase consumers' time spent in the particular place, amount of purchase, and improves decision-making (Wakefield & Baker, 1998; Silva & Giraldi, 2010; Bohl, 2012). In music terms, pleasant music increases time spent in the particular place and increases amount of purchase (Holbrook & Anand, 1990; Herrington & Capella, 1996). Similar to Berlyne (1971), louder music causes an uncomfortable stimulus, resulting in lesser time spent (Smith & Curnow, 1966). Findings showed that cleanliness, good lighting, display, and scent showed significant influences on purchase intention, however, music, temperature, and colour showed almost zero impact. Despite having the findings contradicting to previous literature, this study may not be fully valid as (i) type of music used was not specified, and (ii) results were obtained solely based on questionnaire, thus unwanted interfering factors could have occurred, such as one of the atmospheric variables could have been more apparent than the music which overshadows the music, or that it could have been caused by wrong music choice.

Meng, Zhao, and Kang (2018) studied on how perception of sound environment affects crowd behaviour in urban open spaces in Harbin, China. This study intended the find out if music is able to affect movement speed (walking) and behaviour of the crowd, as well as how music affects non-movement (sitting) behaviours in the open space. It was seen that faster music increases movement speed, while slower music decreases movement speed (Franěk, Van Noorden, & Režný, 2014; Lavia, Witchel, Kang, & Aletta, 2016). The music was played openly through a loudspeaker, which can be heard clearly at any location within the space. The music chosen was a pop song called "Free to Fly", a 120 BPM song played at 88-90 dBA. Findings showed that the background music showed no significant differences towards the movement speed of the people in the area in contrary with the findings of Franěk et al. (2014) and Lavia et al. (2016). Meng et al. thus pointed out that this contradiction is due to the subjects in Lavia et al. (2016)'s study only intending to stroll along the area, while the subjects in Meng et al. (2018)'s study were only passing by the area to get to their destination, in which their movement speed will not be affected, more so that the subjects may not be attentive to the music. However, as the current study requires compulsory exposure to the music, therefore the speed (of decision-making) of each subject involved in the task will be taken into consideration in reference to the findings of Franěk et al. (2014) and Lavia et al. (2016), also including the effects of music on reaction times as mentioned earlier by Mentzoni et al. (2014).

The most recent research on music and decision-making to the current study investigated on the effects of HA and LA music on financial investment decision-making (Israel et al., 2019). People who are in an unpleasant mood usually make more "cold" (analytical and algorithmic) decision-making than pleasant-mood people (Isen, Means, Patrick, & Nowicki, 1982). Israel et al. (2019) had quoted Au, Chan, Wang, and Vertinsky (2003), which studied on how music and mood manipulation affects trading behaviour and financial decision-making, and found that good mood results in lesser accurate decisions and over-confidence than bad mood. Israel et al. (2019) thus expected to see that fast-tempo and HA music would result in a lesser degree of risk-taking, and that “disturbing” music will cause lesser risk-taking. A large number of 367 students from a college in Israel participated, and divided into three groups: fast tempo and HA music group, slow tempo and LA music group, and no-music (control condition) group. Participants then underwent investment decisions by taking part in questionnaires regarding lotteries, investment portfolio diversification, and socio-demographical aspects. Findings showed that slower tempo and LA music led to riskier decision-making than fast tempo and HA music for the lottery and investment tasks. This led to the contradiction to faster tempo music showing more significant impacts in risk-taking and intertemporal choice (Foo, 2011).

Therefore, this section regarding the reviewing of literature on the relations of music and decision-making has been rather interesting. This section is important as findings of the literature showed the effects and elements of music intertwining with the interconnection of arousal and emotion in decision-making and decision behaviours. Despite the inconsistent findings, it cannot be denied music plays an important role in affecting decision-making based on the experimental manipulations of music from the studies reviewed in this section. Limitations and further recommendations from these studies will be taken into consideration for the current study.

2.6 The Role of Music in Gameplay

Currently, there is not much up-to-date research on the effects of music in game-playing can be found, hence the lack of understanding of music and its impacts on game playing. The term “gameplay” is known as the way a game is played, including interaction among players while playing a game (Djaouti, Alvarez, Jessel, Methel, & Molinier, 2008, pp. 5-6). However, as the area of “music and gameplay” is generally associated with “music and gaming”, and conventionally understood as the research in music in video gaming or how music should be composed in order to congruently fit in with the visuals and vibe of the video game, the current study is neither related to video games nor researching on the congruity of music in gaming. This study shall look into how the manipulation of music affects activities that comprise of the combination of all three psychological aspects mentioned in the current study, which are psychophysiological arousal, emotion, and decision-making.

In this case, a "party game" is chosen for the present study, as this activity requires social interaction and is able to measure the arousal and emotional level, and also the decision-making of the game players. The term "party game" is known as a multiplayer game that is usually played in social-gathering events and thus requires and enhances social interaction or icebreaking (Elias, Garfield, & Robert, 2012). Party games in card form such as *Mafia*, *Uno,* and *Blackjack* are usually made easy to learn, as the goal of these game are to facilitate social interaction and relationships. Elias et al. (2012) also stated that these party games face three consequences or risks, which are: risk in elimination, unhappy players that opt to leave the game, and certain players giving every player an opportunity to win (commonly known as intentionally "giving chance") (Ibid.). However, as there are little to no previous studies regarding music and party games, the review of literature regarding effects of music on general gaming (mostly video games) are reviewed instead.

As mentioned earlier, tempo has always been a common aspect of music to be manipulated to measure changes in arousal, emotion, and decision-making. Lawrence (2012) studied on the effects of music tempo in the performance of playing *Tetris*, which was played a number of times while listening to music with its tempo manipulated. In contrary to initial expectations, findings showed the manipulation of music tempo does not cause significant differential effects on gameplay performance. According to Lawrence (2012), findings of the study could have been affected by external interfering factors other than the manipulation of tempo. It could be due to the limitation of sample size, poor choice of gameplay difficulty, the "unwanted influence" of too much repetition, or even the boredom felt by players to the game. Tempo subtlety could have been a problem too, as similar to the studies of Husain et al. (2002) and Bramley et al. (2016), in which the manipulation of tempo was not precisely distinguished – the difference of tempo between the music should be more contrasting, and to be made sure that the problem of tempo unwantedly influencing other aspects apart from arousal, emotion, decision-making, or any intended measuring aspects, is avoided.

Generally, gameplay (including gambling) is known to be able to increase the arousal levels of all types of game players (Leary & Dickerson, 1985). In terms of how music affects arousal levels in gameplay, it has always been understood that music has the ability to induce both positive and negative effects in human performance (particularly physical/motor and cognitive tasks), and that music tempo and mode increases arousal and mood as mentioned earlier by Husain et al. (2002). Also previously mentioned by Cassidy & MacDonald (2007), human performance can also be affected by the arousal level emitted by the music: which are high arousal (HA) and low arousal (LA) music. Levy (2015) investigated on how background music affects video gameplay between gameplay behaviour and gameplay experience of introverts and extroverts. The study questioned on how altering a musical element is able to affect the optimal arousal state of introverts and extroverts and optimal gaming experience, and how is it able to further affect gaming performance. Moreover, a common convention was that majority of game music tend to employ fast tempo (upbeat) to manifest hype and excitement arousal stimuli (Shepard, 2017), however, the issue on whether the fast tempo music enhances or detriments gameplay performance still remains debatable. Levy's (2015) study expected to see that the presence of music will improve gameplay performance, yield more positive experiences, and that engagement of introverts will be at its lowest when playing the game while listening to fast tempo music as compared to extroverts, whose performance will not be negatively affected by the fast tempo music. Findings of the study opposed the expectations of the effects of music improving gameplay performance, showing that music had no effect on improving gameplay performance and no difference when played without the presence of music. However, the findings showed that fast tempo music does indeed detriments engagement of introverts in the game as compared to silence, in accordance with the findings of Cassidy and MacDonald's (2007) study.

In terms of how music affects emotion in games that require social interaction, altruism is commonly associated in this situation. Altruism is known as the act of an individual voluntarily promoting to the benefits of others regardless of his/her risks and sacrifices (Khalil, 2001). Altruism involves sacrificing time, money, or flesh, and is usually rated through feelings of individuals towards others in various situations (Ben-Ner & Kramer, 2010). The opposite of altruism is selfishness, which is known as the act of keeping things to one's self, regardless of its degree of benefits to himself/herself, and without consideration on how much it benefits others as compared to himself/herself (Rachlin, 2002). Ben-Ner and Kramer (2010) did a study to find out how personality and altruism are associated in an economic dictator game experiment based on a few relationship classifications. Findings showed that the relationship classifications in the sequence of the most generously treated to the least generously treated is: kin, collaborators, neutrals, and lastly competitors. This study showed that the degree of altruism will be greater in proportion to the relationship proximity between two individuals.

Tan and Forgas (2010) studied on mood and decision-making, and found out that game players who are exposed to a happy and upbeat environment make more selfish decisions and actions as compared to game players who are exposed to a sad or depressed environment. Putting music into the scene, Chung et al. (2016) studied on the influence mood on decision-making by playing the ultimatum game, and found out that listening to music of unpleasant mood had higher rejection rates than listening to music of pleasant mood. In terms of preferred music, Fukui and Toyoshima (2014) studied on how preferred "chill-inducing" music is able to increase altruism level among the game players, and found out that listening to preferred music does indeed promote altruism. Heisbourg (2017) answered to the previous studies by conducting a study to investigate on how the mood of music affects altruism in a dictator game by manipulating the mood of the music. Heisbourg (2017) questioned on whether mood of the music affects the degree of altruism, and whether the impact of music on the decision-making of game players will be affected in dependence on the extraversion and agreeableness level of the game players which are responsible in moderating musical effects on altruism. Findings showed that sad music induced more altruism than happy music, which answers to Tan and Forgas's (2010) findings. However, the level of extraversion and agreeableness did not show any effects on the degree of altruism in the game players' decision-making.

Another aspect to be studied in gameplay is how background music affects the immersion of game players into the game. Immersion is known as the state of an individual having deep mental involvement and concentration in carrying out a task, for this case, while playing a game (Wood, Griffiths, & Park, 2007; Zhang & Fu, 2015). Apart from mental involvement, immersion also encompasses the game players' physical and virtual experience in the game by having interactions with the virtual environment in the game which provides continuous stimuli to the game player (Witmer & Singer, 1998; Pine & Gilmore, 1999). In addition, having immense immersion will decrease awareness of the game players' real-world surroundings and involvement, and also decrease the awareness of the passage of time, also known as time distortion (Douglas & Hargadon, 2001; Hancock & Weaver, 2005; Rau et al., 2006). There are three factors that can influence gameplay experience, which are sensory, challenge-based, and imaginative immersion (Zhang & Fu, 2015). Background music contributes as a factor to the quality of immersion of video games, as the overall music ambience enhances illusions of "virtual reality" in the game world, in which the music compliments overall gaming experience and immersion (Nelson & Wünsche, 2007; Collins, 2008; Grimshaw & Schott, 2008; Jørgensen, 2008).

Zhang and Fu (2015) studied on the role of background music and how it affects subjective immersion of video game players. To control the variable of gender, only males took part in a survey questionnaire which measured their cognitive and emotional involvement, and also questions in terms of gaming experience. From the questionnaire, a total of 40 "high gamers" (people who have great experience and adaptability in gaming) and 40 "low gamers" (people who have little experience and low adaptability in gaming) were selected and took part by playing *King of Fighters* (KOF). All players played using the same character and having the same powers and abilities, only in different colours to distinguish the players from each other. Players were paired randomly within their own group (high/low gamers) and divided into two music conditions: with music and without music. After 20 minutes of playing, players made evaluations of the game, and immediately went on to do another task (Stroop task). Players then answered an exit questionnaire regarding immersion. The study expected to see impacts of background music in immersion and to investigate how this is affected among high and low gamers. Findings showed that listening to background music does indeed increase immersion and improves narrative experience. However, background music only had significant influences among low gamers. This may be due to boredom that is felt by high gamers as they were easily adaptive to overcoming the challenges in the game, which causes less immersion regardless of whether there is background music or not; due to lower adaptive ability, low gamers showed more curiosity in playing the game, which increases immersion. Moreover, the study pointed out that Stroop task was not a reliable task after the video game as its easiness caused a ceiling effect. However, this study only measured within high and low gamers, and that mixing the experiment between high and low gamers may cause different results.

This section reviewed various literature pertaining to music and gameplay, with the combination of arousal, emotion, and decision-making aspects in game playing. Although some hypotheses of the studies being rejected by the findings, it can be seen that at many parts the findings and conclusions of the various literature are consistent and agreeable with one another, particularly in terms of the effects of music on arousal and emotion (altruism) in game playing. Despite that, amount of research in this field still remains scarce, partly due to the difficulty in combining the fields of musicology (music manipulating), psychology (arousal, emotion, and decision-making), and economics (nature of the game) altogether (Heisbourg, 2017). However, research is this field is vital for future game developers to design the best gaming atmosphere and experience for game players by using the most suitable music for the game.

2.7 EEG Studies on the Psychological Effects of Music

Electroencephalography (EEG) is the study of "detecting and monitoring electrical wave activity in the brain" through the usage of a brain-computer interface (BCI) connected to the EEG device which detects and interprets the detection to the waves (Mostafa & Mostafa, 2012, p. 5; Robbins & Stonehill, 2014, pp. 5-6). Brainwave activity frequencies are chronogically detected through an electrode of an EEG-monitoring device placed on the scalp surface of an individual, measuring brainwave activity through the detection of synchronized activity of neurons in the brain based on the various cortex area of the brain, which are occipital, parietal, temporal, and frontal cortices (Lopota, 2014; Farnsworth, 2018; Ellis et al., 2009).

There are five types of brainwave activity in the brain, which are (from lowest to highest frequency, numbers slightly differ between sources) delta (0.1-3 Hz), theta (4-7 Hz), alpha (8-12 Hz), beta (12-30 Hz), and gamma (>30 Hz, usually around 40 Hz) waves.

Delta-waves are the lowest in frequency which are usually associated with meditative and rejuvenative deep sleep, and also concentration in cognitive and memory tasks. Too much delta-waves may cause severe ADHD and inability to think rationally; lack of delta-waves causes poor sleep and inability for the body to rest itself; while an optimal delta-wave amount enhances natural healing and deep sleep. Theta-waves usually associate with light meditation and dreaming, whereby the individual is still conscious but still in a deep relaxation state. Too much theta-waves may cause hyperactivity and ADHD; too little may cause anxiety; while an optimal theta-wave amount enhances creativity and emotional connection. Alpha-waves are associated with being in the state of conscious relaxation and attention, which helps in mental coordination and cognitive learning. Alpha-waves are easily detectable and observed, and it is commonly found during creative and artistic activities, or right before falling asleep. Too much alpha-waves cause daydreaming and inability to focus due to over-induction of relaxation; too little causes anxiety and stress; while an optimal alpha-wave amount enhances relaxation. Beta-waves are a rather "fast" brainwave activity engaging alertness, problem-solving, and decision-making. Beta-waves are divided into lower beta, midrange beta, and higher beta-waves. Low beta-waves (12-15 Hz) occur during a relaxation-state focus; midrange beta-waves (16-20 Hz) occur during a thinking state with awareness; high beta-waves (21-30 Hz) occur during alertness or agitation. Too much beta-waves cause adrenaline and high arousal; too little causes daydreaming and poor cognition; while an optimal beta-wave amount enhances problem-solving and conscious focusing. Gamma-waves are the highest in frequency which are associated with high-order thinking skills and information processing. Being the subtlest brainwave frequency which is not frequently studied, it is not easily assessable, only if the mind is quiet and at a relaxed mode. Too much gamma-waves causes anxiety; too little causes depression and learning disabilities; while an optimal gamma-wave amount enhances information processing and cognition. (Hermann, 1997; Cheng, 2014; Katona, 2014; Lopota, 2014; Robbins & Stonehill, 2014; NeuroSky, 2015; Sezer, İnel, Seçkin, & Uluçinar, 2015; Kyriaki, 2016; MindWave User Guide, 2017; Ülker, Tabakcıoğlu, Çizmeci, & Ayberkin, 2017; Farnsworth, 2018; Magner, 2018; Muse, 2018; Mindvalley, 2019).

Walker (1977) did an EEG study on the relations of brainwave activity and music stimuli reactions in two musical conditions and a silent condition between a group of musicians and non-musicians. Findings showed that attentiveness is shown through high delta- and theta-wave productive, but low in alpha-wave production. In terms of emotions, findings showed emotional reactions show mostly high delta-waves, concluding that slow brainwave activity is related to more emotional responses. Findings also showed that listening to familiar music produced high theta-wave levels and listening to unfamiliar music produced high alpha-wave levels. Moreover, the experiment saw more brainwave activity while listening to classical music than rock music (Ibid., p. 488), questioning on the legitimacy of the "Mozart Effect" on arousal and emotion as studied by Husain et al. (2012). In terms of EEG and decision-making in gameplay, Yun, Chung, and Jeong (2008) did an EEG analysis on social decision-making while playing the ultimatum game, also investigating on social and emotional interactions in gameplay. Findings showed that the stronger the social interaction between game players, the lower the rejection rate. Lastly, in terms of EEG and music-evoked emotions, Rogenmoser (2016) studied on brainwave activity through felt emotions while listening to music naturally. Findings showed that arousal is associated with alpha-wave suppression, and that music excerpts which induce happiness showed an increase in theta-wave frequency as compared to sad music. The study also stated that arousal is controlled by the right parietal-temporal region of the brain, while emotion is controlled by the left frontal lobe.

Matthews and Amelang (1993) did an EEG study on personality, arousal, and performance. They quoted that EEG evidences on personality and arousal were weak, and that previous findings were rather inconsistent and was unable to see strong evidences on arousal, hence rejected to the legitimacy of the Yerkes-Dodson law. The study also found that the performances of extroverts were at best in low alpha-wave levels, while the performances of introverts were at best in high alpha-wave levels. Thiel (2018) also studied on personality and arousal, but instead included music as a stimulus. This study aimed to find out how music preference affect personality through EEG measurements. The study chose six tunes to represent positive and negative arousal stimuli, and used 10 participants carefully selected through a personality test. This study could only partially confirm that high extroversion shows lower theta-wave and beta-wave activity, and vice versa for neuroticism. High extroversion saw better ratings for positive valence and negative depth, but the vice versa is rejected.

However, one similar shortcoming from these two studies was that the studies recognized their difficulties in handling the EEG instruments. Matthews and Amelang (1993) suggested a further duplication of their research by using an "alternative, more fine-grained" and "more validated" EEG device, which indicated that the difficulties of the EEG device used in the study might have been too complicated, or had faced unknown technical difficulties, which might have caused unwanted disruptions to the findings. Thiel (2018) reported that data from the EEG readings were too complex to be interpreted.

Moreover, there have been EEG studies on the relationship between music types or genres and states of attention and relaxation. Siti Ayuni and Wan Mahani Hafizah (2015) did a study on how different types of music help in attention and memory in various tasks based on EEG recordings (PowerLab and Dual Bio Amp) by analysing two types of waves: alpha and beta. Five types of music were used in this study, which are light music, rock music, Mozart's music, jazz music, and Quran recitation; and the brainwave recordings were taken before, during, and after listening to the music. Findings showed that beta-waves increased while listening to rock, Quran, and Mozart music, and decreased while listening to light and jazz music; in which it showed that these three types of music helps in improving concentration. In terms of alpha-wave results, listening to all five music types decreased alpha-waves, but the greatest decrease gaps were seen in light and jazz music, showing that these two music types are unsuitable during cognitive tasks as it induces relaxation instead. Therefore, this study evidently showed that relaxation is associated with the increase in alpha-waves and decreases beta-waves, while in the contrary, attentiveness or concentration is associated with the increase in beta-waves and decreases alpha-waves. Similarly, Geethanjali, Adalarasu, and Rajsekaran (2012) studied on how three types of music (Carnatic, rock, and jazz) affect brain activity in mental tasks. Findings showed that jazz and Carnatic (both LA) music improved brain function and mental task performance more than rock (HA) music.

In terms of the relationship between EEG and Eysenck's personality theories, Eysenck stated that introversion and extraversion are measured based on the cortical arousal of the individual (Hagemann et al., 1999). Henceforth, the cortical arousal is conventionally measured as "alpha power" in most EEG studies (Küssner, 2017). Küssner (2017) has quoted a number of empirical EEG evidences on the Eysenck theory. Gale, Coles, & Blaydon (1969) saw lower alpha levels in extroverts than introverts when eyes are closed, and then in Gale, Edwards, Morris, Moore, and Forrester (2001) saw more power in the lower alpha in extroverts, but less in the higher alpha. Smith et al. (1995) saw lesser alpha-wave activity for introverts than extroverts in various auditory stimuli. Hagemann et al. (2009) reported on extroverts having greater alpha-wave power as compared to introverts. However, Gale (1983) criticized on the validity of Eysenck's (1967) tests and theories, stating that EEG and extroversion-introversion may not be necessarily related, poor theoretical comprehension, and that data can be easily misinterpreted. Despite the criticism, this study continues the usage of the EPQR-S test as it is only to differentiate the personality traits of participants and not using it as the main measuring instrument for the experiment.

However, Küssner (2017) also reported on various contradicting studies on the relationship between alpha power and introversion/extroversion, in which these studies were unable to find strong evidences on the relationship (Matthews & Amelang, 1993; Beauducel, Brocke, & Leue, 2006), thus stated that alpha power may not be the most suitable wave frequency to indicate cortical arousal and recommended that beta power may be an alternative frequency to be measured (Ray & Cole, 1985). This recommendation was also in-line with Gale et al. (1969) and Matthews and Amelang (1993), which saw positive beta power correlation with introversion/extroversion. Küssner (2017) subsequently argued that extroverts are expected to have lower beta levels than introverts, as high beta power relates to high arousal. Gram, Dunn, and Ellis (2005) stated that extroverts show greater alpha and lower beta power than introverts. Küssner (2017) then summed that the connection of extroversion and cortical arousal still remain unclear despite alpha power being traditionally used as an indication, therefore recommended beta power to be an alternative frequency.

Therefore, this section is important as it provides the fundamental knowledge regarding the applications of EEG, knowledge on the types of brainwave frequencies, and how EEG can be an accurate tool in measuring and determining the levels of arousal, mood, and decision-making in game playing. The invention of EEG is able to greatly benefit in the field of music psychology and therapy as it precisely determines the right music selection to assist in people's thinking and behaviour. However, the utilization of traditional EEG devices was seen as "a time-consuming and sophisticated process". Guðmundsdóttir (2011) mentioned on the sophisticated processes in preparing the EEG electrodes, and this may have linked to the mentioned shortcomings of Matthews and Amelang (1993) and Thiel (2018), which used traditional EEG devices with somewhat complex electrode setups. Despite instances of inconsistent findings due to errors or handling difficulties of their respective EEG devices, the utmost intentions of previous studies were to find out the "most fine-grained" EEG device to provide the most reliable and accurate measurements. In terms of measurements, Küssner (2017) saw the unclear reliability of alpha-wave power, thus suggested beta-wave power to be an alternative measuring frequency.

Studies mentioned in this section used various traditional EEG devices apart from the NeuroSky® MindWave™ Mobile. The NeuroSky® MindWave™ Mobile is specifically reviewed in detail in the following section.

2.8 EEG – NeuroSky® MindWave™ Mobile

One of the well-known commercial EEG BCI device is the NeuroSky® MindWave™ Mobile. Manufactured by NeuroSky®, Inc., the first release of MindWave™ in 2009 is the culmination of many years of research in the EEG biosensor technology field, in which it is a simplified, low-cost, lightweight, mobile, and easily available for home use (Guðmundsdóttir, 2011; NeuroSky®, 2015). This non-invasive commercial device monitors neural activity by detecting human brainwave information signals through its biosensor placed on the forehead scalp, hence reporting the mental state of an individual via its eSense™ algorithms (Robbins & Stonehill, 2014, p. 2). The received wave signals are then divided into various wave types based on its power spectrum (Ibid., p. 2; Teixeira et al., 2018). Moreover, MindWave™ uses wireless Bluetooth connection to a master device (computer, tablet, or smartphone) in a frequency of 1Hz, thus being an ideal tool for this study, which also saves a great amount of time and effort.

There are two patented technologies in the MindWave™: ThinkGear™ enables the device to "interface with the brainwaves of the user and processes the data", while the eSense™ characterizes mental states (MindWave User Guide, 2017, p. 12). In the EEG field, raw brainwave power data contains excessive noise, and has to be translated into figures understandable by humans (Phinyomark, Limsakul, & Phukpattaranont, 2009; Sudirman, Koh, Safri, Daud, & Mahmood, 2010; Gandhi et al., 2011; Mostafa & Mostafa, 2012). The NeuroSky® filtering technology, together with the ThinkGear™ and eSense™ algorithms, filters excessive data noise of the brainwave power and simplifies the data into two meters, which are attention and meditation meters (Mostafa and Mostafa, 2012; MindWave User Guide, 2017). The attention meter shows the intensity of mental focus or attention of the user, which the meditation shows the intensity of relaxation or calmness of the user. Any form of distraction, wandering thoughts, lack of focus, anxiety, etc. shall result in lower values in both the meters (MindWave User Guide, 2017). The ThinkGear™ and eSense™ algorithms help in determining the attention and meditation levels (abbreviated as "Att/Med" levels) based on a scale of 1 – 100, with 1 being the lowest and 100 being the highest, and 0 meaning "poor signal" (NeuroSky®, 2014; Sezer et al., 2015; MindWave User Guide, 2017). Both the attention and meditation meters is utilized in the current study to measure gameplay EEG mental state (see Table 3.14 in Section 3.7.2).

A number of studies have been done using the NeuroSky® MindWave™ Mobile device in various ways. Tests regarding the validity and reliability of the MindWave™ is backed by these sources (Crowley, Sliney, Pitt, & Murphy, 2010; Sezer et al., 2015; Edla, Mangalorekar, Dhavalikar, & Dodia, 2018; Teixeira et al., 2018). Teixeira et al. (2018) studied on the effects of music on attentiveness while performing tasks using the MindWave™. This study intended to find out the best type of music to assist in mental attentiveness while performing a cognitive task (playing a mobile phone game). Five college students, three boys and two girls, participated in various task combinations, either playing the game *Despicable Me: Minion Rush* or just plainly doing nothing, while with exposure to either heavy metal (HA) and a relaxing music (LA). Although findings of the study were individualized among the five students, it was found that the average attention level decreased when participants played the game while listening to heavy metal music as compared to without listening to music, and that the average attention level is increased when participants continued playing the game but changed to listening the relaxing music. This is mainly due to the loudness and fast speed of the heavy metal music which hindered the attention levels of the students, while a relaxing stimulus is able to help regain attention levels. Therefore, this study showed that heavy metal (HA) music which induces high arousal levels causes detriments in attention, while consecutively switching over to a more relaxing (LA) music which lowers arousal levels helps to increase attention.

This section determines the ideality of the NeuroSky® MindWave™ Mobile EEG instrument to be used in the current study. MindWave™ is seen as an innovative device which can be conducted in a way which is "more practically and naturalistically without inducing any form of stress or distractions" (Peters, Asteriadis, & Rebolledo-Mendez, 2009). With it being a device which is easy to set-up and its usage can be easily learned without needing assistances from expertise (Robbins and Stonehill, 2014), MindWave™ is able to bring much more benefits to the society as its affordability, availability, and convenience allows real-time brainwave activity monitoring as well as having fun analysing how daily activities affect brainwave activity, which can all be done at any location and at any point of time.

Essentially, the simple and easily-portable built of MindWave™ is able to eliminate the difficulties of complexity previously faced by Matthews and Amelang (1993) and Thiel (2018). Thus, further research of the applications of EEG in various fields can be easily carried out too. As MindWave™ has received validation through tests of the mentioned studies in this section, the current study indirectly aims to find out how does the mentioned validity of MindWave™ show its effectiveness in producing reliable results for the current experiment.

2.9 Conclusion of Literature Review

In summary, this literature review revolves around three main psychological aspects of music relevant to the topic of this study, which are arousal, emotion, and decision-making, and also how music and these three psychological aspects revolve around a gameplay situation, followed by a brief literature review about the usage of EEG devices in previous studies. Literature regarding arousal, emotion, and decision-making were chosen as these three aspects have strong interactions and influences among each other.

Based on the reviewed literature above in Section 2.2, the greatest gap that can be seen is the inconsistency of previous studies in proving on how music tempo affects arousal and decision-making. Many previous studies on the psychological effects of music tempo had their findings contradict to one another. For instance, Noseworthy and Finlay (2009) found that fast tempo music caused game players (gamblers) to lose track of time and put on greater bets in the game, and Mentzoni et al. (2014) found that fast tempo music causes quicker reaction times, but found that slower music caused greater bets instead in contrary to Noseworthy and Finlay's findings. Findings of Bramley et al. (2016) also contradicted to the two mentioned studies, stating that music tempo had no effect on gambling and arousal at all.

However, findings of Husain et al. (2002) was the most expected and consistent, despite being the earliest among the four studies, concluding that faster music increased arousal and slower music decreased arousal. From this situation, a major flaw was that the tempo manipulation was not contrasting enough. This flaw was also suggested by Bramley et al. (2016), as this study only manipulated slow and fast music to 72 bpm and 120 bpm respectively, a difference of 48 bpm which was not contrasting enough. Similarly, Lawrence (2012) used a tempo manipulation of 4-8% from the original tempo, that was also too subtle to see significant effects despite efforts to ensure ecological validity of the findings. Husain et al. (2002) used 60 BPM and 165 BPM for slow and fast music respectively, a difference of 105 BPM, and saw some significant effects on arousal despite still claiming that results may not be valid. Therefore, the current study will use a greater contrast of music tempo manipulation.

The research gap in music tempo can also be seen in its effects on decision-making, showing that the sole manipulation of music tempo may not be enough to validate its effects on decision-making. As reviewed earlier in Section 2.4, Foo (2011) found that fast tempo music caused significant effects and showed greater risk-taking and intertemporal choice, while both slow music and no-music condition showed no significant effects. The tempo manipulation was a 30% difference from the original tempo (120 BPM), which were 84 bpm for "slow" and 156 bpm for "fast" respectively. This study was in accordance with Wulfert et al.'s (2005) argument that fast tempo music increases arousal and causes riskier decision-making and vice versa, however, the personality of subjects (introverts/extroverts) was not distinguished and other influencing factors such as music arousal level and familiarity/unfamiliarity were not much taken into account. Additionally, findings of Israel et al. (2019) opposed Foo (2011) by stating that slower tempo and LA music resulted in lesser risk-taking than faster tempo and HA music.

Evano (2013) did a similar study as mentioned by manipulating music arousal level (high/low) and tempo by using classical and rock music, since rock music generally is much highly-arousing and faster in tempo compared to classical music. Findings showed that rock music caused more risk-taking and riskier decision-making as compared to classical music, but the presence of lyrics in rock music and its absence in classical music was not taken into consideration, hence its invalidity as claimed by Rinato (2014). Rinato's (2014) study took to a major surprise as all findings contradicted to initial expectations, such as the presence of lyrics resulted in healthier decision-making, and slower mid-tempo music caused riskier decision-making. There may be flaws in the study as pointed out to be avoided in its further research recommendations, but it cannot be denied that music tempo alone may not validate the effects of music on decision-making, as other musical factors such as arousal level, presence/absence of lyrics, and familiarity/unfamiliarity may indirectly affect the results.

It has been a convention that game music generally uses fast and intense background music, as mentioned in Section 2.5. This is an observation to Wulfert et al. (2005) and Shepard (2017), to build the arousal and excitement of game players while playing the game. However, Levy (2015) argued against this convention, questioning on whether the application of fast tempo background music in games improves or hinders gameplay performance and behaviour. This will differ between introverts and extroverts in reference to the optimal arousal hypothesis (Diamond et al., 2007), as fast music increases arousal, which may be acceptable by extroverts by with greatly hinder the gameplay performance of introverts (Cassidy & MacDonald, 2007). Although majority of the hypothesis of Levy (2015) were rejected (hence not having complete validity), the only hypothesis that was met was introverts show the "lowest feelings of flow and engagement" when playing the game in fast tempo music conditions, but perform best during no-music conditions.

The gap that can be seen here is that Levy's (2015) study may have manipulated music tempo (70, 90, and 120 bpm – which also showed not much contrast), but did not consider the arousal level of the music which may be psychologically acceptable to extroverts but not introverts, and that the music playlist chosen were mostly "rock" and "electronic pop", which meant the songs were highly-arousing. Hence, it will be expected that the music will hinder the gameplay performance of introverts, which it did. Therefore, the current study will take music tempo and arousal level into account, manipulating the music tempo of both HA and LA music in order to find out whether does only fast tempo and HA music hinder the gameplay performance of introverts, or whether does LA music cause the detriment as well.

CHAPTER 3

METHODOLOGY

3.1 Overview

This study aimed to investigate how the manipulation of music arousal level and tempo affects gameplay risk-taking and EEG mental state. This study employed three types of music arousal levels (no-music, HA, and LA), and three types of tempo manipulations (normal – 100%, fastened – 175%, and slowered – 75%). In the current study, the term “tempo” is identified with BPM (beats per minute) measurement (Mazzola, 2002), while “speed” is used to identify the manipulation of tempo used in this study (100%, 175%, and 75%). The task involved was to play a party card game called *In-Between*, which involves risk-taking upon betting play money. Gameplay risk-taking is based on the measurements of risk ratio, which is ratio of percentage betting amount from the remaining pool of money of the game players against their probability to win the money. Gameplay EEG mental state is based on EEG measurements of attention and meditation levels through the NeuroSky® MindWave™ Mobile.

3.2 Subjects

A total of 20 voluntary participants were selected for this study through convenient and purposive sampling in order to find out subjects whom were best fit into this study. This experiment was conducted in Dwi Emas International School in Shah Alam, Selangor, Malaysia, in which the NeuroSky® MindWave™ Mobile were available for use. To control influences of gender as concerned by Zhang and Fu (2015), only males were chosen for this study. To control age group factors, this study was only open to male students between 18 to 29 years old.

Among the 20 participants, 10 of the participants are introverts, while the other 10 are extroverts. Prior to the experiment, at least 20 males aged between 18 to 29 who volunteered to take part in the experiment first answered the *Revised Eysenck Personality*

Short Scale Test (EPQR-S) by downloading the *48 Questions: Free Personality Test Collection* app available in both iOS and Android as instructed. The EPQR-S consists of 48 questions to be agreed or disagreed by responding either "YES" or "NO" for each question. This test requires honest and accurate answers from the participants which indicates how they generally feel, think, and act in their daily lives. The end results of the test determine the participants' personality traits based on four dimensions: extroversion/introversion (E/I), neuroticism/stability (N/S), psychoticism/socialization (P/S), and lie/social desirability (L/SD) in reference to the Eysenck Personality Model below in Figure 3.1 (McLeod, 2017).

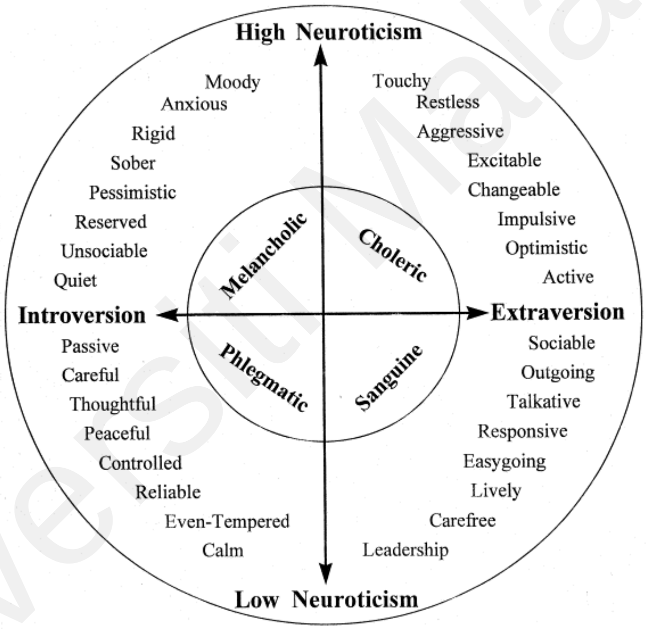

Figure 3.1 Eysenck Personality Theory Model (McLeod, 2017).

Table 3.1 shows the classification of responses for all 48 questions, which are divided into 12 questions for each dimension, thus having a total of 12 points for each dimension (Eysenck & Eysenck, 1975). Every response given that matches the response classifications according to Table 3.1 is worth one point for the respective dimension (for example, answering "No" to Question 27 gives +1 point for the E/I dimension, while responding "Yes" to Question 8 gives 0 point for the P/S dimension). Responding all questions according to the table will result in full (12) marks in all dimensions.

Table 3.1 Classification of EPQR-S Responses (Eysenck & Eysenck, 1975).

Dimensions	Answers to "YES"	Answers to "NO"
Extraversion / Introversion (E/I)	3, 7, 11, 15, 19, 23, 32, 36, 44, 48	27, 41
Neuroticism / Stability (N/S)	1, 5, 9, 13, 17, 21, 25, 30, 34, 38, 42, 46	–
Psychoticism / Socialization (P/S)	10, 14, 22, 31, 39	2, 6, 18, 26, 28, 35, 43
Lie / Social Desirability (L/SD)	4, 16, 45	8, 12, 20, 24, 29, 33, 37, 40, 47

As the purpose of using this test is to distinguish personality traits of the participants, only the results of extroversion-introversion (E/I) were looked upon. Based on Table 3.1, having 5 points and below for the E/I dimension are considered as "introverts" as the personality falls on the left side of the model, while having 7 points and above for the E/I dimension are considered as "extroverts" as the personality falls on the right side of the model. To avoid neutrality (close proximity to "ambiverts"), this study rejected participants with a score of 6 ("ambivert") in the E/I dimension, and the selection of participants is based on the 10 participants with the highest scores on the E/I dimension as "extroverts", and the 10 participants with the lowest scores as "introverts". This test was run continuously until a total of 10 introverts and 10 extroverts among the age group are found and deemed fit for the study. Shortlisted participants were personally contacted and invited to take part in the experiment. This was confirmed after having the selected participants read through the participant information sheet and subsequently sign a consent form of being a part of this study (see Appendix 2). Personal information of participants is fully confidential for research purposes only. Subsequently, participants were divided into 2 groups of 10 based on time availability, in which every group consisted of 5 introverts (I) and 5 extroverts (E), as shown in the participant distribution table below in Table 3.2.

Table 3.2 Distribution of Participants.

Group A		**Group B**	
I_{A1}	E_{A1}	I_{B1}	E_{B1}
I_{A2}	E_{A2}	I_{B2}	E_{B2}
I_{A3}	E_{A3}	I_{B3}	E_{B3}
I_{A4}	E_{A4}	I_{B4}	E_{B4}
I_{A5}	E_{A5}	I_{B5}	E_{B5}

Ethical clearance of this study has been approved by the University of Malaya Research Ethics Committee (UMREC) under reference code UM.TNC2/UMREC – 783.

3.3 The Game – *In-Between*

The task of this study was to play the game *In-Between* within their respective groups. *In-Between* is a fun, high-risk, and high lost-and-return betting party card game, which is a popular card game played among friends and family members especially during Chinese New Year in Malaysia and Singapore (Seet, 2019; Tan, 2019). This game is also popularly known as *Acey Deucey* in the Western world, but commonly known as *In-Between* (or "*tiang*" which means "goalpost" in Malay) in Malaysia and Singapore.

In-Between was chosen as the game to be played in this study as it is purely a "game of chance" – a game which involves luck and a great amount of risky decision-making, which is a simplified quasi-resemblance on how people make decisions (particularly financial decisions) and take risks in real life, mentally and emotionally. Although rules may vary among different cultures, the ultimate concept is that the game players will receive two cards, and place a bet on the value of the third card, whether it value will be between the values of the first two cards (Drakakis, 2010). As the nature of the game involves arousal and risk-taking, a comparison between the reactions of introverts and extroverts towards HA and LA music with the varied tempi can be made. In addition, *In-Between* is a fast-moving game which only has a number of simple rules to follow without the need of sophisticated strategies, thus virtually everyone can take part in this game as long as the person has enough money to bet and cover the losses. This eliminates the influencing effects of boredom and difficulty issues as pointed out by Lawrence (2012).

Participants were first briefed on how to play the game and then play a few warm-up rounds before executing the experiment. To avoid potential financial risks and burdens, this game will not involve real money, only cut-out play-money currency will be used instead, thus, extraneous or confounding variables related to the participants' financial abilities can be avoided. Each participant will receive a total of RM100 of play money (non-legal tender) in various denominations at each set of music conditions (see Table 3.11). Participants were told to treat the received money as real money and play the game as if they were using their own money. All participants in their respective groups sit in a circle, with an ante pot in the middle. All participants contribute an ante of RM1 into the pot at the beginning of each round, while the dealer shuffles the cards. As the dealer distributes the cards, each participant receives two cards faced down. Once all participants have received the cards, the participants will then be allowed to open and see the cards.

There are 13 card values, which are A(1), 2, 3, 4, 5, 6, 7, 8, 9, 10, J(11), Q(12), and K(13), within a standard 52-card poker deck containing four cards for each value. However, for this experiment, four decks are used instead in order to overcome the limitations of only having four cards within one deck, which also eliminates the intentions of the participants to "count the number of possibilities" by looking at their partners' cards. As the participants find out the values of both cards, they will decide either to "play" or "pass" the round. If the participant decides to "play", he will first state his betting amount which is either a portion the total amount of the pot or an "all-in" (colloquially known as *sai lang* or place bet on all of the remaining money on hand). The dealer will then hand over a third card to the participant facing down, allowing the participant to reveal the card value himself. If the third card is within the value range of the first two cards, the participant wins the bet and takes the bet amount from the pot. If the third card is outside the value range of the first two cards, he loses the bet amount into the pot. If the third card is of the same value as either one of the first two cards (colloquially known as "*kena tiang*" or "hit the goalpost" in Malay), he loses double of the bet amount. Henceforth, there is no 100% winning probability in this game.

Rob (2013) suggested an accurate calculation that is able to help the game players place their bets strategically in *In-Between*, by identifying the favourability of situations which guides game players place their bets optimally. This calculation method can be adopted in the current study to measure the participants' gameplay risk-taking. The article stated that there are three probabilities for every betting round in the game, which are $P(A)$, $P(B)$, and $P(C)$. $P(A)$ represents the probability of having the value of the betting third card between the first two cards, in which a successful bet in this event results in the participants gaining back the betting amount from the pot, hence its payoff, $Q(A) = \$$. $P(B)$ represents the probability of the third card being outside the value of the first two cards, which results in the participants losing the bet amount to the pot, hence its payoff, $Q(B) = -\$$. $P(C)$ represents the probability of "*kena tiang*", which results in the participants losing double the bet amount to the pot, hence its payoff, $Q(C) = -2\$$. Henceforth, the total of all three probabilities is 1 (or 100%), in which the equation can be written as $P(A) + P(B) + P(C) = 1$.

Table 3.3 below shows the equations of the probabilities, *P*, and payoffs, *Q*, of all three events in the game (Ibid.). As described earlier, the player wins the round and the money when Event *A* is met, however loses the round and the money when Event *B* or *C* are met.

Table 3.3 Probabilities and Payoffs for Events A, B, and C (Rob, 2013).

Event	Probability, *P*	Payoff, *Q*
A	$P(A) = \frac{(y-x)-1}{13} = \frac{z}{13}$	$Q(A) = \$$
B	$P(B) = \frac{(13-z)-2}{13} = \frac{11-z}{13}$	$Q(B) = -\$$
C	$P(C) = \frac{2}{13}$	$Q(C) = -2\$$

As shown above in Table 3.3, *x* represents the value of the first card, *y* represents the value of the second card, while *z* represents the available gap between the first two cards (for example, if $x = 2$ and $y =$ Q(12), then $z = 9$), and *$* represents the betting amount.

Expected value (hereafter *EV*) is defined as "an anticipated value for a future investment" (Kenton, 2019), also known as the amount expected to win or lose should a player places a bet on repetitive odds for betting situations in sports and games (Pinnacle, 2017). According to Rob (2013), the expected value (*EV*) for *In-Between* is defined as the subtotal of the multiplication of the probability and payoff within each event for all three events, $EV = P(A)Q(A) + P(B)Q(B) + P(C)Q(C)$, thus simplified to: -

$$EV = \frac{(2z - 15)}{13}\$$$

From the equation above, the favourability of each betting situation can be calculated in terms of *$*, as shown in Table 3.4.

Table 3.4 Favourability of Betting Situations (Rob, 2013).

z	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
EV	$-\frac{15}{13}\$$	$-\$$	$-\frac{11}{13}\$$	$-\frac{9}{13}\$$	$-\frac{7}{13}\$$	$-\frac{5}{13}\$$	$-\frac{3}{13}\$$	$-\frac{1}{13}\$$	$+\frac{1}{13}\$$	$+\frac{3}{13}\$$	$+\frac{5}{13}\$$	$+\frac{7}{13}\$$

Based on Table 3.4 above, it is shown that the *EV* is positive when the gap between the first two cards, *z*, is at 8 and above, and negative when the gap is seven and below. According to Rob (2013), it is only safe to place bets when the gap is at 8 and above as the probability of achieving Event *A* is above average. This shows that the chances of winning money are higher when the gap is at 8 and above, and that the chances of winning money is lower when the gap is at 7 and below. Therefore, the risk of losing money is higher when bets are placed at a gap of 7 and below.

3.4 Music Stimuli Selection and Conditions

As this study intends to manipulate the tempo of both HA and LA music stimuli, the aspects of music arousal level and music tempo were manipulated. A total of 12 songs are chosen, six HA and six LA songs. The emotional context of all songs remain constant at a positive level, or better known as “happy” music or music with “positive effect” (Cassidy & MacDonald, 2007). The HA music chosen can be described as lively, upbeat, uplifting, and exciting; while the LA music chosen can be described as calm, soothing, relaxing, and rejuvenating, in accordance with the characteristics of both music (Bartlett, 1996). Tables 3.5 and 3.6 show the playlists for both the HA and LA songs chosen for this study respectively, both which contain six songs respectively, including the tempo and energy level values of the songs.

Table 3.5 HA Music Song Playlist.

	Artist	Song Title	Tempo (BPM)	Energy Level
1	Sheppard	"Coming Home"	143	93
2	Hillsong Young and Free ft. Lecrae	"This Is Living"	128	86
3	Avicii	"The Nights"	126	83
4	Sagan ft. Roman Polonsky	"Music"	126	91
5	Pentatonix	"Sing"	155	83
6	Sigala ft. John Newman and Nile Rodgers	"Give Me Your Love"	125	94

Table 3.6 LA Music Song Playlist.

	Artist	Song Title	Tempo (BPM)	Energy Level
1	Jesse Ruben	"This Is Why I Need You"	80	32
2	The Paper Kites	"Arms"	75	14
3	John Mayer	"Badge and Gun"	65	26
4	Hollow Coves	"These Memories"	77	26
5	Chase McBride	"Days Move Easy"	87	32
6	Plàsi	"Now and Then"	77	25

The "energy level" index of the songs are measured and compared by *Tunebat*, an online database which indexes popular music in terms of tempo, energy level, key, and Camelot value,. The "energy level" of a song determines its intensity based on general musical detail and sonic information within the song in a scale index of 0 – 100, with 0 being "least energetic" and 100 being "most energetic". The energy level range of the HA songs is between 83 – 95 (M = 88.333, SD = 4.967), while the energy level range of the LA songs is between 14 – 32 (M = 25.833, SD = 6.585). The mean difference of energy levels of HA and LA music is M = 62.5 (SD = 7.791). The tempo range for the HA songs is 125 – 155 (M = 133.833, SD = 12.384), and the tempo range for the LA songs is 75 – 87 (M = 76.833, SD = 7.167). The mean difference in tempo between the HA and LA songs is M = 57 (SD = 8.173) Therefore, from the above comparison, the HA songs are generally faster in tempo and much more energetic than the LA songs (Bartlett, 1996; Griffiths, 2015).

In consideration for the song choices, the selected songs are but representational examples of distinguishing the HA and LA music. In terms of tonality, the HA songs contain a mixture of both major and minor tonalities that differ among sections within the songs. *Tunebat* may be a numerical measurement that is relatively new to the music field and has not been formally recognized by previous studies, thus the selected songs were based on Bartlett's (1996) and Griffiths's (2015) descriptors, in which HA music is defined as "highly-rhythmic" and "percussive", thus the rhythm plays the greatest role in maintaining the arousal level, while tonality does not affect the positive excitement induced by the HA songs. The chosen LA songs, however, are strictly in major tonality to maintain positive emotions and to not induce "negative effect".

A few other musical aspects were held constant, which are the emotional context (positive effect), gender (all male lead singers), time signature (4/4), and the presence of audible lyrics in the same language, English. The lyrics issue was raised by Rinato (2014) against Evano (2013), as Evano (2013) overlooked the presence of lyrics as an interfering factor in which Rinato (2014) claimed to be invalid. Furthermore, Rinato (2014) also found out that the presence of lyrics induced healthier decision-making as compared to instrumental music. Thus, this study employed songs with lyrics, and that presence of lyrics is not a tested variable in this study. The song choices are but some general examples that closely match to the types of contemporary music that people listen to today, but not and will not be claimed as a representation of the entire population. Executing this experiment with music that can rather relate to what the subjects usually listen to may be able to induce more accurate findings. Moreover, Cassidy and MacDonald (2007) stated that music with lyrics were reported to be the most common song choices to listen daily for young people (adolescents, students, and up to young adulthood) (Wanamaker & Reznikoff, 1989; Anderson, Carnagey, & Eubanks, 2003). Therefore, all songs chosen contain audible English lyrics sung by male singers.

Concerns regarding music familiarity by Fujikawa and Kobayashi (2010) were noted, including the emphasis of the significance of music familiarity from previous studies (Hahn & Hwang, 1999; Pereira et al., 2011). However, this will not be looked upon as firstly due to time constraints, and secondly which is also due to intentions to maintain naturality, in terms of not wanting the participants to have any prior expectations of the music before participating in the experiment. Various previous research on background music or soundscapes carried out their experiments without giving the participants knowledge what song is going to be played prior to the experiment, particularly in real-life scenarios such as casinos (Noseworthy & Finlay, 2009), restaurants (Caldwell & Hibbert, 2002), and open spaces (Meng et al., 2018). Moreover, majority of the selected songs are non-mainstream in Malaysia which are rarely played by local radio stations (only the most famous being "The Nights" by Avicii), therefore participants are expected to not know at least 75% of the selected songs. Music preference is also least concerned at this point in the current study, as the songs chosen are of "positive effect" which will induce positive moods and emotions, minimizing the likelihood of participants "disliking" the music (Montag et al. 2011; Salimpoor, 2013).

The songs were manipulated into three different speeds via *Audiospeedchanger.com* from original tempo (100%) to a drastically fastened to 175%, and then slowed down to 75% of its original tempo. The speed of 50% is disregarded despite being able to further contrast the tempo difference, as slowing down the music by half its tempo causes the music to be over-stretched and sound distorted, which may cause unwanted disruptions to the players' gameplay behaviour and performance. Hence, the speed of 75% is chosen to represent slower tempo. The speed of 125% is also disregarded as the tempo is rather close to the original tempo which may not show significant differences, and the speed of 150% is disregarded as this tempo difference is rather close to the tempo difference used by Bramley et al. (2006) and Lawrence (2012). Hence, the speed of 175% is by far the most optimal representation of "faster tempo" as this tempo difference shows great contrast from the original and slower tempi as suggested by previous studies, particularly Husain et al. (2002) which used a contrast of 105 BPM.

Tables 3.7 and 3.8 shows the fastened tempo manipulation of the HA and LA music respectively: the original tempo (100%), tempo of songs at 175% speed, and their tempo difference. Subsequently, Tables 3.9 and 3.10 show the details of the decrease in tempo for all songs from 175% to 75%, and their tempo difference.

Table 3.7 Tempo Increase of HA Music, from 100% to 175%.

	Song Title	100% Tempo (BPM)	175% Tempo (BPM)	Tempo Difference
1	"Coming Home"	143	250.25	+107.25
2	"This Is Living"	128	224	+96
3	"The Nights"	126	220.5	+94.5
4	"Music"	126	220.5	+94.5
5	"Sing"	155	271.25	+116.25
6	"Give Me Your Love"	125	218.75	+93.75

Table 3.8 Tempo Increase of LA Music, from 100% to 175%.

	Song Title	100% Tempo (BPM)	175% Tempo (BPM)	Tempo Difference
1	"This Is Why I Need You"	80	140	+60
2	"Arms"	75	131.25	+56.25
3	"Badge and Gun"	65	113.75	+48.75
4	"These Memories"	77	134.75	+57.75
5	"Days Move Easy"	87	152.25	+64.25
6	"Now and Then"	77	134.75	+57.75

Table 3.9 Tempo Decrease of HA Music, from 175% to 75%.

	Song Title	175% Tempo (BPM)	75% Tempo (BPM)	Tempo Difference
1	"Coming Home"	250.25	107.25	–143
2	"This Is Living"	224	96	–128
3	"The Nights"	220.5	94.5	–126
4	"Music"	220.5	94.5	–126
5	"Sing"	271.25	116.25	–155
6	"Give Me Your Love"	218.75	93.75	–125

Table 3.10 Tempo Decrease of LA Music, from 175% to 75%.

	Song Title	175% Tempo (BPM)	75% Tempo (BPM)	Tempo Difference
1	"This Is Why I Need You"	140	60	–80
2	"Arms"	131.25	56.25	–75
3	"Badge and Gun"	113.75	48.75	–65
4	"These Memories"	134.75	57.75	–77
5	"Days Move Easy"	152.25	65.25	–87
6	"Now and Then"	134.75	57.75	–77

According to the tables above, the mean increase in tempo from 100% to 175% for the HA and LA music are *M* = 100.375 (*SD* = 9.288) and *M* = 57.458 (*SD* = 5.100) respectively. The tempo is then dropped from 175% to 75%. The mean decrease in tempo for the HA and LA music from 175% to 75% is *M* = 133.833 (*SD* = 12.384) and *M* = 76.833 (*SD* = 7.167) respectively. The mean difference in tempo increase from 100% to 175% between the HA and LA music is *M* = 42.917 (*SD* = 6.406), while the mean difference in tempo decrease from 175% to 75% between the HA and LA music is *M* = 57 (*SD* = 8.173).

3.5 Experimental Procedure

This study employed the NeuroSky® MindWave™ Mobile device as the measuring instrument for gameplay EEG mental state. Participants first installed three applications on their phones (available in both iOS and Android): *Effective Learner* (by NeuroSky® Dev), *Brainwave Visualizer* (by NeuroSky® Dev), and *eegID* (by Isomer Programming LLC, only available in Android). In view of this issue, additional Android tablets were prepared for participants with Apple smartphones. The device is worn like a headphone with the headband placed around the participants' head. Next, the square-shaped sensor tip of the device's "arm" is then placed directly on the centre of the forehead skin (or frontal cortex) of the user. The ear clip is then clipped at the bottom end of the user's ear pinna which completes the circuit of the device. Participants adjusted the device according to their comfort before the commencement of the game. Lastly, participants had their phones or tablets connected with the device via Bluetooth through the *Effective Learner* application.

This experiment was conducted in an air-conditioned classroom right before lunchtime in two groups. During the experiment, all participants sat in a circle around combined tables and play the game *In-Between*. Tables were arranged accordingly and game players were instructed to sit in a wider circle and among each other in order to not affect the connection between the MindWave^{TM} and their phones. The music was played through portable speakers placed at the front of the classroom with volumes equalized. The entire experimental process took approximately 2.5 hours for both groups. Participants first underwent icebreaking to get to know one another, be briefed on the gameplay procedure (but without knowledge of the type of music to be played) and have a few warm-up rounds before playing. The first 15 minutes of the game was first played without music as a control condition. Subsequently, the music was played for 16 minutes for each condition. For each set of music condition, participants were instructed to sit quietly with eyes closed on the first minute of each music condition and first listen to the music (while resting) to allow participants and the MindWave^{TM} to adapt to the music beforehand. After the 1st minute of rest, participants then play the game for 15 minutes and the EEG data were recorded when the game starts.

All participants were exposed to both HA and LA music, with the playlist order alternated between HA and LA in order to minimize participants' boredom towards the music. With a no-music condition and three conditions each for both HA and LA music respectively, there were seven music conditions having 16 minutes each (including rest for the first minute), therefore the total gameplay procedural time for both groups took approximately 2 hours. Table 3.11 shows the tentative timeline plan of the gameplay procedure.

Table 3.11 Gameplay Procedure.

Gameplay Time (Minutes)	Procedure
(approx. 30 mins)	Setup, introduction, briefing, icebreaking
01 – 16	No music
17 – 32	HA – 100%
33 – 48	LA – 100%
49 – 64	HA – 175%
65 – 80	LA – 175%
81 – 96	HA – 75%
97 – 112	LA – 75%

3.6 Pilot Test

A pilot test was carried out one week prior to the commencement of the actual experiment. The experimental procedure was done as according to plan, however tested among 2 introverts and 2 extroverts. Table 3.12 below shows the age and E/I score of the pilot test participants. The mean age of introverts and extroverts were both $M = 22$, while the Cronbach's alpha for the E/I score was at $\alpha = 1.000$, which indicated that the questionnaire results were perfectly consistent, acceptable, and reliable (Tavakol & Dennick, 2011; Taber, 2017). There were no changes in using the EPQR-S questionnaire scale to distinguish participants between introverts and extroverts.

Table 3.12 Age and E/I Scores of Pilot Test Participants.

	Age	E/I Score
I_1	23	4/12
I_2	21	5/12
E_1	24	12/12
E_2	20	11/12

Initially, it was planned that the time given for each round was 10 minutes, in which the total gameplay time would have been 77 minutes (including the 1st minute of rest for all seven conditions). However, when the pilot test started during the first no-music condition, it was seen that only 4 rounds were played. Thus, the number of rounds will be much lesser when played by 10 participants per group during the actual experiment, in which, 10 minutes of gameplay time per round is insufficient for adequate data collection. Henceforth, the gameplay time per round was extended to 15 minutes per round. After the need for change in time was found out during the no-music condition play round, the game was then restarted to play for 15 minutes instead, and also the same time limit per round for the subsequent rounds. Moreover, it was initially planned that the music conditions would run continuously for the entire game without having participants being purportedly notified about the changes in music conditions. However, the abrupt change in music condition was too subtle to see significant psychophysiological changes, and that the game players and the MindWave^{TM} needed some time to adapt and adjust to the conditions. Henceforth, the change after the pilot test was that the game players will be notified about the music condition change after the end of each 15-minute condition, and that the first minute of each condition will be at rest for the game players to adapt to the music condition before playing to obtain more accurate results.

The pilot test was run smoothly and there were no major changes to the experimental procedure and data collection process, apart from the three changes in the music condition timing as mentioned above. This pilot test ensured a smooth and organized experimental and data collection procedure for the actual experiment day.

3.7 Data Collection

As mentioned, this study utilized a quantitative approach, based on an exploratory study using an experimental research. As many previous studies which are mostly pen-and-paper and observational-based mainly used qualitative approach, this study uses a quantitative approach which allows the findings to be obtained and interpreted based on accurate numerical measurements.

3.7.1 Data Collection Part 1 – Gameplay Risk-Taking

Measurements of gameplay risk-taking was taken based on betting amount and magnitude of risk-taking of the participants. For this study, gameplay risk-taking was based on an originally-formed equation of "risk ratio", which is the ratio of percentage of betting amount from the remaining money the game player has on hand, against the probability to win the bet. The equation for risk ratio is shown below: -

$$\text{Risk Ratio} = \frac{\text{Probability to Win } [P(A)]}{\left(\frac{\text{Betting Amount (RM)}}{\text{Remaining Amount (RM)}}\right)}$$

From the equation above, a lower risk ratio is caused by having a higher percentage of betting amount from the remaining money on hand and a lower probability to win, and vice versa. Risk ratio is inversely proportional: a lower value of risk ratio indicates a greater risk taken by the game players; on the contrary, a higher value of risk ratio indicates a lower risk taken. As shown the equation, the risk ratio takes the probability of occurrence of Event *A*, *P*(*A*) into calculation, by dividing the gap, *z*, by 13. Table 3.13 below shows the *P*(*A*) of all possible values of the gap between the first two cards, *z*.

Table 3.13 P(A) of all values of z.

z	*P*(*A*)	*z*	*P*(*A*)
0	.0000	6	.4615
1	.0769	7	.5385
2	.1538	8	.6154
3	.2307	9	.6923
4	.3077	10	.7692
5	.3864	11	.8462

All acquired data were tabulated and analyzed with the IBM® SPSS 25 statistical analysis software, using both one-way analysis of variance (ANOVA) and paired samples t-test, with the significance threshold value set at $p < .05$ for all statistical tests.

3.7.2 Data Collection Part 2 – Gameplay EEG Mental State

Measurements of gameplay EEG mental state were based on how the manipulation of music arousal level and tempo affect the mental behaviour of the participants, in terms of value measurements of attention and meditation levels (hereafter shortened to "Att/Med" levels) of the MindWave™ device. Data from the MindWave™ will be sent to the master device (such as computer, tablet, and smartphone) in a connecting Bluetooth frequency of 1Hz (Sezer et al., 2015). Measurements can be monitored through the *Brainwave Visualizer* application, which shows a colourful and interactive graphical representation of the user's brainwave activity, as shown in Figure 3.2, in which the values of attention and meditation meters, and the spectrum of brainwave frequencies can be monitored chronologically.

Moreover, the *eegID* application was used to capture and present EEG data with simple and understandable figures for easy reference and storage. Once recorded, the application automatically tabulates the data in .csv file, which can be viewed through both Microsoft

Excel and SPSS. All participants individually record the EEG data through their phones, and send the data in .csv file to the research team. Figure 3.3 shows the main page of the *eegID* application, with the attention and meditation levels boxed in red.

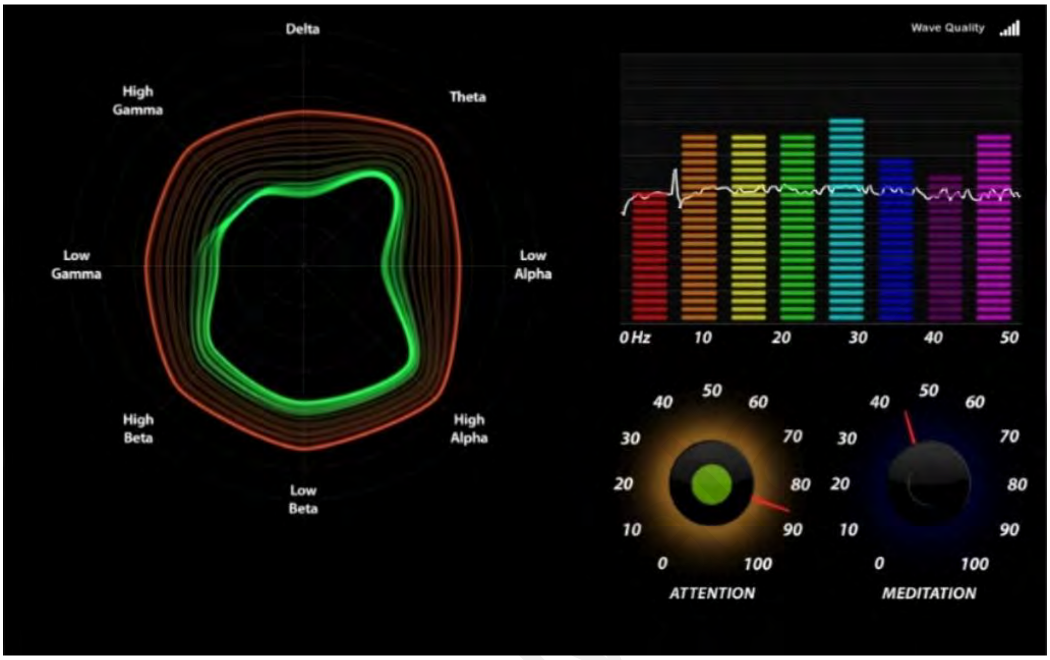

Figure 3.2 *Brainwave Visualizer* Application by NeuroSky®.

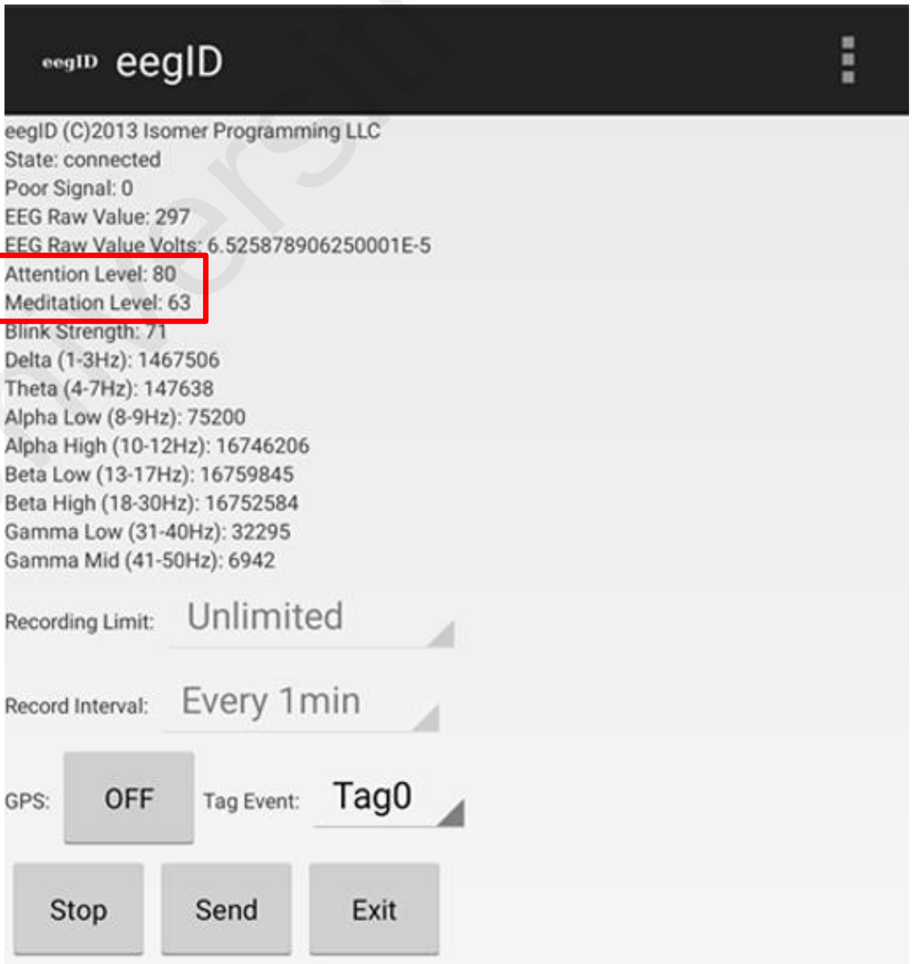

Figure 3.3 Screenshot of *eegID* Application.

As mentioned in Section 2.8 and shown in Figure 3.3, the values of both attention and meditation (Att/Med) levels range from 1 – 100 (1 – lowest, 100 – highest) in both meters (NeuroSky®, 2014; MindWave User Guide, 2017). Table 3.14 below shows the value descriptions for both meters (Ibid.).

Table 3.14 Descriptions of Values of the Attention and Meditation Meters.

Values	Description
0	Unable to calculate / poor signal
1 – 20	"Strongly lowered"
20 – 40	"Reduced"
40 – 60	"Neutral" or "Baseline"
60 – 80	"Slightly Elevated"
80 – 100	"Elevated"

As discussed in Section 2.7, the attention meter measures the "mental focus" level of the user, whereas the meditation meter measures the mental "calmness" of the user. Distractions or anxiety caused by over-arousal can decrease both attention and meditation levels (MindWave User Guide, 2017). This explains that in the attention meter, a high value in the scale is associated with the user being in an optimal-arousal state which induces maximum attentiveness, while a low value in the scale is associated with the user being over-aroused and/or distracted caused by HA conditions; whereas for the meditation meter, a high value in the scale is associated with the user being lowly- or optimally-aroused, while a low value in the scale is similarly associated with the user being highly-aroused. In this study, the average attention and meditation levels of each and every participant in all seven 15-minute (excluding 1st rest minute) conditions were recorded, followed by the total average of all participants in each music condition. Data is set to be recorded at every 1-minute average interval as shown in Figure 3.4. The results were then compared between the various music arousal level and tempo conditions, and between introverts and extroverts.

All acquired data were tabulated and analyzed with the IBM® SPSS 25 statistical analysis software, using both one-way analysis of variance (ANOVA) and paired samples t-test, with the significance threshold value set at $p < .05$ for all statistical tests.

CHAPTER 4

DATA ANALYSIS AND DISCUSSION

4.1 Overview

The purpose of this study is to find out the effects of music arousal level and tempo on card game players' gameplay risk-taking and EEG mental state among introverts and extroverts through a quantitative approach. The objectives of this study as stated earlier in Chapter 1 are to examine how tempo manipulation of both HA and LA music can affect the degree of risk-taking among introverts and extroverts, and also to examine how tempo manipulation of both HA and LA music can affect the mental state among introverts and extroverts during gameplay (in reference to the optimal arousal hypothesis) based on EEG measurements of attention and meditation through the NeuroSky® MindWave™ Mobile.

The subjects involved 20 male participants (10 introverts and 10 extroverts) between age 18 to 29. The experiment was carried out on two separate weekdays at Dwi Emas International School in Shah Alam, Selangor, Malaysia. The task for this study was to play the card game *In-Between*, and data acquired were based on two aspects: gameplay risk-taking, which is based on risk ratio of the game players; and gameplay EEG mental state, which is based on EEG attention and meditation levels of the game players.

This chapter reports, interprets, and discusses the findings acquired from the experiment. The reporting of findings is divided into three sub-sections: demographics, gameplay risk-taking (risk ratio), and gameplay EEG mental state (attention and meditation levels). The findings were analyzed through the IBM® SPSS 25 statistical analysis software, using both one-way analysis of variance (ANOVA) and paired samples t-test. Subsequently, the next section discusses the findings, followed by justifying the acceptancy or rejection of the six null hypotheses (see Section 1.8), and answering the three research questions (see Section 1.7) of this study.

4.2 Demographics

As mentioned, this study required 20 male participants aged between 18-29, in which 10 among them will have to be introverts, and the other 10 will have to be extroverts. Participants were selected through convenient and purposive sampling and 23 volunteers showed interest in participating in this study whilst complying to the required criteria of being a male and aged between 18 to 29. The volunteers then downloaded the *48Questions* application on their phones as instructed, and then proceeded to answer the *Eysenck Personality Questionnaire* (EPQR-S) test (see Appendix 1), which determined whether the person is an introvert or extrovert.

After running the test, 10 introverts and 10 extroverts were identified. Shortlisted participants were then personally contacted and invited to participate in the experiment. Participants were divided into two groups, Group A and Group B consisting of 5 introverts and 5 extroverts each, based on their availability on which day they could participate. The experiment was carried out on a Monday and Wednesday morning at 10am in a clean and spacious air-conditioned classroom. Participants verified their willingness to participate after reading through the participation information sheet and signed the consent form as shown in Appendix 2.

As shown in Section 3.1, a score of 5 and below out of 12 indicates that the individual is an introvert, whereas a score of 7 and above indicates that the individual is an extrovert (Eysenck & Eysenck, 1975). However, 2 participants were classified as "ambiverts" as they scored 6/12 on the extroversion/introversion (E/I) scale, which were not fit for this study, thus discontinued their participation in the experiment. An extrovert participant who scored 9/12 had to pull himself out from participation due to personal reasons. Therefore, the E/I score of the remaining 20 shortlisted participants who were confirmed able to participate in the study is shown in Tables 4.1 and 4.2: Table 4.1 for Group A, and Table 4.2 for Group B.

Table 4.1 E/I Scores of Participants – Group A.

Participant	E/I Score	Participant	E/I Score
$\mathbf{I_{A1}}$	4/12	$\mathbf{E_{A1}}$	10/12
$\mathbf{I_{A2}}$	5/12	$\mathbf{E_{A2}}$	12/12
$\mathbf{I_{A3}}$	4/12	$\mathbf{E_{A3}}$	10/12
$\mathbf{I_{A4}}$	3/12	$\mathbf{E_{A4}}$	7/12
$\mathbf{I_{A5}}$	4/12	$\mathbf{E_{A5}}$	9/12

Table 4.2 E/I Scores of Participants – Group B.

Participant	E/I Score	Participant	E/I Score
$\mathbf{I_{B1}}$	5/12	$\mathbf{E_{B1}}$	11/12
$\mathbf{I_{B2}}$	4/12	$\mathbf{E_{B2}}$	10/12
$\mathbf{I_{B3}}$	4/12	$\mathbf{E_{B3}}$	11/12
$\mathbf{I_{B4}}$	5/12	$\mathbf{E_{B4}}$	10/12
$\mathbf{I_{B5}}$	5/12	$\mathbf{E_{B5}}$	11/12

Based on Tables 4.1 and 4.2, the E/I score range for introverts is between 3 – 5, and between 7 – 12 for extroverts. The average E/I scores are $M = 4.30$ ($SD = 0.68$) for introverts, and $M = 10.10$ ($SD = 1.37$) for extroverts. The average E/I score for introverts in Group A is $M = 4.00$ ($SD = 0.71$), and for Group B is $M = 4.60$ ($SD = 0.55$). The average E/I score for extroverts in Group A is $M = 9.60$ ($SD = 1.82$), and for Group B is $M = 10.60$ ($SD = 0.548$). The mean difference of E/I scores between introverts and extroverts is $M = –5.80$ ($SD = 0.92$, $t(9) = –19.96$, $p = 0.000$). The mean difference of E/I scores between introverts and extroverts for Group A is $M = –5.60$ ($SD = 1.14$, $t(4) = –10.98$, $p = 0.000$); while for Group B is $M = –6.00$ ($SD = 0.71$, $t(4) = –18.97$, $p = 0.00$). In terms of questionnaire reliability, the E/I score results generated a Cronbach's alpha of $\alpha = .846$, indicating that the questionnaire results are highly consistent, acceptable, and reliable (Tavakol & Dennick, 2011; Taber, 2017). The paired samples statistics and t-tests are shown in Tables 4.3 and 4.4 respectively.

Table 4.3 Paired Samples Statistics – E/I Scores Between Introverts and Extroverts.

	I/E	*M*	*N*	*SD*	*SEM*
1	Introverts	4.30	10	.68	.21
2	Extroverts	10.10	10	1.37	.43
3	Introverts – Group A	4.00	5	.71	.32
4	Extroverts – Group A	9.60	5	1.82	.81
5	Introverts – Group B	4.60	5	.55	.25
6	Extroverts – Group B	10.60	5	.55	.25

Table 4.4 Paired Samples t-Test – E/I Scores Between Introverts and Extroverts.

	I/E Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	Intro – Extro	-5.80	.92	.29	-19.96	9	< .001
2	Intro – Extro (Group A)	-5.60	1.14	.51	-10.98	4	< .001
3	Intro – Extro (Group B)	-6.00	.71	.32	-18.97	4	< .001

Among all of the 20 shortlisted participants, Table 4.5 shows the age of all participants in Group A, while Table 4.6 shows the age of all participants in Group B.

Table 4.5 Age of Participants – Group A.

Participant	**Age**	**Participant**	**Age**
$\mathbf{I_{A1}}$	19	$\mathbf{E_{A1}}$	24
$\mathbf{I_{A2}}$	24	$\mathbf{E_{A2}}$	23
$\mathbf{I_{A3}}$	23	$\mathbf{E_{A3}}$	21
$\mathbf{I_{A4}}$	21	$\mathbf{E_{A4}}$	24
$\mathbf{I_{A5}}$	23	$\mathbf{E_{A5}}$	22

Table 4.6 Age of Participants – Group B.

Participant	**Age**	**Participant**	**Age**
$\mathbf{I_{B1}}$	25	$\mathbf{E_{B1}}$	20
$\mathbf{I_{B2}}$	22	$\mathbf{E_{B2}}$	25
$\mathbf{I_{B3}}$	25	$\mathbf{E_{B3}}$	26
$\mathbf{I_{B4}}$	20	$\mathbf{E_{B4}}$	23
$\mathbf{I_{B5}}$	26	$\mathbf{E_{B5}}$	23

Based on Tables 4.5 and 4.6, the age of participants ranges from 19 to 26 years old. The average age of all participants is M = 22.95 (SD = 2.012). The average age for introverts is M = 22.80 (SD = 2.300), while the average age for extroverts is M = 23.10 (SD = 1.792). For Group A, the average age for introverts is M = 22.00 (SD = 2.000), while the average age for extroverts is M = 22.80 (SD = 1.304). For Group B, the average age for introverts is M = 23.60 (SD = 2.510), while the average age for extroverts is M = 23.40 (SD = 2.302). The average age difference between introverts and extroverts is only M = -.20 (SD = 3.05, $t(9)$ = -.21, p = .840), which is very similar between the groups.

4.3 Data Analysis

This section for gameplay risk-taking is divided into two parts, which are the data analysis for risk ratio in gameplay risk-taking (Section 4.3.1), followed by the data analysis for Att/Med levels in gameplay EEG mental state (Section 4.3.2).

4.3.1 Data Analysis Part 1 – Gameplay Risk-Taking

4.3.1.1 Overall Risk Ratio Statistics

Gameplay risk-taking is measured based on "risk ratio" – the ratio of percentage of betting amount from the remaining amount of money the game player has on hand, against the probability to win the bet, $P(A)$.

$$\text{Risk Ratio} = \frac{\text{Probability to Win } [P(A)]}{\left(\frac{\text{Betting Amount (RM)}}{\text{Remaining Amount (RM)}}\right)}$$

As mentioned in Section 3.7.1, a lower risk ratio is caused by having a higher percentage of betting amount from the remaining money on hand and a lower probability to win, and vice versa. Readings of risk ratio is inversely proportional, in which the lower the risk ratio, the higher the risk taken; while the higher the risk ratio, the lower the risk taken. Risk ratio is measured and compared among and between music arousal levels, among and between the various tempo manipulations, and also to find out whether will there be any significant differences in risk ratio between the introverts and extroverts in all of the music conditions. Due to space constraints, the complete tabulation of all rounds and averages of all bet amounts and probabilities are attached in Appendix 3.

Tables 4.7 and Table 4.8 show the risk ratio of all introverts and extroverts among all conditions respectively.

Table 4.7 Risk Ratio of All Introverts Among All Music Conditions.

	No Music	HA 100%	LA 100%	HA 175%	LA 175%	HA 75%	LA 75%
I$_{A1}$	2.5195	4.8470	.7339	2.4665	.9837	4.4030	7.4046
I$_{A2}$	2.2119	5.1156	3.3885	1.1738	3.7242	1.7418	2.2292
I$_{A3}$	2.5428	4.2222	.2503	2.0360	4.2927	2.6362	5.8226
I$_{A4}$	3.6145	1.6526	1.4649	2.9864	1.6868	4.5245	5.2085
I$_{A5}$	2.2653	7.1421	5.9194	2.6658	1.6456	4.5255	3.6874
I$_{B1}$	5.7345	4.3827	.7049	.8673	1.6568	3.5053	3.0497
I$_{B2}$	3.0548	7.3048	2.7624	4.0552	1.9270	6.7114	5.3363
I$_{B3}$	1.4810	7.6158	1.8558	6.2090	6.3688	18.4904	1.1166
I$_{B4}$	9.9010	2.8207	.5738	6.7148	3.5173	4.0620	1.3233
I$_{B5}$	2.4372	5.3881	.6795	3.7304	2.2313	6.1540	3.6180
M	**3.5763**	**5.0492**	**1.8333**	**3.2905**	**2.8034**	**5.6754**	**3.8796**

Table 4.8 Risk Ratio of All Extroverts Among All Music Conditions.

	No Music	HA 100%	LA 100%	HA 175%	LA 175%	HA 75%	LA 75%
E_{A1}	4.2992	4.1891	1.8733	2.0254	4.1635	6.2541	1.9136
E_{A2}	4.3157	6.0931	3.3465	6.0931	2.4291	9.6497	7.8118
E_{A3}	2.3006	5.2222	3.3077	5.9748	1.7727	3.9512	1.0336
E_{A4}	4.4514	6.7148	1.3849	5.5384	18.6699	5.2794	3.8079
E_{A5}	4.3725	7.2979	3.7599	4.6152	5.5669	6.7234	1.6308
E_{B1}	1.1633	11.4238	4.2070	6.8545	2.2063	7.7443	9.0490
E_{B2}	6.6434	5.4893	3.7304	2.3221	.8696	7.1970	4.7056
E_{B3}	7.8458	2.9235	3.1689	3.5204	1.2903	2.5129	4.5692
E_{B4}	4.7353	8.2549	3.2180	3.0465	3.8160	7.4607	.9214
E_{B5}	3.0167	8.9742	2.8527	3.8079	3.6692	7.5412	4.5245
M	**4.3144**	**6.6583**	**3.0848**	**4.3898**	**4.4454**	**6.4314**	**4.2282**

4.3.1.2 Overall Risk Ratio – Music Arousal Level Conditions

This sub-section compares the overall risk ratio among music arousal levels using one-way analysis of variance (ANOVA) test among the no-music, HA (100%), and LA (100%) music conditions, and paired samples t-test between each condition. Firstly, the three music arousal level conditions were compared using one-way ANOVA. Table 4.9 shows the overall risk ratio mean of all participants among the three conditions, while Table 4.10 shows the ANOVA test findings among the conditions.

Table 4.9 Overall Risk Ratio Among Music Arousal Level Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	No Music	20	3.95	2.21	.50
2	HA Music (100%)	20	5.85	2.31	.52
3	LA Music (100%)	20	2.46	1.50	.33
	Total	**60**	**4.09**	**2.45**	**.32**

Table 4.10 ANOVA – Overall Risk Ratio Among Music Arousal Level Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	115.83	2	57.914	13.927	< .001
2	Within Groups	237.03	57	4.158		
	Total	**352.86**	**59**			

Based on Table 4.10, the ANOVA test shows an extremely significant value of $p < .001$, in which it is lower than significance threshold value of .05 ($p < .05$). This indicates that the results are statistically significant, which proves that there is a significant statistical difference of risk ratio among the no-music, HA, and LA music conditions with all introvert and extrovert participants combined (*N* = 20). Thus, the overall risk ratio for the HA music condition (*M* = 5.85) is the highest, followed by the no-music condition (*M* = 3.95), and the LA music condition (*M* = 2.46) which is the lowest. Therefore, the overall risk taken is highest during the LA music condition, followed by the no-music condition, and lowest during the HA music condition.

Subsequently, paired comparisons among the three pairs of music arousal level conditions (no-music – HA; no-music – LA; and HA – LA) were done using paired samples t-test. The paired samples t-test for overall risk ratio among the paired music arousal level conditions are shown below in Table 4.11.

Table 4.11 Paired Samples t-Test – Overall Risk Ratio
Among the Paired Music Arousal Level Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	No Music – HA	-1.91	3.92	.88	-2.18	19	.042
2	No Music – LA	1.49	2.89	.65	2.30	19	.033
3	HA – LA	3.39	2.01	.45	7.55	19	< .001

The results in Table 4.11 show that all of the three pairs of music conditions are statistically significant. The difference of overall risk ratio between during HA and LA music conditions is the most significant (M = 3.39, SD = 2.01, $t(19)$ = 7.55, $p < .001$), followed by the difference of mean overall risk ratio between during no-music and HA music conditions (M = -1.91, SD = 3.92, $t(19)$ = -2.18, p = .042), and then the least significant being between no-music and LA music conditions (M = 1.49, SD = 2.89, $t(19)$ = 2.30, p = .033).

4.3.1.3 Overall Risk Ratio – HA Music Tempo Conditions

This sub-section compares the overall risk ratio among the three HA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for HA music were first compared using one-way ANOVA. Table 4.12 below shows the overall risk ratio mean of all participants among the three tempo conditions, while Table 4.13 shows the one-way ANOVA test findings among the conditions.

Table 4.12 Overall Risk Ratio Among HA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	HA 100%	20	5.85	2.31	.52
2	HA 175%	20	3.84	1.86	.42
3	HA 75%	20	6.05	3.57	.80
	Total	**60**	**5.25**	**2.82**	**.36**

Table 4.13 ANOVA – Overall Risk Ratio Among HA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	59.95	2	29.98	4.17	.02
2	Within Groups	410.03	57	7.19		
	Total	**469.98**	**59**			

The ANOVA test shows a significant value of p = .02, in which it is lower than significance threshold value of .05 (p < .05), hence showing that there is a significant statistical difference of overall risk ratio among the three tempo conditions of HA music with all introverts and extroverts included (N = 20). Thus, the overall risk ratio for the 75% tempo condition (M = 6.05) is the highest, followed by the 100% tempo condition (M = 5.85), and lowest during the 175% tempo condition (M = 3.84). Therefore, the overall risk taken is highest during the 175% tempo condition, followed by the 100% tempo condition, and lowest during the 75% tempo condition.

Subsequently, paired comparisons among the three pairs of HA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test as shown below in Table 4.14.

Table 4.14 Paired Samples t-Test – Overall Risk Ratio Among the Paired HA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	HA 100% – HA 175%	2.01	2.38	.53	3.78	19	.001
2	HA 100% – HA 75%	-.20	3.16	.71	-.28	19	.781
3	HA 175% – HA 75%	-2.21	3.14	.70	-3.15	19	.005

Based on the results shown in Table 4.14, the paired statistical differences of overall risk ratio between 100% and 175% (M = 32.01, SD = 2.38, $t(19)$ = 3.78, p = .001), and

175% and 75% (*M* = -2.21, *SD* = 3.14, *t*(19) = -3.15, *p* = .005) tempi conditions are highly significant; except for between 100% and 75% tempo conditions (*M* = -.20, *SD* = 3.16, *t*(19) = -.28, *p* = .781), in which the difference between this pair of music tempo conditions is not significant as the *p* value is higher than the significance threshold value of .05 (*p* > .05). The difference of overall risk ratio between during 100% and 175% tempo conditions is the most significant (*p* = .001), followed by the difference of overall risk ratio between during 175% and 75% tempo conditions (*p* = .005), and then the least significant and the only insignificant pair being between 100% and 75% tempo conditions (*p* = .781).

4.3.1.4 Overall Risk Ratio – LA Music Tempo Conditions

This sub-section compares the overall risk ratio among the three LA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for LA music were first compared using one-way ANOVA. Table 4.15 below shows the overall risk ratio mean of all participants among the three tempo conditions, while Table 4.16 shows the one-way ANOVA test findings among the conditions.

Table 4.15 Overall Risk Ratio Among LA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	LA 100%	20	2.46	1.50	.33
2	LA 175%	20	3.62	3.85	.86
3	LA 75%	20	3.94	2.38	.53
	Total	**60**	**3.34**	**2.78**	**36**

Table 4.16 ANOVA – Overall Risk Ratio Among LA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	24.29	2	12.15	1.61	.210
2	Within Groups	431.49	57	7.57		
	Total	**455.79**	**59**			

Based on Table 4.16, the ANOVA test shows a highly insignificant value of *p* = .210, higher than the significance threshold value of .05 (*p* > .05). This indicates that the difference in results are statistically insignificant, in which there is insignificant statistical difference of overall risk ratio among the three tempo conditions of LA music with all introvert and extrovert participants combined (*N* = 20). Therefore, there is insufficient evidence to prove any overall difference in risk ratio among the LA music tempo conditions.

Subsequently, paired comparisons among the three pairs of LA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.17.

Table 4.17 Paired Samples t-Test – Overall Risk Ratio Among the Paired LA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	LA 100% – LA 175%	-1.17	4.40	.98	-1.18	19	.251
2	LA 100% – LA 75%	-1.48	2.75	.62	-2.40	19	.027
3	LA 175% – LA 75%	-.31	4.92	1.10	-.29	19	.779

Based on the results shown in Table 4.17, it is shown that only the paired statistical differences of overall risk ratio between 100% and 75% tempo conditions is fairly significant ($M = -1.48$, $SD = 2.75$, $t(19) = -2.40$, $p = .027$). However, both the differences between 100% and 175% ($M = -1.17$, $SD = 4.40$, $t(19) = -1.18$, $p = .251$), and between 175% and 75% ($M = -.31$, $SD = 4.92$, $t(19) = -.285$, $p = .779$) are highly insignificant. This can only show that the overall risk ratio for the 75% tempo condition is significantly higher than the overall risk ratio for the 100% tempo condition. Therefore, only between the 100% and 75% tempo conditions, the risk taken among all participants were generally higher during the LA music at 75% tempo as compared to normal 100% tempo.

4.3.1.5 Risk Ratio of Introverts – Music Arousal Level Conditions

This sub-section compares the risk ratio of the 10 introverts (*N* = 10) in this study among the no-music, HA (100%), and LA (100%) music conditions. The three music arousal level conditions were first compared using one-way ANOVA. Table 4.18 below shows the risk ratio mean of introverts among the three tempo conditions, while Table 4.19 shows the one-way ANOVA test findings among the conditions.

Table 4.18 Risk Ratio of Introverts Among Music Arousal Level Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	No Music	10	3.58	2.50	.79
2	HA (100%)	10	5.05	1.94	.61
3	LA (100%)	10	1.83	1.76	.56
	Total	**30**	**3.49**	**2.42**	**.44**

Table 4.19 ANOVA – Risk Ratio of Introverts Among Music Arousal Level Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	51.83	2	25.91	5.92	.007
2	Within Groups	118.25	27	4.38		
	Total	**170.08**	**29**			

Based on Table 4.19, the ANOVA test shows a highly significant value of $p = .007$ ($p < .05$), indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of risk ratio among the no-music, HA, and LA music conditions among introverts ($N = 10$). Thus, it can be concluded that the risk ratio of introverts for the HA music condition ($M = 5.05$) is the highest, followed the by no-music condition ($M = 3.58$), and the LA music condition ($M = 1.83$) which is the lowest. Therefore, the risk taken of introverts is highest during the LA music condition, followed by the no-music condition, and lowest during the HA music condition.

Subsequently, paired comparisons among the three pairs of music arousal level conditions (no-music – HA; no-music – LA; and HA – LA) were done using paired samples t-test as shown below in Table 4.20.

Table 4.20 Paired Samples t-Test – Risk Ratio of Introverts
Among the Paired Music Arousal Level Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	No Music – HA	-1.47	3.93	1.24	-1.19	9	.266
2	No Music – LA	1.74	3.54	1.12	1.56	9	.154
3	HA – LA	3.22	1.78	.56	5.73	9	< .001

Table 4.20 shows that only the risk ratio for introverts between HA and LA music conditions is statistically significant ($M = -3.22$, $SD = 1.78$, $t(9) = 5.73$, $p < .001$) ($p < .05$). The risk ratio for introverts between no-music and HA ($M = -1.47$, $SD = 3.93$, $t(9) = -1.19$, $p = .266$), and between no-music and LA ($M = 1.74$, $SD = 3.54$,

t(9) = 1.56, *p* = .154) are statistically insignificant (*p* > .05). This shows that only the risk ratio for introverts during HA music condition is significantly higher than during LA music condition, in which the risk taken for introverts during LA music condition is significantly higher as compared to during HA music condition.

4.3.1.6 Risk Ratio of Introverts – HA Music Tempo Conditions

This sub-section compares the risk ratio of introverts among the three HA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for HA music were first compared using one-way ANOVA. Table 4.21 below shows the risk ratio mean of introverts among the three tempo conditions, while Table 4.22 shows the one-way ANOVA test findings among the conditions.

Table 4.21 Risk Ratio of Introverts Among HA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	HA 100%	10	5.05	1.94	.61
2	HA 175%	10	3.29	1.95	.62
3	HA 75%	10	5.68	4.74	1.50
	Total	**30**	**4.67**	**3.22**	**.59**

Table 4.22 ANOVA – Risk Ratio of Introverts Among HA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	30.58	2	15.29	1.53	.235
2	Within Groups	269.78	27	9.99		
	Total	**300.35**	**29**			

Based on Table 4.22, the ANOVA test shows a highly insignificant value of *p* = .235 (*p* > .05), indicating that the results are statistically insignificant, showing that there is no significant statistical difference of risk ratio of introverts among the three HA music tempo manipulation conditions. Therefore, there is insufficient evidence to prove any significant risk ratio difference of introverts among the HA music tempo conditions.

Subsequently, paired comparisons among the three pairs of HA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.23.

Table 4.23 Paired Samples t-Test – Risk Ratio of Introverts Among the Paired HA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	HA 100% – HA 175%	1.76	2.58	.81	2.16	9	.059
2	HA 100% – HA 75%	-.63	4.04	1.28	-.49	9	.636
3	HA 175% – HA 75%	-2.38	3.82	1.21	-1.98	9	.080

Based on Table 4.23, it is shown that none of the three pairs of HA music tempo manipulation conditions show any significant statistical difference, as all significant values are above the threshold significant value of .05 ($p > .05$). Therefore, the t-test was also unable to prove any significant risk ratio difference of introverts among the HA music tempo conditions.

4.3.1.7 Risk Ratio of Introverts – LA Music Tempo Conditions

This sub-section compares the risk ratio of introverts among the three LA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for LA music were first compared using one-way ANOVA. Table 4.24 below shows the mean risk ratio of introverts among the three tempo conditions, while Table 4.25 shows the one-way ANOVA test findings among the conditions.

Table 4.24 Risk Ratio of Introverts Among LA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	LA 100%	10	1.83	1.76	.56
2	LA 175%	10	2.80	1.65	.62
3	LA 75%	10	3.88	2.05	.65
	Total	**30**	**2.84**	**1.96**	**.36**

Table 4.25 ANOVA – Risk Ratio of Introverts Among LA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	20.96	2	10.48	3.13	.06
2	Within Groups	90.39	27	3.35		
	Total	**111.35**	**29**			

Based on Table 4.25, the ANOVA test shows a slight statistical insignificant value of $p = .06$ ($p > .05$), indicating that the difference in results are only marginally statistically insignificant, showing that there is no significant statistical difference of risk ratio of introverts among the three LA music tempo manipulation conditions. Therefore, there is insufficient evidence to prove any significant risk ratio difference of introverts among the LA music tempo conditions.

Subsequently, paired comparisons among the three pairs of LA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.26.

Table 4.26 Paired Samples t-Test – Risk Ratio of Introverts Among the Paired LA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	LA 100% – LA 175%	-.97	2.55	.81	-1.204	9	.259
2	LA 100% – LA 75%	-2.05	2.90	.92	-2.229	9	.053
3	LA 175% – LA 75%	-1.08	3.31	1.05	-1.028	9	.331

Based on Table 4.26, it is shown that none of the three pairs of LA music tempo manipulation conditions show any significant statistical difference, as all significant values are higher than the threshold significant value of .05 ($p > .05$). Therefore, similar to HA music tempo conditions for introverts, the t-test was also unable to prove any significant risk ratio difference of introverts among the LA music tempo conditions, hence there was no difference in risk-taking of introverts among the LA music tempo conditions.

4.3.1.8 Risk Ratio of Extroverts – Music Arousal Level Conditions

This sub-section compares the risk ratio of the 10 extroverts ($N = 10$) in this study among the no-music, HA (100%), and LA (100%) music conditions. The three music arousal level conditions were first compared using one-way ANOVA. Table 4.27 below shows the mean risk ratio of extroverts among the three tempo conditions, while Table 4.28 shows the one-way ANOVA test findings among the conditions.

Table 4.27 Risk Ratio of Extroverts Among Music Arousal Level Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	No Music	10	4.31	1.94	.61
2	HA (100%)	10	6.66	2.47	.78
3	LA (100%)	10	3.08	.86	.27
	Total	**30**	**4.69**	**2.36**	**.43**

Table 4.28 ANOVA – Risk Ratio of Extroverts Among Music Arousal Level Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	65.92	2	32.96	9.34	.001
2	Within Groups	95.28	27	3.53		
	Total	**161.20**	**29**			

Based on Table 4.28, the ANOVA test shows a highly significant value of p = .001 (p < .05), indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of risk ratio among the no-music, HA, and LA music conditions among extroverts. Thus, it can be concluded that the risk ratio of extroverts for the HA music condition (M = 6.66) is the highest, followed by the no-music condition (M = 4.31), and the LA music condition (M = 3.08) which is the lowest. Therefore, the risk taken of extroverts is highest during the LA music condition, followed by the no-music condition, and lowest during the HA music condition.

Subsequently, paired comparisons among the three pairs of music arousal level conditions (no-music – HA; no-music – LA; and HA – LA) were done using paired samples t-test as shown below in Table 4.29.

Table 4.29 Paired Samples t-Test – Risk Ratio of Extroverts Among the Paired Music Arousal Level Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	No Music – HA	-2.34	4.07	1.29	-1.82	9	.102
2	No Music – LA	1.23	2.22	.70	1.75	9	.114
3	HA – LA	3.57	2.31	.73	4.90	9	.001

Table 4.29 shows that only the risk ratio for extroverts between HA and LA music conditions is extremely statistically significant (M = 3.57, SD = 2.31, $t(9)$ = 4.90, p = .001) (p < .05). The risk ratio for extroverts between no-music and HA (M = -2.34, SD = 4.07, $t(9)$ = -1.82, p = .102), and between no-music and LA (M = 1.23, SD = 2.22, $t(9)$ = 1.75, p = .114) music conditions are statistically highly insignificant (p > .05). Thus, the results can only show that – similar to introverts – only the risk ratio for extroverts during HA music condition is significantly higher than during LA music condition, in which the risk taken for introverts during LA music condition is significantly

higher as compared to during HA music condition. There were no significant differences in risk ratio between the no-music and HA music, and the no-music and LA music conditions.

4.3.1.9 Risk Ratio of Extroverts – HA Music Tempo Manipulations

This sub-section compares the risk ratio of extroverts among the three HA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for HA music were first compared using one-way ANOVA. Table 4.30 below shows the mean risk ratio of extroverts among the three tempo conditions, while Table 4.31 shows the one-way ANOVA test findings among the conditions.

Table 4.30 Risk Ratio of Extroverts Among HA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	HA 100%	10	6.66	2.47	.78
2	HA 175%	10	4.39	1.69	.53
3	HA 75%	10	6.43	2.05	.65
	Total	**30**	**5.83**	**2.27**	**.41**

Table 4.31 ANOVA – Risk Ratio of Extroverts Among HA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	31.22	2	15.61	3.56	.042
2	Within Groups	118.42	27	4.39		
	Total	**149.63**	**29**			

Based on Table 4.31, the ANOVA test shows a borderline significant value of $p = .042$ ($p < .05$), indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of risk ratio among the three HA music tempo conditions among extroverts. Thus, the risk ratio for the 175% tempo condition ($M = 6.66$) is the highest, followed by the 100% tempo condition ($M = 6.43$), and lowest during the 75% tempo condition ($M = 4.39$). Therefore, the risk taken is highest during the 75% tempo condition, followed by the 100% tempo condition, and lowest during the 175% tempo condition.

Subsequently, paired comparisons among the three pairs of HA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.32.

Table 4.32 Paired Samples t-Test – Risk Ratio of Extroverts Among the Paired HA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	HA 100% – HA 175%	2.27	2.28	.72	.34	9	.012
2	HA 100% – HA 75%	.23	2.10	.66	-2.59	9	.741
3	HA 175% – HA 75%	-2.04	2.50	.79	-.74	9	.029

Based on Table 4.32, the paired statistical differences of overall risk ratio between 100% and 175% (M = 2.27, SD = 2.28, $t(9)$ = .34, p = .011), and 175% and 75% (M = -2.04, SD = 2.50, $t(9)$ = -.74, p = .029) tempo conditions are significant ($p < .05$); except for between 100% and 75% tempo conditions (M = .23, SD = 2.10, $t(9)$ = -2.59, p = .741 ($p > .05$). The difference of overall risk ratio between during 100% and 175% tempo conditions is the most significant (p = .012), followed by the difference of overall risk ratio between during 175% and 75% tempo conditions (p = .029), and then the least significant and the only insignificant pair being between 100% and 75% tempo conditions (p = .741).

4.3.1.10 Risk Ratio of Extroverts – LA Music Tempo Manipulations

This sub-section compares the risk ratio of extroverts among the three LA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for LA music were first compared using one-way ANOVA. Table 4.30 shows the mean risk ratio among the three tempo conditions, while Table 4.31 shows the one-way ANOVA test findings among the conditions.

Table 4.33 Risk Ratio of Extroverts Among LA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	LA 100%	10	3.85	.86	.27
2	LA 175%	10	4.45	5.20	1.65
3	LA 75%	10	3.99	2.78	.88
	Total	**30**	**3.84**	**3.37**	**.62**

Table 4.34 ANOVA – Risk Ratio of Extroverts Among LA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
1	Between Groups	9.61	2	4.81	.40	.670
2	Within Groups	319.72	27	11.84		
	Total	**329.33**	**29**			

Based on Table 4.34, the ANOVA test shows a highly statistical insignificant value of $p = .670$ ($p > .05$), indicating that the difference in results are very insignificant, showing that there is no significant statistical difference of risk ratio of extroverts among the three LA music tempo manipulation conditions. Therefore, similar to introverts, there is insufficient evidence to prove any significant risk ratio difference of extroverts among the LA music tempo conditions as well.

Subsequently, paired comparisons among the three pairs of LA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.35.

Table 4.35 Paired Samples t-Test – Risk Ratio of Introverts
Among the Paired LA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	LA 100% – LA 175%	-1.36	5.86	1.85	-.735	9	.481
2	LA 100% – LA 75%	-.91	2.62	.83	-1.102	9	.299
3	LA 175% – LA 75%	.45	6.24	1.97	.227	9	.825

Based on Table 4.35, it is shown that none of the three pairs of LA music tempo manipulation conditions show any significant statistical difference, as all significant values are much higher than the threshold significant value of .05 ($p > .05$). Therefore, the t-test was also unable to prove any significant risk ratio difference of extroverts among the LA music tempo conditions, hence there was no significant difference in risk-taking of extroverts among the LA music tempo conditions.

4.3.1.11 Comparing Risk Ratio Between Introverts and Extroverts

This sub-section compares the difference in risk ratio of all music arousal levels (no-music, HA 100%, and LA 100%), and tempo conditions (100%, 175%, and 75%) between introverts and extroverts. Only paired samples t-test is used for the comparison between introverts and extroverts. Tables 4.36 and 4.37 show the mean risk ratio among all music conditions of both introverts and extroverts respectively, while Table 4.38 shows the data comparison among all music conditions between introverts and extroverts.

Table 4.36 Mean – Risk Ratio of Introverts Among Music Arousal Level Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	Introverts – No Music	10	3.58	2.50	.79
2	Introverts – HA 100%	10	5.05	1.94	.61
3	Introverts – HA 175%	10	3.29	1.95	.62
4	Introverts – HA 75%	10	5.68	4.74	1.50
5	Introverts – LA 100%	10	1.83	1.76	.56
6	Introverts – LA 175%	10	2.80	1.65	.62
7	Introverts – LA 75%	10	3.88	2.05	.65

Table 4.37 Mean – Risk Ratio of Extroverts Among Music Arousal Level Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
1	Extroverts – No Music	10	4.31	1.94	.61
2	Extroverts – HA 100%	10	6.66	2.47	.78
3	Extroverts – HA 175%	10	4.39	1.69	.53
4	Extroverts – HA 75%	10	6.43	2.05	.65
5	Extroverts – LA 100%	10	3.08	.86	.27
6	Extroverts – LA 175%	10	4.45	5.20	1.65
7	Extroverts – LA 75%	10	3.99	2.78	.88

Table 4.38 Paired Samples t-Test – Risk Ratio between Introverts and Extroverts Among All Music Conditions.

	Condition Pair (I – E)	*M*	*SD*	*SEM*	*t*	*df*	Sig.
1	No Music	-.74	3.48	1.09	-.67	9	.519
2	HA 100%	-1.61	3.64	1.15	-1.40	9	.196
3	HA 175%	-1.10	3.30	1.04	-1.05	9	.320
4	HA 75%	-.76	6.27	1.98	-.38	9	.712
5	LA 100%	-1.25	1.71	.54	-2.32	9	.046
6	LA 175%	-1.64	6.00	1.90	-.87	9	.410
7	LA 75%	-.12	3.94	1.25	-.09	9	.927

Based on Table 4.38, it is shown that only the difference in risk ratio between introverts and extroverts during the LA music at 100% tempo condition is marginally significant (p = .046), while all of the other differences in risk ratio among introverts and extroverts are insignificant (p > .05). However, despite the insignificance in risk ratio differences, all of the risk ratio of extroverts in all conditions are marginally higher than introverts. Therefore, this shows that the introverts took marginally greater risks than extroverts.

4.3.2 Data Analysis Part 2 – Gameplay EEG Mental State

4.3.2.1 Overall Att/Med Levels Statistics

Gameplay EEG mental state is measured based on attention and meditation (Att/Med) level recordings as captured and presented by the NeuroSky® MindWave™ Mobile. The values of both attention and meditation levels range from 1 – 100, with 1 being the lowest and 100 being the highest (NeuroSky®, 2014; MindWave User Guide, 2017). As shown earlier in Table 3.14, Table 4.39 below reiterates the description of values for attention and meditation meters.

Table 4.39 Descriptions of Values of the Attention and Meditation Meters (Repeat).

Values	Description
0	Unable to calculate / poor signal
1 – 20	"Strongly lowered"
20 – 40	"Reduced"
40 – 60	"Neutral" or "Baseline"
60 – 80	"Slightly Elevated"
80 – 100	"Elevated"

The attention meter measures the "mental focus" level of the user, whereas the meditation meter measures the mental "calmness" of the user. Any form of distractions or anxiety caused by over-arousal can decrease both attention and meditation levels. Therefore, a higher value in both meters indicate that the user is calmer and more mentally focused, and on the contrary, a lower value in both meters indicate that the user is less calm and less mentally focused or more mentally distracted.

Tables 4.40 and 4.41 below show the overall data of attention and meditation levels of introverts and extroverts respectively.

Table 4.40 Att/Med of Introverts Among All Conditions.

	No Music		HA 100%		LA 100%		HA 175%		LA 175%		HA 75%		LA 75%	
	Att	Med	Att	Med	Att	Med	Att	Med	Att	Med	Att	Med	Att	Med
I_{A1}	40.47	47.73	39.27	41.53	59.53	70.87	30.07	36.80	33.27	48.20	56.87	63.73	47.87	63.60
I_{A2}	49.73	68.87	45.33	28.47	67.53	73.73	28.80	15.73	37.53	52.80	53.07	46.33	65.27	68.73
I_{A3}	45.93	52.73	36.87	45.27	70.20	67.20	23.13	18.53	30.87	51.27	59.67	38.60	58.87	76.87
I_{A4}	50.73	50.87	38.47	48.33	72.87	63.27	22.87	25.27	57.13	46.33	53.80	43.87	60.53	70.00
I_{A5}	51.40	53.40	43.60	38.53	71.13	70.87	20.13	17.73	52.80	47.47	49.73	44.60	58.80	61.53
I_{B1}	51.07	53.47	41.93	42.13	68.87	70.07	16.60	22.40	51.00	43.53	50.53	48.33	66.93	60.40
I_{B2}	46.47	49.47	47.87	46.13	66.47	72.80	23.13	20.60	46.07	33.47	48.67	50.93	68.80	64.53
I_{B3}	51.53	58.80	44.47	47.20	64.07	69.47	20.00	17.87	48.80	52.13	53.87	49.20	67.20	69.40
I_{B4}	40.27	51.93	41.73	32.07	70.27	66.53	18.93	17.80	36.47	54.67	55.87	38.53	71.87	71.13
I_{B5}	48.93	45.07	41.40	47.40	68.60	69.60	15.60	20.27	47.80	45.13	60.33	49.87	68.93	76.73
M	**47.65**	**53.23**	**42.09**	**42.70**	**67.95**	**69.44**	**21.93**	**21.30**	**44.17**	**37.50**	**54.24**	**47.40**	**63.51**	**68.29**

Table 4.41 Att/Med of Extroverts Among All Conditions.

	No Music		HA 100%		LA 100%		HA 175%		LA 175%		HA 75%		LA 75%	
	Att	Med	Att	Med	Att	Med	Att	Med	Att	Med	Att	Med	Att	Med
E_{A1}	70.47	70.27	77.53	60.33	67.20	82.47	51.53	32.40	61.53	67.07	74.60	63.87	66.07	76.07
E_{A2}	77.20	71.07	81.87	57.07	61.33	71.27	49.53	36.60	62.33	57.07	70.93	71.80	63.20	68.40
E_{A3}	72.80	70.67	79.53	63.80	64.33	80.67	51.87	41.20	57.13	50.60	75.13	63.07	64.07	54.53
E_{A4}	67.73	75.47	75.27	52.67	65.67	72.47	45.07	33.40	55.27	57.13	68.93	52.27	56.67	57.87
E_{A5}	65.07	60.67	75.80	53.67	68.47	75.53	42.47	23.13	59.47	55.53	61.20	53.93	58.40	63.33
E_{B1}	69.13	60.40	78.53	56.80	67.27	79.80	39.93	41.13	53.20	56.87	65.07	69.13	64.87	65.47
E_{B2}	67.80	56.07	82.47	45.13	55.13	74.73	38.00	43.60	55.47	52.87	59.33	62.73	57.80	68.67
E_{B3}	71.13	57.53	75.87	65.73	67.13	70.27	46.07	31.13	57.20	59.53	60.27	50.67	47.73	69.40
E_{B4}	76.20	48.93	81.07	50.73	64.33	80.27	44.80	33.47	61.73	67.80	68.60	70.67	62.27	66.87
E_{B5}	76.07	61.33	65.93	55.33	66.20	78.67	33.27	35.87	58.20	65.80	71.53	75.07	68.80	67.20
M	**71.36**	**63.24**	**77.39**	**56.13**	**64.71**	**76.61**	**44.25**	**35.19**	**58.15**	**59.03**	**67.56**	**63.32**	**60.99**	**65.78**

4.3.2.2 Overall Att/Med Levels – Music Arousal Level Conditions

This sub-section compares the overall attention and meditation levels among music arousal levels using one-way analysis of variance (ANOVA) test among the no-music, HA (100%), and LA (100%) music conditions, and paired samples t-test between each condition. Firstly, the three music arousal level conditions were compared using one-way ANOVA. Table 4.42 shows the overall mean of all participants among the three conditions, while Table 4.43 shows the ANOVA test findings among the conditions.

Table 4.42 Att/Med Among Music Arousal Level Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	No Music	20	59.51	12.83	2.87
2	HA Music (100%)	20	59.74	18.55	4.15
3	LA Music (100%)	20	66.33	4.14	.93
	Total	**60**	**61.86**	**13.40**	**1.73**
	Meditation				
1	No Music	20	58.24	8.94	2.00
2	HA Music (100%)	20	49.41	9.04	2.02
3	LA Music (100%)	20	73.03	5.19	1.16
	Total	**60**	**60.22**	**12.54**	**1.62**

Table 4.43 ANOVA – Att/Med Among Music Arousal Level Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	600.27	2	300.14	1.71	.190
2	Within Groups	9,990.84	57	175.28		
	Total	**10,591.11**	**59**			
	Meditation					
1	Between Groups	4,936.90	2	2,468.45	30.96	< .001
2	Within Groups	4,539.55	57	79.64		
	Total	**9,476.45**	**59**			

Based on Table 4.43, the ANOVA test show an insignificant value for the attention levels (p = .190) (p > .05), but a significant value for the meditation levels (p < .001). This indicates that the difference in attention levels is insignificant, but the difference in meditation levels is extremely significant. Therefore, the results prove that the meditation levels during the LA music condition is the highest (M = 73.03), followed by the no-music condition (M = 59.51), and the HA music condition being the lowest (M = 51.27).

Subsequently, paired comparisons among the three pairs of music arousal level conditions (no-music – HA; no-music – LA; and HA – LA) were done using paired samples t-test as shown below in Table 4.44.

Table 4.44 Paired Samples t-Test – Overall Att/Med Among the Paired Music Arousal Level Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	No Music – HA	-.23	8.11	1.81	-.129	19	.899
2	No Music – LA	-6.82	14.77	3.30	-2.07	19	.053
3	HA – LA	-6.59	20.82	4.65	-1.42	19	.173
	Meditation						
1	No Music – HA	8.83	10.06	2.25	3.92	19	.001
2	No Music – LA	-14.79	8.11	1.81	-8.16	19	< .001
3	HA – LA	-21.76	9.64	2.16	-10.09	19	< .001

Based on Table 4.44, only the meditation levels compared between all three music conditions are significant, whereas the attention levels compared between all the three music conditions are insignificant. Therefore, comparisons of meditation levels between all the three music arousal level conditions show significant statistical difference, while comparisons of attention levels between all the three music arousal level conditions show no significant difference. Within the meditation level group, the difference between HA and LA music conditions (M = -21.76, SD = 9.64, $t(19)$ = -10.09, p < .001) is the most significant, followed by between no-music and LA music conditions (M = -14.79, SD = 8.11, $t(19)$ = -8.16, p < .001), and the least significant difference being between no-music and HA music conditions (M = 8.83, SD = 9.64, $t(19)$ = 3.92, p = .001).

4.3.2.3 Overall Att/Med Levels – HA Music Tempo Manipulations

This sub-section compares the overall attention and meditation levels among the three HA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for HA music were first compared using one-way ANOVA. Table 4.45 shows the mean among the three tempo conditions, while Table 4.46 shows the one-way ANOVA test findings.

Table 4.45 Overall Att/Med Among HA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	HA 100%	20	59.74	18.55	4.15
2	HA 175%	20	33.09	12.60	2.82
3	HA 75%	20	60.90	8.38	1.87
	Total	**60**	**51.24**	**18.77**	**2.42**
	Meditation				
1	HA 100%	20	49.41	9.04	2.02
2	HA 175%	20	28.25	9.23	2.06
3	HA 75%	20	55.36	11.25	2.52
	Total	**60**	**44.34**	**15.24**	**1.97**

Table 4.46 ANOVA– Overall Att/Med Among HA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	9,899.76	2	4,949.89	25.91	< .001
2	Within Groups	10,888.17	57	191.02		
	Total	**20,787.94**	**59**			
	Meditation					
1	Between Groups	8,123.15	2	4,061.58	41.50	< .001
2	Within Groups	5,578.97	57	97.88		
	Total	**13,702.12**	**59**			

Based on Table 4.46, the ANOVA test shows a highly significant value of $p < .001$ ($p < .05$) for both overall attention and meditation levels among the HA tempo conditions, indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of overall attention and meditation levels among the three conditions. Thus, the attention levels during the HA 75% condition (M = 60.90, SD = 8.38) is the highest, followed by HA 100% (M = 59.74, SD = 18,55), and the lowest being HA 175% (M = 33.09, SD = 12.60). Similarly, the meditation levels during the HA

75% condition (*M* = 55.36, *SD* = 11.25) is the highest, followed by HA 100% (*M* = 49.41, *SD* = 9.04), and the lowest being HA 175% (*M* = 28.25, *SD* = 9.23).

Subsequently, paired comparisons among the three pairs of HA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.47.

Table 4.47 Paired Samples t-Test – Overall Att/Med Among the Paired HA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	HA 100% – HA 175%	26.65	8.65	1.93	13.78	19	< .001
2	HA 100% – HA 75%	-1.16	13.38	2.99	-.39	19	.703
3	HA 175% – HA 75%	-27.81	7.59	1.70	-16.39	19	< .001
	Meditation						
1	HA 100% – HA 175%	21.90	8.44	1.89	11.60	19	< .001
2	HA 100% – HA 75%	-5.21	9.72	2.17	-2.40	19	.027
3	HA 175% – HA 75%	-27.11	6.39	1.43	-18.98	19	< .001

Based on Table 4.47, only the difference in attention levels between HA 100% and HA 75% tempo conditions is highly insignificant ($p = .703$) ($p > .05$), while the other comparisons are highly significant ($p < .05$). Thus, apart from the comparison of attention levels between HA 100% and HA 75% tempo conditions which show no significant difference, all the other comparisons of attention and meditations among HA tempo conditions show significant differences. Therefore, the difference in attention levels between HA 175% and 75% tempo conditions (*M* = -27.81, *SD* = 7.59, $t(19) = -16.39$, $p < .001$) is the most significant, followed by between HA 100% and 175% (*M* = 26.65, *SD* = 8.65, $t(19) = 13.78$, $p < .001$), and the least significant being between HA 100% and 75% (*M* = -1.16, *SD* = 13.38, $t(19) = -.39$, $p = .703$). Similarly, the difference in meditation levels between HA 175% and 75% tempo conditions (*M* = -27.11, *SD* = 6.39, $t(19) = -18.98$, $p < .001$) is the most significant, followed by between HA 100% and 175% tempo conditions (*M* = 21.90, *SD* = 8.44, $t\ (19) = 11.60$, $p < .001$), and the least significant being between HA 100% and 75% tempo conditions(*M* = -5.21, *SD* = 9.72, $t\ (19) = -2.40$, $p = .027$).

4.3.2.4 Overall Att/Med Levels – LA Music Tempo Manipulations

This sub-section compares the overall attention and meditation levels among the three LA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempi conditions for HA music were first compared using one-way ANOVA. Table 4.48 shows the mean among the three tempi conditions, while Table 4.49 shows the one-way ANOVA test findings.

Table 4.48 Overall Att/Med Among LA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	LA 100%	20	66.33	4.15	.93
2	LA 175%	20	51.16	9.70	2.17
3	LA 75%	20	62.25	6.54	1.46
	Total	**60**	**59.91**	**9.56**	**1.23**
	Meditation				
1	LA 100%	20	73.03	5.19	1.16
2	LA 175%	20	53.26	8.34	1.86
3	LA 75%	20	67.04	5.92	1.32
	Total	**60**	**64.44**	**10.58**	**1.37**

Table 4.49 ANOVA – Overall Att/Med Among LA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	2,463.61	2	1,231.81	23.97	< .001
2	Within Groups	2,929.38	57	51.39		
	Total	**5,392.99**	**59**			
	Meditation					
1	Between Groups	4,107.83	2	2,053.91	46.86	< .001
2	Within Groups	2,498.18	57	43.83		
	Total	**6,606.01**	**59**			

Based on Table 4.46, the ANOVA test shows a highly significant value of $p < .001$ ($p < .05$) for both overall attention and meditation levels among the LA tempo conditions, indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of overall attention and meditation levels among the three conditions. Thus, the attention levels during the LA 100% condition ($M = 66.33$, $SD = 4.15$) is the highest, followed by LA 75% ($M = 62.25$, $SD = 6.54$), and the lowest being LA 175% ($M = 51.16$, $SD = 9.70$). Similarly, the meditation levels during the

LA 100% condition (*M* = 73.03, *SD* = 5.19) is the highest, followed by HA 100% (*M* = 67.04, *SD* = 6.54), and the lowest being LA 175% (*M* = 53.26, *SD* = 8.34).

Subsequently, paired comparisons among the three pairs of LA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.50.

Table 4.50 Paired Samples t-Test – Overall Att/Med Among the Paired LA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	LA 100% – LA 175%	15.17	11.01	2.46	6.16	19	< .001
2	LA 100% – LA 75%	4.08	6.69	1.50	2.73	19	.013
3	LA 175% – LA 75%	-22.08	11.66	2.61	-4.25	19	< .001
	Meditation						
1	LA 100% – LA 175%	19.76	7.02	1.57	12.58	19	< .001
2	LA 100% – LA 75%	5.99	8.79	1.97	3.05	19	.007
3	LA 175% – LA 75%	-13.77	9.28	2.08	-6.63	19	< .001

Based on Table 4.50, all the differences in both attention and meditation levels between all the LA music tempo conditions are significant ($p < .05$), indicating that the results show significant statistical differences. Therefore, the difference in attention levels between LA 175% and 75% tempo conditions (*M* = -22.08, *SD* = 11.66, $t(19) = -4.25$, $p < .001$) is the most significant, followed by between LA 100% and 175% (*M* = 15.17, *SD* = 11.01, t (19) = 6.16, $p < .001$), and the least significant being between LA 100% and 75% (*M* = 4.08, *SD* = 6.69, t (19) = 2.73, $p = .013$). However, the difference in meditation levels between LA 100% and 175% tempo conditions (*M* = 19.76, *SD* = 7.02, $t(19) = 12.58$, $p < .001$) is the most significant, followed by between LA 175% and 75% (*M* = -13.77, *SD* = 9.28, t (19) = -6.63, $p < .001$), and the least significant being between LA 100% and 75% (*M* = 5.99, *SD* = 8.79, $t(19) = 3.05$, $p = .007$).

4.3.2.5 Att/Med Levels of Introverts – Music Arousal Level Conditions

This sub-section compares the attention and meditation levels of introverts among music arousal level conditions using one-way analysis of variance (ANOVA) test among the no-music, HA (100%), and LA (100%) music conditions, and paired samples t-test between each condition. Firstly, the three music arousal level conditions were compared using one-way ANOVA. Table 4.51 shows the mean of all introverts among the three conditions, while Table 4.52 shows the ANOVA test findings among the conditions.

Table 4.51 Att/Med of Introverts Among Music Arousal Level Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	No Music	10	47.65	4.30	1.36
2	HA Music (100%)	10	42.09	3.35	1.06
3	LA Music (100%)	10	67.95	3.86	1.22
	Total	**30**	**52.57**	**11.90**	**2.17**
	Meditation				
1	No Music	10	53.23	6.62	2.09
2	HA Music (100%)	10	42.70	5.90	1.87
3	LA Music (100%)	10	69.44	3.09	.98
	Total	**30**	**55.12**	**12.35**	**2.25**

Table 4.52 ANOVA – Att/Med of Introverts Among Music Arousal Level Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	3,705.81	2	1,852.91	124.48	< .001
2	Within Groups	401.89	27	14.89		
	Total	**4,107.704**	**29**			
	Meditation					
1	Between Groups	3,629.61	2	1,814.81	61.75	< .001
2	Within Groups	793.49	27	29.39		
	Total	**4,423.10**	**29**			

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Based on Table 4.52, the ANOVA test show a highly significant value (p < .001) for both the attention and meditation levels (p < .05), This indicates that the difference in both attention and meditation levels of introverts among the music arousal level conditions is extremely significant. Therefore, the results prove that the attention levels during the LA music condition is the highest (M = 67.95, SD = 3.86), followed by the no-music condition (M = 47.65, SD = 4.30), and the HA music condition being the lowest (M =42.09, SD = 3.35). Similarly, the results prove that the attention levels during the LA music condition is the highest (M = 69.44, SD = 3.09), followed by the no-music condition (*M* = 53.23, *SD* = 6.62), and the HA music condition being the lowest (*M* =42.70, *SD* = 5.90).

Subsequently, paired comparisons among the three pairs of music arousal level conditions (no-music – HA; no-music – LA; and HA – LA) were done using paired samples t-test as shown below in Table 4.53.

Table 4.53 Paired Samples t-Test – Att/Med of Introverts Among Music Arousal Level Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	No Music – HA	5.56	4.71	1/49	3.74	9	.005
2	No Music – LA	-20.30	4.57	1.45	-14.03	9	< .001
3	HA – LA	-25.86	5.56	1.76	-14.71	9	< .001
	Meditation						
1	No Music – HA	10.54	11.64	1.97	2.86	9	.019
2	No Music – LA	-16.21	6.23	2.56	-8.23	9	< .001
3	HA – LA	-26.74	8.10	2.67	-10.44	9	< .001

Based on Table 4.53, all the differences in both attention and meditation levels between all the LA music tempo conditions are significant ($p < .05$), indicating that the results show significant statistical differences. Therefore, the difference in attention levels between HA and LA conditions (*M* = -25.86, *SD* = 5.56, $t(9) = -14.71$, $p < .001$) is the most significant, followed by between no-music and LA conditions (*M* = -20.30, *SD* = 4.57, $t\ (9) = -14.03$, $p < .001$), and the least significant being between no-music and HA conditions (*M* = 5.56, *SD* = 4.71, $t(9) = 3.74$, $p = .005$). Similarly, the difference in meditation levels between HA and LA conditions (*M* = -26.74, *SD* = 8.10, $t(9) = -8.23$, $p < .001$) is the most significant, followed by between no-music and LA conditions (*M* = -16.21, *SD* = 6.23, $t(9) = 2.56$, $p < .001$), and the least significant being between no-music and HA conditions (*M* = 10.54, *SD* = 11.64, $t(9) = 2.86$, $p = .019$).

4.3.2.6 Att/Med Levels of Introverts – HA Music Tempo Manipulations

This sub-section compares the attention and meditation levels of introverts among the three HA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for HA music were first compared using one-way ANOVA. Table 4.54 shows the mean among the three tempo conditions, while Table 4.55 shows the one-way ANOVA test findings among the conditions.

Table 4.54 Att/Med of Introverts Among HA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	HA 100%	10	42.09	3.35	1.06
2	HA 175%	10	21.93	4.73	1.50
3	HA 75%	10	54.24	3.99	1.26
	Total	**30**	**39.42**	**14.11**	**2.58**
	Meditation				
1	HA 100%	10	42.70	5.90	1.87
2	HA 175%	10	21.30	6.09	1.93
3	HA 75%	10	47.40	7.20	2.28
	Total	**30**	**37.13**	**13.11**	**2.39**

Table 4.55 ANOVA – Att/Med of Introverts Among HA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	5,327.96	2	2,663.98	161.51	< .001
2	Within Groups	445.39	27	16.50		
	Total	**5,773.32**	**29**			
	Meditation					
1	Between Groups	3,870.50	2	1,935.25	46.88	< .001
2	Within Groups	1,114.68	27	41.29		
	Total	**4,985.18**	**29**			

Based on Table 4.55, the ANOVA test shows a highly significant value of $p < .001$ ($p < .05$) for both attention and meditation levels of introverts among the HA tempo conditions, indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of overall attention and meditation levels among the three conditions. Thus, the attention levels during the HA 75% condition ($M = 54.24$, $SD = 3.99$) is the highest, followed by HA 100% ($M = 42.09$, $SD = 3.35$), and the lowest being HA 175% ($M = 21.93$, $SD = 4.73$). Similarly, the meditation levels during the HA 75% condition ($M = 47.40$, $SD = 7.20$) is the highest, followed by HA 100% ($M = 47.20$, $SD = 5.90$), and the lowest being HA 175% ($M = 21.30$, $SD = 6.09$).

Subsequently, paired comparisons among the three pairs of HA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.56.

Table 4.56 Paired Samples t-Test – Att/Med of Introverts Among Paired HA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	HA 100% – HA 175%	20.17	5.89	1.86	10.84	9	< .001
2	HA 100% – HA 75%	-12.15	6.73	2.13	-5.71	9	< .001
3	HA 175% – HA 75%	-32.31	6.23	1.97	-16.41	9	< .001
	Meditation						
1	HA 100% – HA 175%	21.40	7.51	2.37	9.01	9	< .001
2	HA 100% – HA 75%	-4.70	9.29	2.94	-1.60	9	.144
3	HA 175% – HA 75%	-26.10	4.72	1.49	-17.48	9	< .001

Based on Table 4.56, only the difference in meditation levels of introverts between HA 100% and HA 75% tempo conditions is highly insignificant (p = .144) (p > .05), while the other comparisons are highly significant (p < .05). Thus, apart from the comparison of meditation levels of introverts between HA 100% and HA 75% tempo conditions which did not show any significant differences, all the other comparisons of attention and meditation levels of introverts among the HA tempo conditions show significant differences. Therefore, the difference in attention levels between HA 175% and 75% tempo conditions (M = -32.31, SD = 6.23, $t(9)$ = -16.41, p < .001) is the most significant, followed by between HA 100% and 175% (M = 20.17, SD = 5.89, $t(19)$ = 10.84, p < .001), and the least significant being between HA 100% and 75% (M = -123.15, SD = 6.73, $t(9)$ = -5.71, p < .001). Similarly, the difference in meditation levels between HA 175% and 75% tempo conditions (M = -26.10, SD = 4.72, $t(9)$ = -17.48, p < .001) is the most significant, followed by between HA 100% and 175% (M = 21.40, SD = 7.51, $t(9)$ = 9.01, p < .001), and the least significant difference being between HA 100% and 75% (M = -4.70, SD = 9.29, $t(9)$ = -1.60, p = .144) tempo conditions.

4.3.2.7 Att/Med Levels of Introverts – LA Music Tempo Manipulations

This sub-section compares the attention and meditation levels of introverts among the three HA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for LA music were first compared using one-way ANOVA. Table 4.57 shows the mean among the three tempo conditions, while Table 4.58 shows the one-way ANOVA test findings among the conditions.

Table 4.57 Att/Med of Introverts Among LA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	LA 100%	10	67.95	3.86	1.22
2	LA 175%	10	44.17	8.99	2.84
3	LA 75%	10	63.51	7.09	2.24
	Total	**30**	**58.54**	**12.47**	**2.28**
	Meditation				
1	LA 100%	10	69.44	3.09	.98
2	LA 175%	10	47.50	6.10	1.93
3	LA 75%	10	68.29	5.79	1.83
	Total	**30**	**61.74**	**11.41**	**2.08**

Table 4.58 ANOVA – Att/Med of Introverts Among LA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	3,196.80	2	1,598.40	32.85	< .001
2	Within Groups	1,313.90	27	48.67		
	Total	**4,510.70**	**29**			
	Meditation					
1	Between Groups	3,050.14	2	1,525.07	57.01	< .001
2	Within Groups	722.32	27	26.75		
	Total	**3,772.45**	**29**			

Based on Table 4.58, the ANOVA test shows a highly significant value of $p < .001$ ($p < .05$) for both attention and meditation levels of introverts among the LA tempo conditions, indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of overall attention and meditation levels among the three conditions. Thus, the attention levels during the LA 100% condition (M = 67.95, SD = 3.86) is the highest, followed by LA 75% (M = 63.51, *SD* = 7.09), and the lowest being LA 175% (*M* = 44.17, *SD* = 8.99). Similarly, the meditation levels during the LA 100% condition (*M* = 69.44, *SD* = 3.09) is the highest, followed by HA 100% (*M* = 68.29, *SD* = 5.79), and the lowest being LA 175% (*M* = 47.50, *SD* = 6.10).

Subsequently, paired comparisons among the three pairs of LA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.59.

Table 4.59 Paired Samples t-Test – Att/Med of Introverts Among Paired LA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	LA 100% – LA 175%	23.78	8.23	2.60	9.14	9	< .001
2	LA 100% – LA 75%	4.45	6.65	2.10	2.12	9	.064
3	LA 175% – LA 75%	-19.33	9.92	3.14	-6.17	9	< .001
	Meditation						
1	LA 100% – LA 175%	21.94	7.63	2.39	9.15	9	< .001
2	LA 100% – LA 75%	1.15	6.65	2.41	.48	9	.646
3	LA 175% – LA 75%	-20.79	6.01	2.10	-9.25	9	< .001

Based on Table 4.59, only the differences between LA 100% and LA 75% tempo conditions are highly insignificant (*p* > .05) for both attention (*p* = .064) and meditation (*p* = .646) levels of introverts, while all the other comparisons are extremely significant (*p* < .001). Thus, apart from the comparison of attention and meditation levels of introverts between LA 100% and LA 75% tempo conditions which did not show any significant differences, all the other comparisons of attention and meditation levels of introverts among the HA tempo conditions show significant differences. Therefore, the difference in attention levels between LA 100% and 175% tempo conditions (*M* = 23.78, *SD* = 8.23, *t*(9) = 9.14, *p* < .001) is the most significant, followed by between LA 175% and 75% (*M* = -19.33, *SD* = 9.92, *t*(9) = -6.17, *p* < .001), and the least significant being between LA 100% and 75% (*M* = 4.45, *SD* = 6.765, *t*(9) = 2.12, *p* = .064). Similarly, the difference in meditation levels between LA 100% and 175% tempo conditions

(M = -21.94, SD = 7.63, $t(9)$ = 9.15, p < .001) is the most significant, followed by between LA 175% and 75% (M = -20.79, SD = 2.10, $t(9)$ = -9.25, p < .001), and the least significant difference being between LA 100% and 75% (M = 1.15, SD = 6.01, $t(9)$ = .48, p = .646) tempo conditions.

4.3.2.8 Att/Med Levels of Extroverts – Music Arousal Level Conditions

This sub-section compares the attention and meditation levels of extroverts among music arousal level conditions using one-way analysis of variance (ANOVA) test among the no-music, HA (100%), and LA (100%) music conditions, and paired samples t-test between each condition. Firstly, the three music arousal level conditions were compared using one-way ANOVA. Table 4.60 shows the mean of all extroverts among the three conditions, while Table 4.61 shows the ANOVA test findings.

Table 4.60 Att/Med of Extroverts Among Music Arousal Level Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	No Music	10	71.36	4.12	1.30
2	HA Music (100%)	10	77.39	4.78	1.51
3	LA Music (100%)	10	64.71	3.93	1.24
	Total	**30**	**71.15**	**6.70**	**1.22**
	Meditation				
1	No Music	10	63.24	8.32	2.63
2	HA Music (100%)	10	56.13	6.14	1.94
3	LA Music (100%)	10	76.61	4.34	1.37
	Total	**30**	**65.33**	**10.66**	**1.95**

Table 4.61 ANOVA – Att/Med of Extroverts Among Music Arousal Level Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	804.57	2	402.28	21.81	< .001
2	Within Groups	498.12	27	18.45		
	Total	**1,302.68**	**29**			
	Meditation					
1	Between Groups	2,163.83	2	1,081.92	25.85	< .001
2	Within Groups	1,130.27	27	41.86		
	Total	**3,294.10**	**29**			

Based on Table 4.61, the ANOVA test show a highly significant value (p < .001) for all conditions (*p* < .05), This indicates that the difference in both attention and meditation levels of extroverts among the music arousal level conditions is extremely significant. Therefore, the results prove that the attention levels during the HA music condition is the highest (*M* = 77.39, *SD* = 4.78), followed by the no-music condition (*M* = 71.36, *SD* = 4.12), and the LA music condition being the lowest (*M* = 64.71, *SD* = 3.93). However, the meditation levels during the LA music condition is the highest (*M* = 76.61, *SD* = 4.34), followed by the no-music condition (*M* = 63.24, *SD* = 8.32), and the HA music condition being the lowest (*M* = 56.13, *SD* = 6.14).

Subsequently, paired comparisons among the three pairs of music arousal level conditions (no-music – HA; no-music – LA; and HA – LA) were done using paired samples t-test as shown below in Table 4.62.

Table 4.62 Paired Samples t-Test – Att/Med of Extroverts Among Music Arousal Level Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	No Music – HA	-6.03	6.48	2.05	-2.94	9	.016
2	No Music – LA	6.65	6.01	1.90	3.50	9	.007
3	HA – LA	12.68	7.66	2.42	5.24	9	.001
	Meditation						
1	No Music – HA	7.11	8.46	2.67	2.66	9	.026
2	No Music – LA	-13.37	9.77	3.09	-4.33	9	.002
3	HA – LA	-20.49	7.39	2.34	-8.77	9	< .001

Based on Table 4.62, all the differences in both attention and meditation levels between all the LA music tempo conditions are significant (*p* < .05), indicating that the results show significant statistical differences. Therefore, the difference in attention levels between no-music and LA conditions (*M* = 12.68, *SD* = 7.66, *t*(9) = 5.24, *p* = .001) is the most significant, followed by between HA and LA conditions (*M* = 6.65, *SD* = 6.01, *t*(9) = 3.50, *p* = .007), and the least significant being between no-music and HA conditions (*M* = -6.03, *SD* = 6.48, *t*(9) = 2.05, *p* = .016). However, the difference in meditation levels between HA and LA conditions (*M* = -20.49, *SD* = 7.39, $t(9) = -8.77$, $p < .001$) is the most significant, followed by between no-music and LA conditions (*M* = -13.37, *SD* = 9.77, $t(9) = -4.33$, $p = .002$), and the least significant being between the no-music and HA conditions (*M* = 7.11, *SD* = 8.46, $t(9) = 2.66$, $p = .026$).

4.3.2.9 Att/Med Levels of Extroverts – HA Music Tempo Manipulations

This sub-section compares the attention and meditation levels of extroverts among the three HA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for HA music were first compared using one-way ANOVA. Table 4.63 shows the mean among the three tempo conditions, while Table 4.64 shows the one-way ANOVA test findings.

Table 4.63 Att/Med of Extroverts Among HA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	HA 100%	10	77.39	4.78	1.51
2	HA 175%	10	44.25	6.01	1.90
3	HA 75%	10	67.56	5.82	1.84
	Total	**30**	**63.07**	**15.12**	**2.76**
	Meditation				
1	HA 100%	10	56.13	6.14	1.94
2	HA 175%	10	35.19	5.97	1.89
3	HA 75%	10	63.32	8.63	2.73
	Total	**30**	**51.55**	**13.90**	**2.54**

Table 4.64 ANOVA – Att/Med of Extroverts Among HA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	5,791.94	2	2,895.97	93.62	< .001
2	Within Groups	835.21	27	30.93		
	Total	**6,627.15**	**29**			
	Meditation					
1	Between Groups	4,720.19	2	787.10	25.83	< .001
2	Within Groups	1,330.10	27	30.47		
	Total	**5,600.30**	**29**			

Based on Table 4.64, the ANOVA test shows a highly significant value of $p < .001$ ($p < .05$) for both attention and meditation levels of extroverts among the HA tempo conditions, indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of overall attention and meditation levels among the three conditions. The attention levels during the HA 100% condition (M = 77.39, SD = 4.78) is the highest, followed by HA 75% (M = 67.56, SD = 5.82), and the lowest being HA 175% (M = 44.25, SD = 6.01). However, the meditation levels during the HA 75% condition (M = 63.32, SD = 8.63) is the highest, followed by HA 100% (M = 56.13, SD = 6.14), and the lowest being HA 175% (M = 35.19, SD = 5.97).

Subsequently, paired comparisons among the three pairs of HA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.65.

Table 4.65 Paired Samples t-Test – Att/Med of Extroverts Among Paired HA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	HA 100% – HA 175%	33.13	5.47	1.73	19.15	9	< .001
2	HA 100% – HA 75%	9.83	8.04	2.54	3.87	9	.004
3	HA 175% – HA 75%	-23.31	6.14	1.94	-12.01	9	< .001
	Meditation						
1	HA 100% – HA 175%	20.93	9.15	2.89	7.24	9	< .001
2	HA 100% – HA 75%	-7.19	11.51	3.64	-1.98	9	.079
3	HA 175% – HA 75%	-28.13	7.85	2.48	-11.34	9	< .001

Based on Table 4.65, only the difference in meditation levels of extroverts between HA 100% and HA 75% tempo conditions is insignificant (p = .079) (p > .05), while the other comparisons are highly significant (p < .05). Thus, apart from the comparison of meditation levels of extroverts between HA 100% and HA 75% tempo conditions which did not show any significant differences, all the other comparisons of attention and meditation levels of introverts among the HA tempo conditions show significant differences. Therefore, the difference in attention levels between HA 100% and 175% tempo conditions (M = 33.13, SD = 5.47, $t(9)$ = 19.15, p < .001) is the most significant, followed by between HA 175% and 75% (M = -23.31, SD = 6.14, $t(9)$ = -12.01, p < .001), and the least significant being between HA 100% and 75% (M = 9.83, *SD* = 8.04, *t*(9) = 3.87, *p* = .004). However, the difference in meditation levels between HA 175% and 75% tempo conditions (*M* = -28.13, *SD* = 7.85, *t*(9) = -11.34, *p* < .001) is the most significant, followed by between HA 100% and 175% (*M* = 20.93, *SD* = 9.15, *t*(9) = 7.24, *p* < .001), and the least significant (and the only insignificant) difference being between HA 100% and 75% (*M* = -7.19, *SD* = 11.51, *t*(9) = -1.98, *p* = .079).

4.3.2.10 Att/Med Levels of Extroverts – LA Music Tempo Manipulations

This sub-section compares the attention and meditation levels of extroverts among the three LA music tempo manipulations: normal tempo (100%), fastened tempo (175%), and slowered tempo (75%). The three tempo conditions for LA music were first compared using one-way ANOVA. Table 4.66 shows the mean among the three tempo conditions, while Table 4.67 shows the one-way ANOVA test findings.

Table 4.66 Att/Med of Extroverts Among LA Music Tempo Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	LA 100%	10	64.71	3.93	1.24
2	LA 175%	10	58.15	3.08	.97
3	LA 75%	10	60.99	6.05	1.91
	Total	**30**	**61.28**	**5.15**	**.94**
	Meditation				
1	LA 100%	10	76.61	4.34	1.37
2	LA 175%	10	59.03	5.97	1.89
3	LA 75%	10	65.78	6.08	1.92
	Total	**30**	**67.14**	**9.09**	**1.66**

Table 4.67 ANOVA – Att/Med of Extroverts Among LA Music Tempo Conditions.

		Sum of Squares	*df*	M^2	*F*	Sig.
	Attention					
1	Between Groups	216.04	2	108.02	5.27	.012
2	Within Groups	553.82	27	20.51		
	Total	**769.87**	**29**			
	Meditation					
1	Between Groups	1,574.20	2	787.10	25.83	< .001
2	Within Groups	822.68	27	30.47		
	Total	**2,396.87**	**29**			

Based on Table 4.67, the ANOVA test shows a highly significant value of *p* = .012 and *p* < .001 (*p* < .05) respectively for both attention and meditation levels of extroverts among the LA tempo conditions, indicating that the difference of results is statistically significant, which proves that there is a significant statistical difference of overall attention and meditation levels among the three conditions. Thus, the attention levels during the LA 100% condition (*M* = 64.71, *SD* = 3.93) is the highest, followed by LA 75% (*M* = 60.99, *SD* = 6.05), and the lowest being LA 175% (*M* = 58.15, *SD* = 3.08). Similarly, the meditation levels during the LA 100% condition (*M* = 76.61, *SD* = 4.34) is the highest, followed by LA 75% (*M* = 65.78, *SD* = 6.08), and the lowest being LA 175% (*M* = 59.03, *SD* = 5.97).

Subsequently, paired comparisons among the three pairs of LA music tempo conditions (100% – 175%; 100% – 75%; 175% – 75%) were done using paired samples t-test, as shown below in Table 4.68.

Table 4.68 Paired Samples t-Test – Att/Med of Extroverts Among Paired LA Music Tempo Conditions.

	Condition Pair	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	LA 100% – LA 175%	6.55	4.85	1.53	4.27	9	.002
2	LA 100% – LA 75%	3.72	7.06	2.23	1.67	9	.130
3	LA 175% – LA 75%	-2.83	6.11	1.93	-1.47	9	.177
	Meditation						
1	LA 100% – LA 175%	17.59	6.01	1.90	9.25	9	< .001
2	LA 100% – LA 75%	10.83	7.26	2.30	4.72	9	.001
3	LA 175% – LA 75%	-6.75	5.31	1.68	-4.02	9	.003

Based on Table 4.68, only the differences in attention levels between LA 100% and LA 75% tempo conditions (p = .130), and between LA 175% and 175% tempo conditions (p = .177) are highly insignificant (p > .05), while all the other comparisons are highly significant (p < .05). Thus, apart from the comparison of attention and meditation levels of extroverts between LA 100% and LA 75% and between LA 175% and 75% tempo conditions which did not show any significant differences, all the other comparisons of attention and meditation levels of introverts among the LA tempo conditions show significant differences. Therefore, the difference in attention levels between LA 100% and 175% tempo conditions (*M* = 6.55, *SD* = 4.85, $t(9)$ = 4.27, p = .002) is the most significant, followed by between LA 100% and 75% (*M* = 3.72, *SD* = 7.06, *t*(9) = 1.67, *p* = .130), and the least significant being between LA 175% and 75% (*M* = -2.83, *SD* = 6.11, *t*(9) = -1.47, *p* = .177). Similarly, the difference in meditation levels between LA 100% and 175% tempo conditions (*M* = 17.59, *SD* = 6.01, *t*(9) = 9.25, *p* < .001) is the most significant, followed by between LA 100% and 75% (*M* = 10.83, *SD* = 7.26, *t*(9) = -4.02, *p* = .001), and the least significant difference being between LA 175% and 75% (*M* = -6.75, *SD* = 5.31, *t*(9) = -4.02, *p* = .003) tempo conditions.

4.3.2.11 Comparing Att/Med Levels Between Introverts and Extroverts

This sub-section compares the difference in attention and meditation levels of all music arousal levels (no-music, HA 100%, and LA 100%), and tempo conditions (100%, 175%, and 75%) between introverts and extroverts. Only paired samples t-test is used for the comparisons of all attention and meditation levels between introverts and extroverts. Tables 4.69 and 4.70 show the mean among all music conditions of both introverts and extroverts respectively, while Table 4.71 shows the data comparison among all music conditions between introverts and extroverts.

Table 4.69 Mean – Att/Med of Introverts Among All Music Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	Introverts – No Music	10	47.65	4.30	1.36
2	Introverts – HA 100%	10	42.09	3.35	1.06
3	Introverts – HA 175%	10	21.93	4.73	1.50
4	Introverts – HA 75%	10	54.24	3.99	1.26
5	Introverts – LA 100%	10	67.95	3.86	1.22
6	Introverts – LA 175%	10	44.17	8.99	2.84
7	Introverts – LA 75%	10	63.51	7.09	2.24
	Meditation				
1	Introverts – No Music	10	53.23	6.62	2.09
2	Introverts – HA 100%	10	42.70	5.90	1.87
3	Introverts – HA 175%	10	21.30	6.09	1.93
4	Introverts – HA 75%	10	47.40	7.20	2.28
5	Introverts – LA 100%	10	69.44	3.09	.98
6	Introverts – LA 175%	10	47.50	6.10	1.93
7	Introverts – LA 75%	10	68.29	5.79	1.83

Table 4.70 Mean – Att/Med of Extroverts Among All Music Conditions.

	Conditions	*N*	*M*	*SD*	*SE*
	Attention				
1	Extroverts – No Music	10	71.36	4.12	1.30
2	Extroverts – HA 100%	10	77.39	4.78	1.51
3	Extroverts – HA 175%	10	44.25	6.01	1.90
4	Extroverts – HA 75%	10	67.56	5.82	1.84
5	Extroverts – LA 100%	10	64.71	3.93	1.24
6	Extroverts – LA 175%	10	58.15	3.08	.97
7	Extroverts – LA 75%	10	60.99	6.05	1.91
	Meditation				
1	Extroverts – No Music	10	63.24	8.32	2.62
2	Extroverts – HA 100%	10	56.13	6.14	1.94
3	Extroverts – HA 175%	10	35.19	5.97	1.89
4	Extroverts – HA 75%	10	63.32	8.63	2.73
5	Extroverts – LA 100%	10	76.61	4.34	1.37
6	Extroverts – LA 175%	10	59.03	5.97	1.89
7	Extroverts – LA 75%	10	65.78	6.08	1.92

Table 4.71 Paired Samples t-Test – Att/Med between
Introverts and Extroverts Among All Music Conditions.

	Condition Pair (I – E)	*M*	*SD*	*SEM*	*t*	*df*	Sig.
	Attention						
1	No Music	-23.71	6.87	2.17	-10.91	9	< .001
2	HA 100%	-35.29	5.01	1.58	-22.27	9	< .001
3	HA 175%	-22.33	4.07	1.29	-17.34	9	< .001
4	HA 75%	-13.32	3.54	1.12	-11.90	9	< .001
5	LA 100%	3.25	5.44	1.72	1.89	9	.092
6	LA 175%	-13.98	11.09	3.51	-3.99	9	.003
7	LA 75%	2.52	10.06	3.18	.79	9	.449
	Meditation						
1	No Music	-10.01	9.76	3.09	-3.24	9	.010
2	HA 100%	-13.43	8.55	2.70	-4.97	9	.001
3	HA 175%	-13.89	8.68	2.75	-5.06	9	.001
4	HA 75%	-15.92	11.15	3.53	-4.52	9	.001
5	LA 100%	-7.17	5.62	1.78	-4.04	9	.003
6	LA 175%	-11.53	6.96	2.20	-5.24	9	.001
7	LA 75%	2.51	9.96	3.15	.80	9	.446

Based on Table 4.71, it is shown that the differences in attention levels between introverts and extroverts for no-music, all HA tempo conditions, but only LA 175% music condition are highly significant ($p < .001$, $p = .003$) ($p < .05$), whereas the difference in attention levels between introverts and extroverts during LA 100% (p = .092) and 75%

(p = .449) are insignificant (p > .05). The differences in meditation levels between introverts and extroverts for all music conditions are significant (p < .05), except for during LA 75% (p = .446) which is highly insignificant.

Moreover, based on the mean differences, M, of attention and meditation levels between introverts and extroverts as shown earlier in Table 4.71, it is shown that both the attention and meditation levels of extroverts are significantly higher than introverts during most of the conditions (all of the conditions with significant differences, p < .05), except for the differences in attention levels during LA 100% and 75% conditions and the difference in meditation levels during LA 75% condition in which the levels are only marginally (insignificantly, p > .05) higher than introverts.

4.4 Discussion – Answering Null Hypotheses and Research Questions

This section answers all six null hypotheses (see Section 1.8) and three research questions (see Section 1.7) of this study based on the data analysis in the previous section. This section is divided into two parts based on the two dependent variables of this study: gameplay risk-taking, which answers H01, H02, H03, RQ1, and RQ3(a); and gameplay EEG mental state, which answers H04, H05, H06, RQ2, and RQ3(b).

4.4.1 Answering Null Hypotheses Part 1 – Gameplay Risk-Taking

4.4.1.1 Answering Null Hypothesis H01

The first null hypothesis (H01) of this study stated that there will be no significant differences in gameplay risk-taking among the card game players among and between the music arousal [no-music, HA (100%), and LA (100%) music] conditions overall and among introverts and extroverts. Based on the ANOVA test results in Sections 4.1.3.2, 4.3.1.5, and 4.3.1.8, it was shown that the overall differences in risk ratio among music arousal levels were extremely significant (p < .001), including among introverts (p = .007) and extroverts (p = .001). Based on the paired samples t-test results between the music arousal level conditions, difference of overall risk ratio between each pairs of conditions were significant as well (p = .042, .033, and < .001). However, there was only significant differences in risk ratio between the HA and LA conditions when divided among introverts (p < .001) and extroverts (p = .001), but no significant differences (p >.05) were shown between no-music and HA, and between no-music and LA conditions among both introverts and extroverts. This shows that among the music arousal levels, there were significant differences in overall risk ratio among all conditions, but only significant differences in risk ratio between HA and LA when distributed among both introverts and extroverts, in which the no-music condition show no significant differences when compared between HA and LA music conditions.

Therefore, H01 can be rejected overall, but not fully rejected among introverts and extroverts. Thus, the alternative hypothesis (H1) can be partially accepted, whereby: -

H1: There were significant differences in gameplay risk-taking among the card game players among and between the music arousal level conditions overall, but there were only significant differences between HA and LA music conditions among introverts and extroverts.

4.4.1.2 Answering Null Hypothesis H02

The second null hypothesis (H02) stated that there will be no significant differences in gameplay risk-taking among the card game players between normal (100%), faster (175%), and slower (75%) tempi of both (a) HA and (b) LA music conditions overall and among introverts and extroverts. Based on the ANOVA test results in Sections 4.3.1.3, 4.3.1.6, and 4.3.1.9, it was shown that the differences in overall risk ratio among the HA tempo conditions were fairly significant (p = .02), however, when compared between conditions using paired samples t-test, the only insignificant difference between overall ratio was between during HA 100% and 75% music conditions (p = .781, > .05). Comparing between introverts and extroverts, the significance of differences of risk ratio among extroverts were similar to overall, in which the differences of risk ratio among the HA tempo conditions were significant (*p* = .042), but when compared between conditions, only the difference between HA 100% and 75% music conditions were insignificant (*p* = .741). The differences of risk ratio of introverts among and between the HA tempo conditions were greatly insignificant (*p* = .235, > .05).

For LA tempo conditions based on the ANOVA test results in Sections 4.1.3.4, 4.3.1.7, and 4.3.1.10, the difference in overall risk ratio among LA tempo conditions were greatly insignificant (*p* = .21, > .05), but when compared between conditions using paired samples t-test, the only significant difference in risk ratio was seen between during LA 100% and 75% music conditions (*p* = .027), which was the total opposite to among the HA tempo conditions. The differences in risk ratio were, however, insignificant (*p* > .05) among both introverts (*p* = .06) and extroverts (*p* = .670), both among and between the LA tempo conditions.

Therefore, H02 can only be partially rejected among HA tempo conditions overall and among extroverts, as the only insignificant difference in risk ratio was between HA 100% and 75% music conditions. However, H02 has to be fully accepted among introverts. Thus, the alternative hypothesis, H2(a), can be partially accepted, whereby: -

H2(a): There were significant differences in gameplay risk-taking among the card game players only between the normal (100%) and fastened (175%), and between the fastened (175%) and slowered (75%) tempo of the HA music, overall and only among extroverts.

For risk ratio among LA tempo conditions, the differences among and between all tempo conditions were all insignificant. Therefore, H02(b) has to be accepted, in which there were no significant differences in gameplay risk-taking among the card game players between all the three LA tempo conditions, both overall and among introverts and extroverts.

4.4.1.3 Answering Null Hypothesis H03

The third null hypothesis (H03) stated that there will be no significant differences in gameplay risk-taking among all music arousal level and tempo conditions between introverts and extroverts. Based on the comparisons of risk ratio between introverts and extroverts shown in Table 4.38 in Section 4.3.1.11, it was shown that all comparisons in risk ratio between introverts and extroverts were insignificant ($p > .05$), except for during LA 100% whereby the difference was only marginally significant ($p = .042$). Therefore, H03 has to be accepted, whereby there were generally no significant differences in gameplay risk-taking among the music conditions between introverts and extroverts.

4.4.2 Answering Null Hypotheses Part 2 – Gameplay EEG Mental State

4.4.2.1 Answering Null Hypothesis H04

The fourth hypothesis (H04) stated that there will be no significant differences in gameplay EEG mental state (attention and meditation levels) among the card game players between the music arousal level [no-music, HA (100%), and LA (100%) music] conditions overall and among introverts and extroverts. Based on the ANOVA test results in Sections 4.3.2.2, 4.3.2.5, and 4.3.2.8, it was shown that the overall differences in attention levels among the music arousal levels were highly insignificant ($p = .190$, $> .05$), but were extremely significant among both introverts ($p < .001$) and extroverts ($p < .001$). However, the insignificant differences of attention levels overall was actually caused by the wide gap of difference in attention levels among the music arousal level conditions, as shown below in Table 4.72.

Table 4.72 Difference in Attention Levels between Introverts and Extroverts among Music Arousal Level Conditions.

	Conditions	Attention Levels		Mean Difference
		Introverts	Extroverts	
	Attention			
1	No Music	47.65	71.36	-23.71
2	HA Music (100%)	42.09	77.39	-35.29
3	LA Music (100%)	67.95	64.71	3.25
	Average	**52.57**	**71.15**	

Based on Table 4.72, and previously on Tables 4.52, 4.53, 4.61, and 4.62, all comparisons between attention levels among introverts and extroverts using paired samples t-test were generally greatly significant ($p < .05$), and that the readings of overall attention levels consisted of both introverts and extroverts combined. This could be also due to the insignificant difference of attention levels between introverts and extroverts during LA 100% music condition ($p = .092$) as shown in Table 4.71 and 4.75, which may have affected the significance level overall.

All differences in meditation levels among and between all music arousal level conditions overall and among introverts and extroverts, however, were highly significant ($p < .05$). Therefore, H04 in terms of differences in attention levels can be rejected only among introverts and extroverts, but not overall, while it can be fully rejected for the differences in meditation levels. Thus, the alternative hypothesis (H4) can be partially accepted, whereby: -

H4: There were significant differences in attention levels among the card game players among and between the music arousal level conditions among introverts and extroverts but not overall; but there were significant differences in meditation levels overall and among introverts and extroverts among and between all music arousal level conditions.

4.4.2.2 Answering Null Hypothesis H05

The fifth hypothesis (H05) stated that there will be no significant differences in gameplay EEG mental state (attention and meditation levels) among the card game players between normal (100%), faster (175%), and slower (75%) tempi of both (a) HA and (b) LA music conditions overall and among introverts and extroverts. Based on the ANOVA test results in Sections 4.3.2.3, 4.3.2.6, and 4.3.2.9, it was shown that all differences of both attention and meditation levels overall and among introverts and extroverts among the HA music tempo conditions were extremely significant ($p < .001$).

However, when comparing the attention and meditation levels between each HA music tempo condition, it was shown that there was an insignificant difference in attention levels overall between HA 100% and 75% tempo conditions (p = .703, > .05), and that there were insignificant differences in meditation levels also between HA 100% and 75% tempo conditions among both introverts (p = .144, > .05) and extroverts (p = .079, > .05).

It was noted that all insignificant differences in attention and meditation levels only occurred between 100% and 75% tempi. Therefore, H05 can be generally rejected, however, have to be accepted when compared between HA 100% and 75% tempo conditions. Thus, the alternative hypothesis (H5) can be partially accepted, whereby: -

H5: There were significant differences in both attention and meditation levels among and between the HA tempo conditions (except between HA 100% and 75%) overall and among introverts and extroverts.

4.4.2.3 Answering Null Hypothesis H06

The sixth hypothesis (H06) stated that there will be no significant differences in gameplay EEG mental state (attention and meditation levels) among all music arousal levels and tempo manipulation conditions between introverts and extroverts. Based on the comparisons of risk ratio between introverts and extroverts shown in Table 4.71 in Section 4.3.2.11, it was shown that the differences were generally significant between introverts and extroverts (p < .05), except during LA 100% (p = .092) and 75% (p = .449) music conditions for attention levels and during LA 75% (p = .446) music condition for meditation levels whereby the differences were insignificant.

The insignificant differences in attention and meditation levels were only seen during LA music conditions. Therefore, H06 can be rejected but only among no-music and HA music arousal level conditions, and only among HA tempo conditions. However, H06 has to be accepted among and between LA music tempo conditions. Thus, the alternative hypothesis (H6) can be partially accepted, whereby: -

H6: There were significant differences in both attention and meditation levels between introverts and extroverts during no-music, HA music and among the HA tempo conditions, but there were no significant differences during LA music and among the LA tempo conditions.

4.4.3 Answering Research Questions

4.4.3.1 Answering Research Question RQ1

The first research question (RQ1) questioned on how different arousal levels and tempo manipulations of music affect gameplay risk-taking, overall and among introverts and extroverts. The difference in overall risk ratio among and between the music arousal level conditions were significant. As analyzed in Section 4.3.1.2, the overall risk ratio was highest during the HA music condition, followed by the no-music condition, and then the LA music condition which was the lowest. This shows that overall gameplay risk-taking was the highest during the LA music condition, followed by the no-music condition, and that gameplay risk-taking was the lowest during HA music condition.

Moreover, in terms of comparing bet amounts against the winning probabilities, Table 4.73 below shows the average bet amount against the remaining money on hand (bet %), bet range available between the first two cards, *z* (between 1 – 11), winning probabilities [*P*(*A*)], and the overall risk ratio for each music arousal level condition.

Table 4.73 Overall %, z, P(A), and Risk Ratio among Music Arousal Level Conditions.

	Condition	Bet %	*z*	*P*(*A*)	Overall Risk Ratio
1	No Music	19.14%	6.70	.5153	3.95
2	HA (100%)	12.27%	7.09	.5455	5.85
3	LA (100%)	49.99%	6.56	.5045	2.46

Based on Table 4.73, it is shown the game players overall bet 12.27% of their remaining money on hand against a winning probability of 54.55% during the HA (100%) music condition ($M = 5.85$), while the game players overall bet 49.99% of their remaining money on hand against a winning probability of 50.45% during the LA (100%) music condition ($M = 2.46$). The overall risk taken during the LA music condition was a staggering 237.80% greater than the overall risk taken during the HA music condition. The results were also consistent when analyzed among introverts and extroverts, whereby the risk taken during LA music condition was the highest. Table 4.74 below shows the comparisons among introverts and extroverts respectively.

Table 4.74 %, z, P(A), and Risk Ratio of Introverts and Extroverts among Music Arousal Level Conditions.

	Condition	Bet %	*z*	*P*(*A*)	Overall Risk Ratio
	Introverts				
1	No Music	19.78%	6.24	.4800	3.58
2	HA (100%)	13.60%	6.83	.5529	5.05
3	LA (100%)	42.31%	5.62	.4321	1.83
	Extroverts				
1	No Music	18.51%	7.17	.5506	4.31
2	HA (100%)	10.94%	7.35	.5657	6.66
3	LA (100%)	57.69%	7.50	.5769	3.08

Based on the results, in terms of music arousal level comparisons, it can be concluded that a lower-arousing stimuli condition can prompt greater risk-taking than a higher-arousing stimuli condition. In comparison with previous literature, the results are in accordance with the most recent study reviewed in the current study which stated that slower tempo and LA music induces greater risk-taking, as compared to faster tempo and HA music, as well as during no-music conditions (Israel et al., 2019). Similarly, the current study also agrees with Mentzoni et al. (2014) in which slower jazz music induces greater risk-taking than faster pop music; also including being in-line with the findings of Rinato (2014) in which mid-tempo classical music caused greater risk-taking than fast rock music. As Cockerton et al. (1997) stated that music improves task performance in comparison to silence, the current study can partially agree with this study, as risk-taking was consistently lower during HA music conditions than no-music conditions. These relations were only based on normal tempo music arousal level comparisons without any tempo manipulations involved, in which in the current study, the HA music were averagely 57 BPM (or 174%) faster than the LA music (M = 57, SD = 8.173). In terms of tempo manipulations, Tables 4.75 to 4.78 show the risk ratio comparisons overall and among introverts and extroverts for HA and LA music respectively.

Table 4.75 Overall %, z, P(A), and Risk Ratio among HA Music Tempo Conditions.

	Condition	Bet %	*z*	*P*(*A*)	Overall Risk Ratio
1	HA 100%	12.27%	7.09	.5455	5.85
2	HA 175%	26.53%	6.66	.5122	3.84
3	HA 75%	11.44%	6.39	.4914	6.05

Table 4.76 %, z, P(A), and Risk Ratio of Introverts and Extroverts among HA Music Tempo Conditions.

	Condition	Bet %	*z*	*P*(*A*)	Overall Risk Ratio
	Introverts				
1	HA 100%	13.60%	6.83	.5529	5.05
2	HA 175%	24.30%	5.67	.4359	3.29
3	HA 75%	11.77%	5.63	.4330	5.68
	Extroverts				
1	HA 100%	10.94%	7.35	.5657	6.66
2	HA 175%	28.77%	7.65	.5885	4.39
3	HA 75%	11.10%	7.15	.5497	6.05

Table 4.77 Overall %, z, P(A), and Risk Ratio among LA Music Tempo Conditions.

	Condition	Bet %	*z*	*P*(*A*)	Overall Risk Ratio
1	LA 100%	49.99%	6.56	.5045	2.46
2	LA 175%	25.40%	6.44	.4952	3.62
3	LA 75%	18.78%	6.22	.4784	4.05

Table 4.78 %, z, P(A), and Risk Ratio of Introverts and Extroverts among LA Music Tempo Conditions.

	Condition	Bet %	*z*	*P*(*A*)	Overall Risk Ratio
	Introverts				
1	LA 100%	42.31%	5.62	.4321	1.83
2	LA 175%	28.77%	6.83	.5256	2.80
3	LA 75%	15.64%	5.04	.3878	3.88
	Extroverts				
1	LA 100%	57.69%	7.50	.5769	3.08
2	LA 175%	22.04%	6.04	.4648	4.45
3	LA 75%	21.91%	7.40	.5689	4.23

In terms of favourability of betting situations as shown in Table 3.4, both introverts and extroverts averagely placed bets on a gap of $z < 8$ in all conditions, showing a moderately-high amount of risk taken (Rob, 2013). From the tables above, despite having several insignificant differences ($p > .05$), a consistency was seen whereby the lowest risk ratio among the HA music tempo conditions was during HA 175% overall and among both introverts and extroverts; while the lowest risk ratio among the LA music tempo conditions was during LA 100%. Moreover, the percentage of bet amount from the remaining money on hand was also the greatest during HA 175% and LA 100% among the HA and LA music tempo conditions, overall and among introverts and extroverts.

For the HA 175% condition, there is a high chance in which the overly-fast and overly-arousing music could have caused a massive distraction to the performance of the game players, in which as shown earlier in the optimal arousal hypothesis in Figure 1.2, an arousal stimulus which is too high shall impair the task performance of individuals due to anxiety overload (Salamé & Baddeley, 1982; Hallam et al., 2002; Diamond et al., 2007). This finding, however, agrees to the conclusion of Foo (2011) (which manipulated Mozart's "Turkish March" to faster and slower tempi) in which faster tempo increases the arousal level of subjects, and in turn induces greater risky behaviours. This opposes to Bramley et al. (2016) which stated that music tempo does not affect risk-taking.

Foo (2011) also found that there were no significant differences in risk during lower-arousal conditions, which were the slowered tempo and no-music conditions. Similarly, the results of this study agrees with Foo (2011) that generally there were no significant differences (p > .05) in risk-taking found overall (p = .210) and among both introverts (p = .06) and extroverts (p = .670). However, a valid explanation could not be found as to why risk-taking was consistently the highest during LA 100% when compared among the LA music tempo conditions overall and among both introverts and extroverts. A theory can be made from here whereby comfort level or preference of the game players towards the music stimuli could have affected risk-taking (Lynar et al., 2017), in which the greater the comfortability of the game players towards the music, the greater the extent of risk-taking. This was noted from Clark (2010), which stated that there may be other external influencing factors which indirectly affect task performance, in which one of the predicted influencing factors was comfort level. This theory is projected as according to the gameplay EEG mental state results, both the attention and meditation levels were highest during the LA 100% condition when compared among the LA music tempo conditions, overall and among both introverts and extroverts. The induced attentiveness and relaxation among the game players may have a correlation with the extent of risk-taking, in which further research can be done to validate this theory.

4.4.3.2 Answering Research Question RQ2

The second research question (RQ2) questioned on how do different arousal levels and tempi manipulations of music affect gameplay EEG mental state, overall and among introverts and extroverts. In terms of attention and meditation levels among the music arousal level conditions, only the difference in attention levels was insignificant overall (p = .247), in which as mentioned, was due to the extremely significant difference when compared among introverts and extroverts for all three music conditions (both $p < .001$). All differences in meditation levels were significant overall and among both introverts and extroverts. Table 4.79 below shows the attention and meditation levels among the music arousal level conditions, overall and among introverts and extroverts.

Table 4.79 Overall Att/Med and among Introverts and Extroverts among Music Arousal Level Conditions.

	Condition	Attention	Meditation
	Overall		
1	No Music	59.51	58.24
2	HA (100%)	59.74	49.41
3	LA (100%)	66.33	73.03
	Introverts		
1	No Music	47.65	53.23
2	HA (100%)	42.09	42.70
3	LA (100%)	67.95	69.44
	Extroverts		
1	No Music	71.36	63.24
2	HA (100%)	77.39	56.13
3	LA (100%)	64.71	76.61

Based on Table 4.79, the overall attention levels were highest during LA music condition. The comparisons of attention levels were rather inconsistent when split amongst introverts and extroverts, as the attention levels of introverts were highest during LA music condition, but the attention levels of extroverts were highest during HA music condition. This only partially agrees with Teixeira et al. (2018) which stated that HA stimuli detriments attention levels, while LA stimuli regains attention levels, as this statement was on the contrary when compared among extroverts in which attention levels were highest during the HA music condition.

However, the meditation levels among all music arousal level conditions were consistent, in which the highest readings were during LA music condition overall and among both introverts and extroverts, followed by during no-music condition, and then during HA music condition in which the lowest readings were found. This shows that overall, the LA music condition induces the greatest attentiveness and mental calmness among the game players, similarly among introverts but not for extroverts. Consequently, in reference to the optimal arousal hypothesis (Yerkes & Dodson, 1908; Diamond et al., 2007), the LA music condition provides optimal arousal stimuli overall and only among introverts, which puts the game players in an optimal arousal level, and hence, induce high attention and meditation levels. Moreover, findings of the current study also emphasize on the questioning on whether fast-paced highly-arousing music is still the most suitable background music for all gaming purposes (Levy, 2015; Shepard, 2017).

In terms of tempo manipulations, Tables 4.80 to 4.83 show the attention and meditation level comparisons overall and among introverts and extroverts for HA and LA music respectively.

Table 4.80 Overall Att/Med among HA Music Tempo Conditions.

	Condition	Attention	Meditation
1	HA 100%	59.74	49.41
2	HA 175%	33.09	28.25
3	HA 75%	60.90	55.36

Table 4.81 Att/Med of Introverts and Extroverts among HA Music Tempo Conditions.

	Condition	Attention	Meditation
	Introverts		
1	HA 100%	42.09	42.70
2	HA 175%	21.93	21.30
3	HA 75%	54.24	47.40
	Extroverts		
1	HA 100%	77.39	56.13
2	HA 175%	67.56	35.19
3	HA 75%	44.25	63.32

Table 4.82 Overall Att/Med among LA Music Tempo Conditions.

	Condition	Attention	Meditation
1	LA 100%	66.33	73.03
2	LA 175%	51.16	53.26
3	LA 75%	62.25	67.04

Table 4.83 Att/Med of Introverts and Extroverts among the LA Music Tempo Conditions.

	Condition	Attention	Meditation
	Introverts		
1	LA 100%	67.95	69.44
2	LA 175%	44.17	47.50
3	LA 75%	63.51	68.29
	Extroverts		
1	LA 100%	64.71	76.61
2	LA 175%	58.15	59.03
3	LA 75%	60.99	65.78

The one-way ANOVA tests showed that the differences in attention and meditation levels among the HA and LA music tempo conditions overall and among both introverts and extroverts were extremely significant ($p < .001$), except the attention levels among extroverts during the LA music tempo conditions, which was still highly significant ($p = .012$). Through paired samples t-tests, it was seen that almost all insignificant differences ($p > .05$) in readings occurred between 100% and 75% tempo conditions. It can be concluded that it was due to the small contrast in tempo manipulation (25% difference) which caused the differences to not be significant, as pointed out by Bramley et al. (2016).

Among the HA music tempo conditions, the attention and meditation levels during the HA 175% music tempo condition were consistently the lowest overall and among both introverts and extroverts. The paired samples t-test showed that all differences in attention and meditation levels during the HA 175% as compared to 100% and 75% were extremely significant ($p < .001$). Similar to gameplay risk-taking, in reference to the optimal arousal hypothesis, the overly-fast tempo of HA 175% caused a major distraction to all game players of both introverts and extroverts, which overwhelmed the game players and hence caused strong anxiety and lose focus, as shown in the significantly low readings of attention and meditation levels.

Among the LA music tempo conditions, the attention and meditation levels during the LA 100% music tempo condition were consistently the highest, and the attention and meditation levels during the LA 175% music tempo condition were consistently the lowest overall and among both introverts and extroverts. The differences in attention and meditation levels between LA 100% and LA 175% were generally extremely significant overall and among introverts ($p < .001$), and being highly significant among extroverts ($p = .002$). Moreover, the insignificant differences in attention and meditation levels were mostly seen between LA 100% and LA 75% music tempo conditions ($p > .05$). This opposes to the findings of Bramley et al. (2016) in which music tempo does not show any psychophysiological effects, despite stating that a wider tempo contrast is required, as the LA music tempo manipulations were not as contrasting as the HA music but had yielded consistent findings as well, in which music tempo indeed had significant effects on arousal. However, the current study agrees to Bramley et al. (2016) that small tempo manipulation contrasts does not show any psychophysiological effects, as shown by the insignificant differences between during LA 100% and LA 75%. Therefore, in reference to the optimal arousal hypothesis, it can be said that the LA 100% music had created an optimally-stimulating environment overall (HA 100% for extroverts), which matched to the optimal arousal levels of the game players which then maximized their mental performance.

4.4.3.3 Answering Research Question RQ3

The third research question (RQ3) questioned on whether will there be any significant differences in the findings of (a) gameplay risk-taking, and (b) gameplay EEG mental state, between introverts and extroverts during the card game among all of the music conditions. The differences in risk ratio, and attention and meditation levels are shown below in Tables 4.84 and 4.85 respectively.

Table 4.84 Difference in Risk Ratio between Introverts and Extroverts Among All Music Conditions.

	Condition Pair (I – E)	Risk Ratio		Difference	Sig.
		Introverts	Extroverts		
1	No Music	3.58	4.31	-.74	.519
2	HA 100%	5.05	6.66	-1.61	.196
3	HA 175%	3.29	4.39	-1.10	.320
4	HA 75%	5.68	6.43	-.76	.712
5	LA 100%	1.83	3.08	-1.25	.046
6	LA 175%	2.80	4.45	-1.64	.410
7	LA 75%	3.88	3.99	-.12	.927

Table 4.85 Difference in Att/Med between Introverts and Extroverts Among All Music Conditions.

	Condition Pair (I – E)	Introverts	Extroverts	Difference	Sig.
	Attention				
1	No Music	47.65	71.36	-23.71	< .001
2	HA 100%	42.09	77.39	-35.29	< .001
3	HA 175%	21.93	44.25	-22.33	< .001
4	HA 75%	54.24	67.56	-13.32	< .001
5	LA 100%	67.95	64.71	3.25	.092
6	LA 175%	44.17	58.15	-13.98	.003
7	LA 75%	63.51	60.99	2.52	.449
	Meditation				
1	No Music	53.23	63.24	-10.01	.010
2	HA 100%	42.70	56.13	-13.43	.001
3	HA 175%	21.30	35.19	-13.89	.001
4	HA 75%	47.40	63.32	-15.92	.001
5	LA 100%	69.44	76.61	-7.17	.003
6	LA 175%	47.50	59.03	-11.53	.001
7	LA 75%	68.29	65.78	2.51	.446

Based on Table 4.84, in terms of gameplay risk-taking, the differences in risk ratio were insignificant (p > .05) between introverts and extroverts (except during LA 100%), hence having the third null hypothesis (H03) accepted. However, it was seen that all risk ratio of extroverts in all music arousal and tempo conditions are marginally (or insignificantly) higher than introverts. Thus, this shows that introverts had taken marginally higher risks than extroverts.

Based on Table 4.85, in terms of gameplay EEG mental state, it is shown that the condition with the highest attention level for introverts is during the LA 100% condition (M = 67.95), while the condition with the highest attention level for extroverts is during the HA 100% condition (M = 77.39). In reference to the optimal arousal hypothesis between introverts and extroverts as shown in Figure 1.3, introverts generally have an optimal arousal level lower than extroverts. Findings of this study is in-line with the optimal arousal hypothesis, whereby the attention levels of introverts were highest during LA music conditions, while the attention levels of extroverts were highest during HA music conditions, in which the HA music stimulated greater arousal than the LA music.

For meditation levels, it is shown that the meditation levels for both introverts and extroverts were highest during LA 100% music condition, with the meditation levels of extroverts (M = 76.61) being significantly higher (p = .003) than introverts (M = 69.44). This can be referred to the theory in which greater comfortability of the game players towards the music as discussed in Section 4.4.3.1 may improve attention and meditation levels. However, for both introverts and extroverts, the condition with the lowest readings of attention and meditation levels were during the HA 175% condition, with the attention levels of introverts during this condition (M = 21.93) being much lower ($p < .001$) than extroverts (M = 44.25). Similarly, the meditation levels of introverts during this condition (M = 21,30) being much lower (p = .001) than extroverts (M = 35.19). As mentioned, the overly-arousing music condition could have impaired their mental performances. In comparison between introverts and extroverts, the disruptive effects of the HA 175% music condition were much more detrimental towards introverts than extroverts. As the optimal arousal level for introverts is generally lower than extroverts, the over-arousal threshold point for introverts will also be lower than extroverts, hence both the attention and meditation levels of extroverts being not as severely deteriorated as introverts during the HA 175% music tempo condition.

Findings of the current study agrees to the study of Furnham and Allass (1999) which stated that extroverts show better task performance in more mentally-stimulating fast-tempo upbeat music environments than introverts, who prefer less stimulating slower tempo music. Cassidy and MacDonald (2007) found in their study that introverts perform better than extroverts in most tasks, but will be detrimentally affected by highly-arousing stimuli conditions, and that HA music over-arouses introverts which results in distraction and poorer mental and task performance. The current study only agrees to their statement in which highly-arousing stimuli conditions will detriment mental and task performance of introverts, in which the attention and meditation levels were mostly the lowest during HA music and its various tempo manipulation conditions. However, the current study rejects the statement whereby introverts will generally perform better than extroverts during lowly-arousing and silence conditions, as seen from the results of the current study, the risk ratio of introverts were generally lower than extroverts (in which the risk taken by introverts were greater than extroverts), and that the attention and meditation levels of introverts were all lower, if not marginally higher, than extroverts as well.

Mistry (2015) found that extroverts performed better with music than silence, and the vice versa for introverts. This statement is opposed based on the findings of the current study, in which the risk ratio, attention and meditation levels of extroverts were higher than introverts during no-music conditions. In extension, the current study strongly agrees with Cockerton et al. (1997), which stated that music improves task performance than silence overall, however, in condition whereby the music stimulus has to be optimally-arousing according to the listeners' optimal arousal levels to see significant effects.

CHAPTER 5

CONCLUSION

5.1 Overview

This chapter serves as a conclusion to the current study, which studied on the effects of manipulating music arousal level and tempo on card game players' risk-taking and EEG mental state in terms of attention and meditation levels among introverts and extroverts. This study had involved the participation of 20 male participants (10 introverts and 10 extroverts) aged between 18 to 29, and the task for the experiment of this study was to play a card game called *In-Between*, which involves betting money and risk-taking. As a quantitative study, this study obtained findings through two aspects: (1) gameplay risk-taking, in which the results were based on calculations of risk ratio of the participants during the game; and (2) gameplay EEG mental state, in which the results were based on the attention and meditation levels of the participants as obtained from the NeuroSky® MindWave™ Mobile EEG device.

5.2 Summary of Findings

5.2.1 Summary Part 1 – Gameplay Risk-Taking

There were two research objectives, three research questions, and six null hypotheses in this study. Gameplay risk-taking included RO1, RQ1, RQ3(a), H01, H02, and H03, which questioned on how the manipulation of music arousal level and tempo affect risk-taking overall and among introverts and extroverts, and whether will there be any significant differences among and between the conditions. In terms of gameplay risk-taking among the manipulated music arousal level conditions, H01 was rejected and the alternative hypothesis (H1) was partially accepted, in which there were significant differences in gameplay risk-taking overall, but only between HA and LA music conditions when compared among introverts and extroverts. In terms of gameplay risk-taking among the manipulated tempo conditions, H02 was rejected and the alternative hypothesis (H2) was partially accepted, in which were significant differences in gameplay risk-taking among the card game players only between the normal (100%) and fastened (175%), and between the fastened (175%) and slowered (75%) tempo of the HA music, overall and only among extroverts. In terms of gameplay risk-taking compared between introverts and extroverts, H03 was accepted and the alternative hypothesis (H3) was rejected, in which there were generally no significant differences in gameplay risk-taking among the music conditions between introverts and extroverts.

In terms of how different arousal levels of music affect gameplay risk-taking, overall and among introverts and extroverts, it was found that the overall risk taken was greatest during the LA music condition, followed by no-music condition, and lowest during HA music condition. Thus, findings of this study were in-line with previous studies which stated that slower tempo lower-arousal music stimuli resulted in greater risk-taking than faster tempo higher-arousal music stimuli (Mentzoni et al., 2014; Rinato, 2014; Israel et al. 2019). Comparing specifically among the HA and LA tempo conditions, findings showed that the risk taken overall and among introverts and extroverts were highest during the HA 175% condition among the HA music tempo conditions, and highest during the LA 100% condition among the LA music tempo conditions. This could have been caused by over-arousal from the HA 175% music condition which significantly impaired task performance (Diamond et al., 2007), and predicted that it may have been caused by high comfortability level of the game players towards the music during the LA 100% music condition (Clark, 2010).

Comparing between introverts and extroverts, all differences in risk ratio between introverts and extroverts were not significant ($p > .05$), except for during the LA 100% condition ($p = .046$). The greatest risks for both introverts and extroverts also occurred during the LA 100% condition. However, despite the insignificant differences, the risk taken by introverts were marginally higher than extroverts.

5.2.2 Summary Part 2 – Gameplay EEG Mental State

Gameplay EEG mental state included RO2, RQ2, RQ3(b), H04, H05, and H06, which questioned on how the manipulation of music arousal level and tempo affect gameplay EEG mental state in terms of attention and meditation levels overall and among introverts and extroverts, and whether will there be any significant differences among and between the conditions. H04 was only partially rejected for attention levels but fully rejected for meditation levels, in which the alternative hypothesis (H4) was that there were significant differences in attention levels among the card game players among and between the music arousal level conditions among introverts and extroverts but not overall; but there were significant differences in meditation levels overall and among introverts and extroverts among and between all music arousal level conditions. H05 was partially rejected and the alternative hypothesis (H5) was partially accepted, whereby there were significant differences in both attention and meditation levels among and between the HA tempo conditions (except between HA 100% and 75%) overall and among introverts and extroverts. H06 was rejected and the alternative hypothesis (H6) was partially accepted, whereby there were significant differences in both attention and meditation levels between introverts and extroverts during no-music, HA music and among the HA music tempo conditions, except during LA music and among the LA music tempo conditions.

In terms of how different arousal levels of music affect gameplay EEG mental state, overall and among introverts and extroverts, the condition in which the attention and meditation levels were the highest overall and among introverts during the LA 100% condition (in which the game players were most attentive and mentally calm during this condition), but highest during HA 100% condition for extroverts; whereas the attention and meditation levels were the lowest overall during the HA 175% condition (in which the game players were least attentive and mentally calm, or most distracted, during this condition). This shows that the game players were most comfortable with the LA 100% music condition, in which the condition matched to the optimal arousal levels of the game players; whereas being most distracted by the HA 175% music condition, in which the music overly-aroused the game players and thus distracted them mentally and impaired task performance, in reference to the optimal arousal hypothesis (Yerkes & Dodson, 1908; Diamond et al., 2007).

Comparing among the tempo manipulations of HA and LA music, it was shown that most insignificant differences were between 100% and 75% tempo conditions, particularly among the LA music, while significant difference were generally noticed when compared between 100% and 175%, and 175% and 75% tempo conditions. The insignificant difference between 100% and 75% tempo conditions was most likely due to the small tempo contrast (25% difference) which show little to no significant psycho-physiological effects (Bramley et al., 2016). Moreover, the contrast of attention and meditation levels among the tempo manipulations of LA music were not as wide as HA music, in which greater tempo difference can show greater psychophysiological effects among individuals.

Comparing between introverts and extroverts, as mentioned, the condition with the highest levels of attention and meditation for introverts were during LA 100% condition, but the highest levels of attention and meditation for extroverts were during HA 100% condition. On the contrary, the condition with the lowest levels of attention and meditation for both introverts and extroverts were during HA 175% condition. Findings of the current study revealed to be in accordance with the optimal arousal hypothesis (Diamond et al., 2007), in which the optimal arousal level of extroverts is generally higher than the optimal arousal level of introverts, and that an arousal stimulus that is too high (HA 175%) will impair mental state and task performance, and this effect will be much more significant among introverts as compared to extroverts.

5.3 Implications of Study

Prior to the commencement of the current study, it was noted previous literature that a greater contrast in music tempo was needed in order to see its psychophysiological effects, and that the manipulation of only one characteristic of music (most commonly music tempo) is insufficient to prove how music affects listeners psychophysiologically (Bramley et al., 2016). Thus, the current study included a second manipulation of music, which was the arousal level of music (HA and LA music). With two arousal level manipulations (and a no-music condition) and a wider tempo manipulation contrast as compared to previous studies, the current study found various significant contrasts in gameplay risk-taking and EEG mental state among the music arousal level and tempo conditions, overall and among introverts and extroverts.

The current study placed basis on the Hebbian version of the Yerkes-Dodson law or the optimal arousal hypothesis (see Figure 1.2), and findings were shown to be in-line with the law, in which task performance was best when the individual is at an optimal arousal level, as under-arousal caused inertness while over-arousal caused strong anxiety, both which had detrimented task performance. Findings of the current study also proved that the optimal arousal level of extroverts are generally higher than introverts (see Figure 1.3), in which task performance of extroverts will be better during optimally higher-arousal stimuli conditions, while task performance of introverts will be better during optimally lower-arousal stimuli conditions (Mistry, 2015).

Thus, the current study serves as an evidence to vouch for the validity of the optimal arousal hypothesis. Henceforth, the current study questions on the convention in which fast tempo and upbeat music being the most suitable background music condition during gameplay activities, in which in the current study, the overall attention and meditation levels among both introverts and extroverts were highest during the LA music condition (Levy, 2015; Shepard, 2017). However, despite the attention and meditation levels were highest, the risk taken were also the highest during the LA music condition. Findings of the current study may serve as a reference to game developers and gameplay event production teams not only to provide the most optimal background music to bring out the best performances of game players, but also able to enhance brand reputation and influence of the game developers and the coordinating teams, creating a positive win-win situation for both parties.

5.4 Further Research Recommendations

This is s a study in the field of music psychology which examined the effects of music arousal level and tempo on card game players' risk-taking and EEG mental state among introverts and extroverts. The current study is one of the first attempts in Malaysia to incorporate the aspects of gameplay, risk-taking, and EEG with music altogether through a quantitative approach. Thus, the current study has created a new area of study in the field of music psychology.

Therefore, there is still an enormous amount of ample space for further research, as research in this particular area is currently still at an infancy stage. Henceforth, there is ample room for creativity in terms of experimental task choice in this area apart from playing *In-Between*, for example, other party card games such as *Blackjack*, *Big Two*, or *Texas Hold'em* poker, board games such as *Monopoly*® or *Rich Dad CASHFLOW*® *101*, sports, purchasing behaviour, investing, or any other tasks which involves risk-taking. Further research can be done by duplicating the study in the form of risk-taking and EEG mental state as the dependent variables and having music stimuli as the independent variable, while the experimental task choice is subjected to the researchers' discretion and creativity. In addition, future research may also be carried out in observance to the original Yerkes-Dodson law (see Figure 1.1) whereby task difficulty is also manipulated, in which simple tasks maximizes attention while overly-difficult task impairs attention and decision-making (Yerkes & Dodson, 1908; Diamond et al., 2007).

Moreover, two characteristics of music for the current study was manipulated, which were arousal level (no-music, HA, and LA) and tempo (100%, 175% and 75%). Other than music arousal level and tempo, the other aspects of music remain controlled in the current study, which were time signature in 4/4, presence of lyrics, language of lyrics in English, positive emotional context, and music volume; while some aspects were not concerned in the current study, such as music familiarity, preference, and lyrical vs instrumental music. Thus, further research can be done by also duplicating the current nature of study, but having the manipulation of music stimuli subjected to the researchers' discretion, however, with at least two musical aspects being manipulated (Bramley et al., 2016). Researchers whom are interested in further expanding this research may also delve deeper into incorporating the manipulation of specific musical characteristics, such as tonality (major/minor, or tonal/atonal), timbre, simple and complex harmonic and melodic progressions, reharmonization, inclusion or exclusion of specific musical instruments, genres, tuning frequency (Hz), regular and irregular time signatures, regular and irregular rhythmic patterns, but also with a minimum requirement of at least two musical characteristics being manipulated. Being a delimitation of this study, future research may also compare and contrast between the psychophysiological effects of lyrical and instrumental music.

The current study only tested on male participants aged between 18 to 29, between introverts and extroverts. In terms of gender, this was due to the factor of gender which can externally influence risk-taking and mental state (Zhang & Fu, 2015). Hence, further research can also be done among female participants, or can be compared between males and females. In terms of age group, further research can be carried out in various age groups such as among students, working adults, senior citizens, or compared between two of the mentioned age groups. Other recommended demographic factors include ethnicity, culture, occupation, education level, income level, mentality/mindset, marital status, and

IQ/EQ levels. In addition, this study may also be compared between individuals with or without musical knowledge or background.

Moreover, the current study only utilized a quantitative approach for both gameplay risk-taking and EEG mental state. The current study measured gameplay risk-taking based on calculations of risk ratio, whereas gameplay EEG mental state is measured based on attention and meditation levels by having the game players put on the NeuroSky® MindWave™ Mobile. As this was one of the only available EEG instrument for use in the region, future research can also compare and contrast readings using different EEG instruments. Furthermore, one of the limitations of this study was that due to space constraints and to avoid data over-complexity, qualitative methods were not utilized in the current study, unlike many of the previous similar studies which obtained their data through qualitative approaches. However, the current study contributed as a quantitative evidence to the field of music psychology on the effects of music on human psycho-physiology, which opens as a fresh fundamental groundwork in welcoming future research to measure and compare human behaviour and decision-making through numerical data. Future research may expand the current study with the inclusion of qualitative methods in order to strengthen the validity of the quantitative data (Atieno, 2009; Rahman, 2016; Almeida et al., 2017), for examples, detailed transcriptions through video-recording observations, survey questionnaire, and mostly importantly conducting semi-structured interviews with the game players to better understand how the game players felt about the music stimuli and how the music stimuli affected them mentally and emotionally.

On a final note, this study was carried out using play money and not real currency, and this may have indirectly affected risk-taking in which no real currency was involved whereby the game players may not feel as much anxiety and burden as compared to using real currency (the players compete for a prize gift instead for this study). Despite the usage of real currency being able to fetch more accurate findings, this study had to forgo this move in order to not cause major risks and financial burdens to the participants, which may breach ethical research codes. However, the possibility of duplicating this research but by using real currency instead in the future is greatly anticipated.

5.5 Conclusion

In summary, the current study experimented on the manipulation of music arousal level and tempo conditions, and thus then effect of both variables can generally affect gameplay risk-taking and EEG mental state among introverts and extroverts significantly while playing a card game which involves betting and risk-taking. Findings of the current study also vouches for the validity of the optimal arousal hypothesis, which shows that the task performance of individuals will be at best when the individuals are optimally-aroused by an optimally-arousing stimulus, and that the optimal arousal level for extroverts are generally higher than introverts and vice versa.

Overall, the current study serves as a contribution to the relevant knowledge body by filling in the gaps concerning the usage of adequate contrast in music tempo in finding out the effects of music towards humans psychophysiologically, and also choosing the most suitable background music for all individuals in all situations in order to maximize effectiveness in terms of mental and task performance. However, as a disclaimer, findings of the current study is based from a laboratory experiment and does not stereotypically represent the entire population, in which more future research is needed to support the current study by duplicating similar research but in other various tasks and demographics. Ultimately, it is hoped that findings of the current study are able to significantly benefit industries and opportunities in various areas pertaining to music psychology.

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