

3.0 REVIEW OF SCIENTIFIC LITERATURE

The multi-dimensional effects of music have been documented through the ages. However, objective measures that could measure or track these amazing changes that music brings about are needed and current research is actively exploring and contributing to fill this lacunae. The effects of music on the human brain has been studied vastly, employing various functional neuroimaging modalities (Blood & Zatorre, 2001; Brattico et al., 2011; Brattico & Jacobsen, 2009; Koelsch, 2014; Koelsch et al., 2006; Menon & Levitin, 2005; Salimpoor et al., 2011). Music listening, performance and composition engages nearly every area of the brain that we have so far identified, and involves nearly every neural subsystem (Levitin, 2006). This implicates the potential of music as therapy and in rehabilitation of various ailments and traumatic conditions (Bunt & Hoskyns, 2013; Gilbertson & Aldridge, 2008; Sihvonen et al., 2017; Thaut & Hoemberg, 2014). In rehabilitating individuals suffering from various disorders of consciousness, terminally ill conditions, Post-Traumatic Stress Disorder (PTSD), stroke rehabilitation, dementing disorders, etc., individualized music therapy is key, as music listening and internalization is a subjective phenomenon and this is one of the key approaches followed in music therapy (Bunt & Hoskyns, 2013; Wheeler, 2015; Wheeler et al., 2005; Wigram et al., 2002). Clients' personalized musical assessments are made using standard assessments such as the Individualized Music Therapy Assessment Profile (IMTAP) (Baxter et al., 2007), following which music tailor-made to the individual's music preferences are administered. However, to our knowledge, there does not exist a measure that can quantify an individual's extent or depth of internalization to a given piece of music and also appraise the nature and intensity of his subjective experience, while he listened to it. This motivated us to develop the construct, Music Receptivity. Related studies focuses mostly on the trait aspect of music listening (T. C. Chin et al., 2018; T. Chin & Rickard, 2012; Law & Zentner, 2012; Müllensiefen et al., 2014; Nagy & Szabó, 2004; Sandstrom & Russo, 2013).

3.1 Studies related to music receptivity

Emotional responses to music in everyday settings are usually appraised by observing bodily cues, Foot tapping (shows involvement), humming or singing along shows emotional involvement, etc. With an objective of empirically measuring the extent of

emotional involvement and to map the neural correlates of music listening, various functional neuroimaging modalities such as EEG (Ghosh et al., 2018; Kroupi et al., 2011; Maidhof et al., 2010; Tervaniemi et al., 1997; Thammasan et al., 2016), fMRI (Abrams et al., 2013; Alluri et al., 2015; Brattico et al., 2011; Burunat et al., 2016; Cong et al., 2014; Koelsch et al., 2006; Puolivali et al., 2013), and PET (Blood & Zatorre, 2001; Brown et al., 2006; Salimpoor et al., 2011), etc. have been employed. For a detailed review, see (Koelsch, 2014). However, these are not something that we could use in an everyday setting, owing to its sophisticated nature and also the fact that such studies can only be carried out in a laboratory environment where artificially constructed stimuli is employed which do not represent music as it is commonly heard and individuals may not be able to internalize music the same way they do it in natural settings. This limits the ecological validity of such studies. Moreover, in today's world, individuals being endowed with smartphones, high quality portable speakers or headphones, anybody with a reasonable knowhow of how music therapy works, could act as a music therapist, as far as certain non-clinical situations are concerned. They could apply music as a therapeutic intervention on themselves or on anyone around them. Post-intervention, we need an assessment that can appraise the individual's experience and a measure to quantify his depth/extent of internalization to the given music. The assessment should also assess whether the music helped the individual positively or if it triggered any negative thoughts. In order for this measure to have ecological validity, it has to be something that could be assessed in life-like situations. The musical stimulus has to be a non-laboratory like stimulus and the situation should also ideally be, life-like. Employing visual-analogue scale (VAS) or a rating scale would often yield erroneous results owing to that human self-introspective ability is often not reliable when what is being assessed is an experience so complex and deep such as the musical experience. Also, self-introspective ability varies drastically from person to person. Validated psychometric tools with excellent psychometric properties will have considerably lesser rate of error compared to such measures. Understanding and studying the construct music receptivity, its constituent domains and their interplay, we believe, would contribute towards understanding *musical identities* and *musicality* better, and a psychometric instrument, that could be a quick assessment, could be further developed on the basis of this. The Geneva Emotional Music Scale (GEMS) measures perceived and felt emotions to music (Zentner, Grandjean & Scherer, 2008). The GEMS appears to have tremendous

application in music therapy. However, it does not measure the extent or depth of internalization to a given piece of music. Given below is a table which lists top studies related to music perception and receptivity.

Table 1: Studies related to music receptivity

Author & Year	Summary	Strength	Limitation
1. Mullensiefen et al., 2014	Describes the concept of ‘musical sophistication’ and developed a novel measurement instrument, the Goldsmiths Musical Sophistication Index (Gold-MSI) to assess self-reported musical skills and behaviors on multiple dimensions in the general population using a large Internet sample (n = 147,636).	1.A novel construct and instrument developed 2.Large sample size 3. Investigated psychological correlates and socio-demographic contexts of musical sophistication with the aim of elucidating the conditions that are associated with individual differences in musical sophistication in general.	It was better to field test the instrument in a sub-sample with direct testing than the internet study.
2. Sandstrom & Russo, 2011	The Absorption in Music Scale (AIMS), a 34-item measure of individuals’ ability and willingness to allow music to draw them into an	1. AIMS shows good internal consistency and temporal reliability. 2. AIMS converges with measures of general absorption, musical	The study employed only classical music stimuli

	emotional experience.	involvement and empathy.	
3. Chin & Rickard, 2012	<p>A self-report questionnaire was developed to assess both quality and quantity of different forms of music use, with eight music background items, and a further 124 items testing music engagement.</p> <p>Analysis of an independent sample with a refined 50-item scale ($N = 124$; mean age = 22.78 years, $SD = 6.17$) supported the findings, further differentiating between “Physical Exercise” and “Dance.” Taken together with the eight music background items, the Music USE (MUSE) questionnaire can be used as a 58-item, or in a reduced 32-item</p>	<p>1. This study provides a reliable and valid tool for measuring an individual’s level of active engagement with music.</p> <p>2. The MUSE questionnaire is a novel measure incorporating quality and quantity indices of both music production and music reception.</p>	<p>The absence of correlation – in both samples – between years of training with music reception measures such as MES-I, III, IV, V, and the Index of Music Listening could imply that a high level of music engagement is independent of the traditional notion of musicianship. This possibility needs to be further evaluated in future research.</p>

	format.		
4. Chin et al., 2018	A multi-modular self-report instrument (the Music Use and Background Questionnaire, or MUSEBAQ) was developed to measure a diverse set of music engagement constructs. The MUSEBAQ offers researchers and practitioners a comprehensive, modular instrument that can be used in whole, or by module as required to capture an individual's level of engagement with music and to serve as a background questionnaire to measure and interpret the effects of dispositional differences in emotional reactions	<p>1. The MUSEBAQ is a comprehensive, modular instrument that can be used in whole, or by module as required.</p> <p>2. The entire profile provides substantially more information about an individual's musical engagement than has been previously available, and requires an average of less than 10 minutes to complete.</p> <p>3. The individual modules can be used in isolation if a more targeted assessment is required, for instance of musical capacity.</p> <p>4. This study is the first to identify four robust factors within this construct:</p>	There is age bias in each of the three studies reported. The age distribution was positively skewed such that the factors identified in these samples may reflect music characteristics of individuals better for the under 40 demographic than older demographics.

	to music.	emotional sensitivity; listening sophistication; music memory and imagery; and personal commitment to music.	
5. Nagy & Szabo, 2004	<p>The aim of the study were to discover whether the phenomenological change in one's experiences induced by music shows differences depending on the intensity of musical involvement and type of music in a laboratory setting.</p> <p>Intensity of musical involvement was measured by the Musical Involvement Scale among 500 university students.</p> <p>High and low involvers were chosen for the</p>	<p>The results are useful for music therapy. It is often the therapist's personal choice which music he gives to the patient.</p> <p>The knowledge about the person's intensity of involvement and about the general effects of a particular musical piece help the therapist choose the best type of music for the person and predict the probable effects of music-listening.</p>	<p>1. Further studies should be done on the influence of degree of liking for the musical piece.</p> <p>2. More delicate analysis should be done on structural elements of music, too, in connection with particular experiences, to be able to define general effects of certain components.</p>

	laboratory experiments (N=125).		
6. Law & Zentner, 2012	a new test battery (Profile of Music Perception Skills; PROMS) was developed that measures perceptual musical skills across multiple domains: tonal (melody, pitch), qualitative (timbre, tuning), temporal (rhythm, rhythm-to-melody, accent, tempo), and dynamic (loudness).	<p>1. Created a battery consisting of nine sub-tests, tapping skills across various sub-domains of pitch, rhythm, and sound quality (e.g., timbre).</p> <p>2. In contrast to most other musical test batteries, which were designed for special populations (e.g., children, amusics, or adults with hearing or musical impairments), the PROMS is a test for the normal adult population.</p> <p>3. This battery is having multi-dimensionality including aspects of music perception such as timbre, tempo, tuning or accent.</p>	<p>1. A rigorous examination of the battery required repeated and lengthy testing sessions that limited the number of people that could be tested.</p> <p>2. Questions need to be addressed, Such as the distribution of musical skills in the general population for example, whether distributions vary according to parameters such as age, gender, and socioeconomic status, or to the presence of strong musical institutions.</p>

Music has its value majorly as a consumable of man. Music is created so that we could enjoy and appreciate it. The potential of music as therapy is huge and researchers are trying to find optimal and effective ways to tap this potential in therapy settings. Music and its applications have been burgeoning in recent years. Among complementary and alternative medicine (CAM) modalities, music therapy is one of the least standardized ones. Standardizing music for therapy purposes is quite challenging as music therapy is most effective when it is tailor-made to conform to the musical identity of an individual. We need assessments that could assess an individual's musical identity as accurate as possible. When applied in an individual specific manner, music therapy is quite effective and has documented outcomes (Bunt & Hoskyns, 2013; Sihvonen et al., 2017; Thaut & Hoemberg, 2014). The USA has a certifying body for music therapists known as the American Music Therapists Association and the certification is termed Board Certified Music Therapist (MT-BC). In India we do not have such certifying body or a certification. It is high time that we have a certifying body for music therapists. This step would be an integral process towards standardizing music as medicine. Music has been extensively used in psychotherapy (Metzner, 2004; Grocke et al., 2008; Lin et al., 2011), education (Larsson and Georgii-Hemming, 2019), sports (Belkhir et al., 2019), and so on. Understanding how music influences the human mind and how it induces and modulates mood states has been always a key question that researchers are trying to address. When an individual listens to a piece of music, musical identity is a major player which mediates music receptivity. The more the music conforms to the musical identity, more are the chances of mood modulation to happen (Bleye, 1992) and more are the chances of music receptivity to be high. Existing research has focused on using music in therapy, finding neural correlates of music, music perception, etc. (Carterette & Kendall, 1999; Deutsch, 2007; Justus & Bharucha, 1996; Koelsch & Siebel, 2005; Lynch et al., 1990). Subjective human experiences to music are an area where there are mixed research evidences, owing to its complex nature. Therefore, understanding individual differences in music listening is of colossal significance. Investigating how individuals experience music can give a profound insight on how music influences the human mind. Lack of appropriate tool limits research in an area, and we found that there is a need for a tool that can assess the extent or depth of internalization of music. Further we developed the construct music

receptivity and developed and validated a psychometric assessment (Music Receptivity Scale) to measure music receptivity.

3.2 Receptivity in psychological and biological processes

Search for traits that uniquely identify a person's inclination towards music has been a curious quest (Schäfer, 2016). Miranda (2020) identified that neuroticism is associated with musical habits like extent of music listening, musical sensibility (emotional reactions), music preferences (music genres), and functions of music (emotion regulation). Miranda et al. (2010) likewise found that in high school students, extraversion and openness alone are related to music preference and not the other dimensions of the big five personality factors. A meta-analysis reported a small to medium correlation between neuroticism and emotion regulation through music listening (Miranda and Blais-Rochette, 2018). Similarly, some genetic studies have identified genetic markers related to musical abilities. Genes like MAPK10, SNCA, ARHGAP24, TET2, UBE2D3, FAM13A and NUDT9 are associated with music abilities (Oikkonen et al., 2016). Another study of genome wide analysis of 76 pedigrees comprising 767 people, showed genetic linkage related to discrimination of pitch, duration, and sound patterns, which are essential for music perception. The key genetic component, PCDH7, is associated with cochlear-amygdala areas (Oikkonen et al., 2015). Similarly, the AVPR1A gene is related to music perception, music memory, and music listening (Tan et al., 2014). Järvelä (2018) showed that alpha-synuclein gene and GATA-binding protein 2 gene are related to musical aptitude, and suggested that these genes are also involved in the dopaminergic circuits that regulate reward mechanism, and hence got evolutionary linkages. Even though these studies successfully hint towards deep rooted psychological and genetic traits associated with musical abilities, we need a construct that shows how these traits dynamically interact and result in different musical experiences such as elation, thrills, chills, feeling-moved, and awestruck. The construct music receptivity might justify this requirement.

3.3 Need for a new construct – Music Receptivity

Music Perception restricts to basic perceptual aspects of music, like pitch, rhythm, tempo etc., and predominantly, the cognitive processes associated with it. These physical attributes are well studied and elucidated to show how they invoke a higher

order experience (Justus and Bharucha, 2002; Deutsch, 2007). Levitin et al. (2018) have discussed temporal factors in music as a preliminary step in understanding how and why music literally moves us. However, in order for music to have a transformational influence and reconfigure psychological states, it must be accompanied by higher order cognitive and emotional processing, which may lead to one experiencing higher-order mind-body experiences. For music therapy to be effective, this higher dimension of processing has to occur in the individual. The emphasis in this study is towards internal psychological processes. Unlike music perception, where different physical features can have identifiable thresholds and ranges, we propose music receptivity to follow a psychological continuum varying from a lower degree to a higher degree of receptivity. This differential receptivity would have a direct implication in standardizing music for therapy in various clinical conditions. Towards this end, an individual-centric approach to music therapy is key, as music listening is a highly subjective phenomenon. Therefore, it is important to know how and to what extent a piece of music affected an individual while he listened to it. This motivated us to think of the construct - Music Receptivity.

3.4 Other tools that attempt to assess related constructs

Music self-concept Inventory (MSCI) was developed to evaluate change or development in music self-concept, and it has three subscales, support or recognition from others, personal interest or desire, and self-perception of music ability (Hash, 2017). Interpersonal music-communication competence scale was developed to measure a set of abilities that can help develop the interpersonal communication through music training (Hald et al., 2017). Music perception ability questionnaire was developed to assess the general perception ability of non-musicians and enable them to assess their music abilities. The Music USE (MUSE) questionnaire was developed to assess the engagement styles of eight different background music, and provide an overall qualitative and quantitative measure of music use. This questionnaire had shown four distinct engagement styles, cognitive and emotion regulation, engaged production, social connection, dance and physical exercise (Chin and Rickard, 2012). Motivation for Learning Music (MLM) questionnaire, based on the Self-Determination Theory (Deci and Ryan, 1985) was developed to assess the degree of inherent motivation of music students to learn music (Comeau et al., 2019). Adaptive Functions of Music Listening Scale was another novel perspective to assess various

music listening functions related to general wellbeing. This questionnaire has 11 domains like stress regulation, anxiety regulation, anger regulation, loneliness regulation, rumination, reminiscence, strong emotional experiences, awe and appreciation, cognitive regulation, identity, and sleep. Their study showed higher functions of music listening in females (Groarke and Hogan, 2018). To evaluate the influence of home ambiance of music exposure and engagement in infants and preschool children, Music@Home questionnaire was developed, and this study also revealed distinct patterns of parents' music characteristics (Politimou et al., 2018). Based on the music model of motivation (Jones, 2009), Music Model of Academic Inventory was developed in a music education setting. This tool had five domains, namely empowerment, usefulness, success, interest, and caring (Jones and Skaggs, 2016). A modular tool for music research to assess musicianship, musical capacity, music preferences, and motivations for music use was developed (Chin et al., 2018). Barcelona Music Reward Questionnaire (BMRQ) was developed to assess the variations in how listeners experience reward in any music related activities (Mas-Herrero et al., 2013). Goldsmiths Musical Sophistication Index (Gold-MSI) measures inherent characteristics like musical skill, expertise, achievements, and other such related behaviours related to a variety of musical contexts. This tool gives an estimate of mastery of a person in a particular area of music and can reflect musical talent, ability, aptitude or musical potential (Müllensiefen et al., 2014). Apart from these wide varieties of tools based on various psychological constructs, some tools were also developed to assess perceptual deficits in music and hearing like the Adaptive Music Perception (AMP) test, which assesses the threshold of discrimination for various features of music like meter, harmony, melody, and timbre (Kirchberger and Russo, 2015); and Music Perception battery based on M-factors that has 80 items to measure various domains like contour, timbre, meter, pitch, scale, duration, and loudness, and they help in understanding any psychological or biological linkages with speech and language deficits (Barros et al., 2017).