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THE ATTENTION PROFILE IN MUSIC THERAPY ASSESSMENT FOR CHILDREN. DEVELOPMENT AND PILOT STUDY OF VALIDITY AND RELIABILITY

BY
JUANITA ESLAVA-MEJÍA

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DENMARK

THE ATTENTION PROFILE IN MUSIC THERAPY ASSESSMENT FOR CHILDREN. DEVELOPMENT AND PILOT STUDY OF VALIDITY AND RELIABILITY

by

Juanita Eslava-Mejía

AALBORG UNIVERSITY
DENMARK

Dissertation submitted

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PhD supervisor: Associate Prof. Ulla Holk
Aalborg University

Assistant PhD supervisor: Prof. Cheryl Dileo,
Temple University

PhD committee: Associate professor, PhD Stine Lindahl Jacobsen
Aalborg University (chair), Denmark

Professor Gregorio García Aguilar
Benemerita Universidad Autonoma de Puebla, Mexico

Professor, PhD Helen Odell-Miller OBE, Director
Music for Health Centre; Head of Therapies,
Department of Music and Performing Arts,
Anglia Ruskin University, Cambridge, UK

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CV

Juanita Eslava studied Choral Conducting at the Universidad de los Andes in Bogota, Colombia. In 2002 she entered the Master's equivalency in Music Therapy program at Temple University graduating in 2004. She has been a professor of Music Therapy postgraduate programs in Colombia and Venezuela. For over 12 years, Juanita has been working in private institutions providing services of neurologic and neuropsychologic rehabilitation to children in Colombia. In the period 2010-2016 she was president of the Comité Latinoamericano de Musicoterapia. Currently a member of the Sociedad Latinoamericana de Neuropsicología. Her research interests include: music therapy assessment, children neuropsychological development, music psychology, music therapy and culture.

ENGLISH SUMMARY

This study was designed to establish if it is possible to assess attention as music therapy in a reliable and valid manner.

Music processing is a complex function that recruits several brain structures in both hemispheres, according to the characteristics of the music, the musical expertise of the therapist the developmental characteristics of the individual, and the task (Levitin & Tirovolas, 2009; Tirovolas & Levitin, 2011). Some of the processes related to music such as musical attention, categorization, memory and feature detection have been described to be higher cognitive functions in music, involving specific neural networks (Levitin, 2012). Attention is an important function in human development, taking part in several processes of cognitive functioning. Previously thought to be a unitary process, it is currently better defined as a processing system (Spikman & Van Zomeren, 2010), implicating several brain structures and systems. According to its function and operating mechanisms, Cohen (2014), presents a classification of attention types including: focused, selective, divided, sustained, and effortful attention. In psychology and neuropsychology, both quantitative and qualitative methods for assessing attention have been widely used.

In Music Therapy, even though attention is a frequent reason for referral and indeed a treatment goal, there is a lack of reliable or valid methods of assessment of attention when working with children with learning disabilities or developmental challenges, . Research evidence points to the potential to examine and develop attention skills through music therapy. In terms of specialized modules of attention for music processing, Janata, Tillmann, and Bharucha (2002), found that the areas recruited when attending to music are not specific for music, but general areas implicated in several processes including attention. Analyzing the attentional response to music, Koelsch (2009) mentions that listening to music automatically captures activity in attention networks. Furthermore, when comparing music stimuli and spoken or play stimuli , music stimuli has shown to have better capacity to recruit attention networks (Wolfe &Noguchi, 2009), and improve attentive behaviors (Robb, 2003). Other researchers, while restating the enhancement of cortical arousal when attending to auditory stimuli, have also found that attention to familiar music generates a stronger response of cortical arousal, which is at the base of attention (De Jong, Toffanin & Harbers, 2010; Saupe, Widmann, Bendixen., Müller & Schröger 2009; Meltzer, Reichenbach, Braiman, Schiff, Hudspeth, & Reichenbach (2015). Two assessments of attention using music are found in the literature: The Music Based Attention Assessment for patients with traumatic brain injury (Jeung, 2013), and the Music Attentiveness Screening Assessment (Waldon, Lesser, Weeden & Messik, 2016)

This research study uses knowledge from the areas of neuropsychology, music psychology, music therapy assessment and clinical practice to design the Attention

Profile in Music Therapy assessment tool (APMT) and conducts a pilot study to establish reliability and validity of the of the tool.

The APMT is an assessment designed in Spanish Language, taking into account the context of clinical music therapy in Latin America. Its goal is to provide a baseline profile of children's attentional skills, as displayed in the music therapy setting. The structure of the assessment is similar to some commonly used session structures in clinical practice. Musical materials chosen take into account emerging knowledge from music psychology research regarding auditory processing and attentional functions, and include music composed for the assessment, children's familiar music, and improvisation. APMT items are classified into attention categories and complementary scales. The attention categories include: alert, divided, selective and sustained attention. The complementary scales include: motivation, relationship, overall performance, and impulsivity.

The first version of the APMT was used in a small pilot study, to obtain information regarding clarity of instructions, and content validity. Adjustments were implemented taking into account the researcher's experience, and feedback from other music therapists.

A second pilot study including 40 participants from Colombia and Argentina was conducted to examine inter-rater reliability, internal consistency, concurrent validity and construct validity of the second version of the APMT.

Results indicate that APMT is a reliable assessment tool. Inter-rater reliability scores using Fleiss Kappa and Krippendorf's alpha statistics ranged between 0.73 and 0.76 for the nominal variables. Coefficients for the ordinal variables, using Krippendorf's alpha ranged between 0.90 and 0.97. Inter-rater reliability between pairs of raters (clinician performing the assessment and each external rater), using weighted kappa statistics, ranged between 0.60 and 0.99. Cronbach's of the final item pool following Factor Analysis procedures was 0.739 indicating internal consistency.

Construct validity of the APMT, was evaluated through Exploratory Factor Analysis indicating multi-dimensionality of the data as evidenced by the extraction of several factors. Exploratory Factor Analysis identified six factors which were labeled using the construct of attention functions from the Mirsky attention model (Mirsky & Duncan, 2004) as themes: encode, stability, focus/execute, shift, sustain, and stability/control. Correlations between the Evaluación Neuropsicológica Infantil - ENI (Rosselli et al. 2004) and the APMT are not conclusive. Therefore, it is not possible to establish concurrent validity of the APMT. Sample size and data collection difficulties, characteristics of the tasks from both assessments, and differences concerning information gathering assessment models and collaborative assessment models were highlighted as possible difficulties to establish concurrent validity in the pilot study.

APMT will be adjusted according to pilot study results. Consequently, studies to establish validity and reliability of the adjusted version are recommended. According to this pilot study findings, a different approach to establish concurrent validity of the APMT is recommended, using the attention battery from the Mirsky Model, as well as comparisons with results on neuropsychological assessments framed on the qualitative approach.

DANSK RESUME

Opmærksomhedsprofil i musikterapiassessment med børn.

Udvikling og pilotundersøgelse af validitet og pålidelighed

Denne undersøgelse er udarbejdet for at fastslå, om det er muligt at vurdere opmærksomhedsfunktioner, der viser sig i musikterapi, på en pålidelig og valid måde.

Bearbejdning af musik en kompleks funktion, som involverer adskillige hjernestrukturer i begge hemisfærer alt efter musikkens karakteristika, personens musikalske ekspertise og udviklingsmæssige karakteristika samt den givne opgave (Levitin & Tirovolas, 2009; Tirovolas & Levitin, 2011). Nogle af de processer, som er forbundet med musik, såsom musikalsk opmærksomhed, kategorisering, hukommelse og registrering af karakteristiske egenskaber, har været beskrevet som højere kognitive funktioner i musik, der involverer specifikke neurale netværk (Levitin, 2012). Opmærksomhed er en vigtig funktion i den menneskelige udvikling, idet den er involveret i flere processer, der vedrører kognitiv funktion. Hvad man tidligere antog for at være en og samme proces defineres nu som et bearbejdende system (Spikman & Van Zomeren, 2010), der implicerer adskillige hjernestrukturer og systemer. Alt efter funktion og aktive mekanismer præsenterer Cohen (2014) en klassificering af opmærksomhedstyper, herunder: fokuseret, selektiv, delt, vedvarende og krævende opmærksomhed. Inden for psykologien og neuropsykologien har såvel kvantitative som kvalitative metoder været alment benyttet til assessment af opmærksomhed.

I musikterapi er der ingen pålidelige eller valide metoder til assessment af opmærksomhed hos børn med indlæringsvanskeligheder eller udviklingsmæssige udfordringer, selvom netop opmærksomhed ofte er årsagen til henvisning til og mål for behandling med denne gruppe børn. Forskningsevidens peger på et potentiale ift. at undersøge og udvikle opmærksomhedskompetencer gennem musikterapi. Hvad angår specialiserede opmærksomhedsmoduler til musikbearbejdning har Janata, Tillmann, og Bharucha (2002) påvist, at de områder som er involveret i forbindelse med musiklytning ikke er specifikke for musik, men i stedet er generelle områder, der omfatter adskillige processer, herunder opmærksomhed. Ved at analysere opmærksomhedsrespons på musik, påpeger Koelsch (2009) at musiklytning automatisk aktiverer opmærksomhedsnetværk. Ved sammenligning af musikalske stimuli med talte stimuli eller leg, viser musikalske stimuli desuden bedre kapacitet til at rekruttere netværk som vedrører opmærksomhed (Wolfe &Noguchi, 2009) og forbedrer opmærksom adfærd (Robb, 2003). Andre forskere, som har fundet at auditive stimuli forstærker kortikal arousal, påpeger at lytning til velkendt musik fremkalder stærkere kortikal arousalrespons, som er en forudsætning for opmærksomhed (De Jong, Toffanin & Harbers, 2010; Saupe, Widmann, Bendixen,

Müller & Schröger 2009; Meltzer, Reichenbach, Braiman, Schiff, Hudspeth, & Reichenbach, 2015). I musikterapilitteraturen findes der to assessmentredskaber til at vurdere opmærksomhed ved hjælp af musik: The Music Based Attention Assessment for Patients with Traumatic Brain Injury (Jeung, 2013) og The Music Attentiveness Screening Assessment (Waldon, Lesser, Weeden & Messick, 2016).

I denne undersøgelse anvendes viden fra neuropsykologi, musikpsykologi, musikterapiassessment og klinisk praksis til at designe The Attention Profile in Music Therapy Assessment Tool (APMT), samt gennemføre en pilotundersøgelse mhp. at opnå pålidelighed og validitet af redskabet.

APMT er et redskab udarbejdet på spansk under hensyntagen til klinisk musikterapipraksis i Latinamerika. Dets mål er at tilvejebringe en baseline-profil af børns opmærksomhedskompetencer, sådan som de viser sig i den musikterapiske setting. Assessmentredskabets opbygning er den samme som andre lignende redskaber der anvendes i klinisk praksis. Det valgte musikalske indhold tager højde for den voksende viden fra musikpsykologisk forskning om auditiv bearbejdning og opmærksomhedsfunktioner, og indeholder musik som er komponeret til assessmentredskabet, velkendte børnesange samt improvisation. APMT's elementer er klassificeret i opmærksomhedskategorier og komplementære skalaer. Opmærksomhedskategorierne omfatter agtpågivende, delt, selektiv og vedvarende opmærksomhed. De komplementære skalaer omfatter motivation, relation, generelt præstationsniveau og impulsivitet.

Den første version af APMT blev brugt i en lille pilotundersøgelse med henblik på at skaffe viden om instruktionernes klarhed og 'content validity'. Justeringer blev gennemført ud fra forskerens erfaringer og de andre musikterapeuters feedback.

En efterfølgende pilotundersøgelse, der omfattede 40 deltagere fra Colombia og Argentina, blev gennemført med henblik på at undersøge den anden AMPT-versions 'internal consistency', 'concurrent validity' og 'construct validity'.

Resultaterne viser, at APMT er et pålideligt assessmentredskab. De nominelle variabler for interraterpålidelighed på grundlag af Fleiss Kappa og Krippendorf's alfa statistik varierede mellem 0,73 og 0,76. Koefficienter for de numeriske variabler på grundlag af Krippendorfs alfa varierede mellem 0,90 og 0,97. Interraterpålidelighed mellem par af ratere (klinikeren og den eksterne rater der foretager vurderingen) på grundlag af vægtet kappa statistik varierede mellem 0,60 og 0,99. Cronbach's alpha af den endelige mængde af elementer efter faktoranalyseprocedurer var 0,739, hvilket indikerer intern konsistens.

Undersøgelse af APMT's validitet viser 'construct validity' evalueret på grundlag af Exploratory Factor Analysis der indikerer dataenes multidimensionalitet godtgjort ved ekstraktion af flere faktorer. Exploratory Factor Analysis identificerede seks faktorer, der ud fra opmærksomhedsfunktionerne i Mirskys opmærksomhedsmodel (Mirsky & Duncan, 2004) blev rubriceret som latente temaer: encode, stability, focus/execute, shift, sustain, and stability/control. Korrelationer mellem APMT og assessmentredskabet Evaluación Neuropsicológica Infantil (Rosselli et al. 2004) er ikke endegyldige. Derfor er det ikke muligt at fastslå APMTs 'concurrent validity'. Som mulige vanskeligheder ved at opnå 'concurrent validity' mellem de to assessmentredskaber i pilotundersøgelsen fremhæves: Sample size og dataindsamlingsvanskeligheder, karakteren af opgaverne i de to assessmentredskaber og forskelle ift. model for informationsindsamling og model for vurdering af samarbejde.

APMT vil blive justeret ud fra pilotundersøgelsernes resultater. Derfor anbefales undersøgelser, der kan fastslå den justerede versions validitet og pålidelighed. På basis af pilotundersøgelserne kan en anden fremgangsmåde til at fastslå APMT's 'concurrent validity' anbefales, med brug af batteriet af opmærksomhedsfunktioner fra Mirskys model samt sammenligninger med resultater af kvalitative neuropsykologiske vurderinger.

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CHAPTER 1. INTRODUCTION

Chapter one will present an overview of the motivations, purpose and context for the research process.

1.1. MOTIVATIONS

I have worked for several years in institutions offering clinical services for preschool and school aged children with learning disabilities, neurological syndromes, and psychological disorders. This work, carried out with a neuropsychological orientation, inevitably involved my learning new vocabulary and concepts, and guided my research of relevant music psychology and music therapy literature. The scarcity of literature carried out from a music therapy perspective within this approach became evident, and was a driving force in the construction of an integrative theoretical framework useful in my everyday practice. Case study discussions, team meetings and participation in research and conferences, sparked new questions, while at the same time reinforcing the idea that music therapy theory and practice could be looked at through the lens of neuropsychology.

Another important element in the genesis of this study was the difficulty in finding valid and reliable assessments of attention for children in clinical music therapy. Given that assessment is such an important part of the treatment process, why are there so few tools? This shortage has led many music therapists to mostly use assessment tools from other disciplines, or to design personal music therapy questionnaires and formats that cannot be generalized to other settings for validity reasons. Obviously, this makes it harder to communicate findings to families and other therapists, to report in a reliable manner on the process of therapy, and to do research. From a cultural point of view, this problem is even more evident in Spanish speaking countries. Few of the available validated assessments have been translated or are in the process of being translated to Spanish and validated in the Latin American countries, leaving music therapists in the region in a precarious situation in terms of assessment procedures. Such a situation, in a region where music therapy has been recognized as a profession in only two countries (Argentina and Brazil), makes it even harder for music therapy advocates to build a case for the importance of the recognition of the discipline and the profession.

With these ideas in mind, this study was initially geared towards the broad question of whether it was possible to measure neuropsychological development in music therapy. However, this is a large and complex topic. Even though there is research that could lead us to believe that this type of measurement is possible, many assumptions would have to be made in order to design such a tool. There was therefore a need to find a starting point to approach this question.

Taking into account evidence from Music Therapy literature and the clinical experiences of the researcher, the focus of the study turned to attention. This subject has been reported in research as an outcome for Music Therapy when working with children's development, and in the author's clinical experience it is one of the most frequent reasons for referral. Additionally, colleague therapists from other fields believe this to be an area in which Music Therapy can be of particular use in the therapeutic process. Thus, the focus of the study became the design and pilot study of the Perfil de la Atención en Musicoterapia (in English: Attention Profile in Music Therapy) assessment tool.

Given that there are already attention assessments in neuropsychological literature, what then is unique to Music Therapists' observations and reporting in terms of the attention skills unfolding in therapy processes? Firstly, in traditional attention assessments, visual tasks have been given a lot of relevance. Even though there are auditory attention tasks, these are usually linked to language skills, and assess particular aspects of auditory attention, leaving music out of the scope. Music psychology research provides evidence to support the fact that music activates attention structures in the brain. Therefore, the use of music and its elements should be a part of attention assessment. Its use, within a music therapy session, provides unique therapeutic opportunities that arise from working with, adapting, and supporting involvement in the music. In contrast to other professionals using music activities in their practices, music therapists have the training to improvise, switch the format of stimuli presentation, present simultaneous stimuli (i.e: voice and instruments), and to adapt to situations present in music making. A music therapy attention assessment involves the client in culturally sensitive situations where multiple attention processes take place, not only in an isolated manner but also in a musical and relational context providing a framework and purpose for the assessment situation. In a context where neuropsychological testing has been criticized for its ecological validity, given the lack of relationship between the tasks and aspects of everyday life (Spikman & Zomeren, 2010), such characteristics of a Music Therapy assessment tool are valuable and offer new perspectives on the important subject of attention.

Also unique to music therapy is that it is strength oriented and takes as a starting point the person's innate musicality, musical background, and preferences. Within the boundaries of standard procedures that assessment tests require, such characteristics of a music therapy assessment tool will also provide new information on the person's attention, and the role of motivation in the execution of attentions tasks.

The purpose of this study is to incorporate previous research in music therapy, neuropsychology, and psychology of music, with emerging knowledge from clinical practice in Music Therapy, in order to design and pilot the Perfil de la Atención in Musicoterapia/Attention Profile in Music Therapy. Neuropsychological assessments of attention, as well as validated music therapy assessments, will be examined

carefully for incorporation of some of their elements into the tool. The theoretical framework provided in the literature review takes into account Latin American literature, as well as clinical and research practices, since the region is the context for developing the assessment tool. Music therapists in Spanish speaking countries would find in the assessment tool a protocol similar to the structure of a music therapy session, using a regular music therapy setting and providing for easy administration. The goal of the assessment is to provide a profile of the child's attention skills as they are displayed in a music therapy session, as well as an orientation towards the most useful support strategies used in the session.

1.2. PURPOSE OF THE THESIS

This study has two main purposes. The first one is to develop the Perfil de la Atención en Musicoterapia (in English: Attention Profile in Music therapy, APMT-from now on, referred to only as APMT). APMT is a tool designed for the Latin American context (in terms of language, settings, health practices, and accessibility to materials). The second purpose is to carry out a reliability and validity study on the tool, exploring its characteristics and providing a rationale for its use in clinical practices.

When referring to the topic of assessment, different approaches are found. As Aschieri (2012) describes while discussing psychological assessment practices, there has been a movement between the natural sciences approach and the human sciences approach. In the former, emphasis is on description through test scores on an objective tool, and the role of the clinician is abstinent and objective. In contrast, in the human sciences approach, the emphasis is on understanding, through the client's point of view on experiences. The role of the clinician is of a participant-observer. In the natural sciences approach, standardized assessment is used, while in the human sciences approach, collaborative and therapeutic assessment is used. Even though the two approaches are considered opposite in their world views, Aschieri calls for a complementary approach, taking into account that the type of information that can derive from both approaches can actually complement each other through triangulation, so that there are more elements in place guiding clinical reasoning.

The Attention Profile in Music Therapy (APMT) as the name indicates, is not intended as an standardized assessment, and is not aimed to be a diagnostic tool differentiating children with or without an attention disorder. Its purpose is to widen the understanding of the child's attentional skills, as they are displayed in the context of the music therapy session.. Additionally, APMT recognizes the impact of motivation and the therapist/client relationship in assessment performance, and includes these issues into the assessment. This type of assessment, allowing for broader understanding of individual skills in reference to the person, not to a norm, is congruent with my personal conception of music therapy as a strength-oriented discipline, and more congruent with the human sciences approach.

In designing the APMT, careful thought has been given to the structure of the assessment and the administration protocol, so that the assessment situation has a flow similar to a regular music therapy session. It is not thought as a series of isolated tasks to be performed, but as a logical chain of tasks building up, and allowing the therapist to observe the display of attentional skills framed in a variety of music therapy experiences. Being the first time a child and a therapist meet, an assessment (while following a reliable and valid protocol), should provide opportunities for the child to achieve a sense of comfort and trust with the therapist, naturally fostering opportunities for the child to display his skills. In terms of the usefulness of the assessment, such a feature could facilitate the inclusion of the tool in music therapy clinical practice.

Even though the current research study excludes the population on the Autism spectrum, or with neurological disorders, I would like to take the results of this study as a step forward towards developing research-based assessments for these populations.

The second stated purpose of this study is to carry out the reliability and validity study of the designed tool. Even though APMT is not designed to be standardized, still there is a need to establish whether or not the tool provides consistent results under different circumstances and if the observation part of the tool actually relates to the function of attention.

The design process of the APMT was research based and consulted with experts. With a first version of the tool, a small pilot study (Pilot A) was carry out. Then, a second version of the tool was designed. Using this version of the APMT, a second pilot study (Pilot B) was carried out. The results from the pilot study were analyzed using statistical methods appropriate for the type of data presented in the APMT, to establish reliability and validity of the tool. Additionally, correlations with results from neuropsychological assessments of the participants were also used for establishing validity of the APMT.

APMT will be accessible and easy to use in regular music therapy settings tool, aiming to broaden the knowledge and understanding of a child's attentional skills, provide a baseline rationale for clinical decisions (goal settings, methods and techniques), and allow for dialogue in interdisciplinary professional teams grounded on a common language.

1.3. CONTEXT

Access to therapeutic services in Colombia occurs mostly through the public healthcare system (even though certain fees might be associated with some services), and it is a right for all in need of such services to receive them through what is called the POS (Mandatory Health Plan). However, a small portion of the population

accesses these services through private practice. Often, institutions offering therapeutic services for children serve multiple populations, ranging from children with mild learning and/or emotional difficulties, to children with complex medical diagnosis, requiring more support and services. Such is the case in the institution in which I currently work (CENPI), where an inter-disciplinary team including occupational therapists, speech therapists, physical therapists, neuropsychologists, psychologists, and physicians (generally, child neurologists and psychiatrists), provide services to multiple populations. The children attend other institutions for education services.

Music therapy however, is not a recognized profession in Colombia. This situation makes access to music therapy services uncommon in the neurorehabilitation area. The public healthcare system, sometimes covers the services, but there needs to be a justification from the physician and the music therapist, validating the need for services and carefully reporting on the progress of the children.

In this context, the difficulty to establish protocols for referrals is notorious, as is the difficulty to report on baselines, progress, and discharge in the absence of reliable and valid assessments. Having practiced as a music therapist for over 10 years while confronting such circumstances, and trying to come up with ideas to overcome this obstacle, I decided to dedicate my PhD research to assessment design and validation.

Even though I work with multiple populations, I decided to concentrate my research on protocols useful for working with children with learning disabilities, and/or developmental delays impacting their learning process. Such children usually attend regular school settings, and are referred to therapeutic services, due to school or family reporting learning challenges to medical doctors.

Even though the context I provided earlier in this section centers on Colombia's situation, the need for valid and reliable music therapy assessment expands to other countries of Latin America. In a region were music therapy is regulated as a profession only in Argentina and Brazil (probably in Chile too, by the time this thesis is published), we all share the need to make music therapy services accessible through the health system.

Currently, there are validated music therapy assessments available for use. However, in the context of Latin America, their use could be limited by at least two factors. The first one is the cultural factor. Given that most assessments were designed in other cultures, and that reliability and validation studies have not been replicated in Latin American countries, such tools are not necessarily considered valid and reliable. This does not take away their value, but in terms of inclusion into the health system and evidence based practices, it could hinder their use. It would be ideal to carry out replication studies of those assessments, so that more validated tools could be used.

A second factor is accessibility. This relates not only to economic factors, but also to the language barrier as not all music therapists in the region speak English. There is also the question of accessibility to training when the assessment tool requires specific training for the therapists. The issue of training has been advancing in recent years, which have seen an increase in training based in Latin America. But the language barrier continues to be pose accessibility difficulties. While this dissertation document is written in English, the APMT tool was first designed in Spanish, and all its materials are available in both Spanish and English.

Hopefully, an increase of interest in assessment design will be seen in the following years in the continent, so that a variety of tools will become accessible for music therapists working in different clinical areas, providing more and better evidence, advocating for the regular inclusion of music therapy services.

1.4. OVERVIEW

This document has been structured in a way that parallels the research process itself. In the first chapter, the reader finds the genesis of the study: how the idea guiding the research was conceived, the rationale for designing the APMT, and expectations for what can be accomplished through the APMT design and validation process.

The second chapter presents a literature review, compiling evidence on different areas related to the topic of the study. Findings from chapter two provide a foundation for understanding the main research question and sub-questions presented in a short but highly important chapter three.

Chapter 4 deals with methodology and design of the research study. A careful and thorough description of the research process presented in five stages is included. The chapter does not follow a "traditional" outline for research studies, but in turn, seeks to "walk" the reader through the research stages to facilitate a thorough understanding of each part of the process. This chapter goes from the first steps of deciding on the research topic, to addressing ethical issues, selecting the participants, and goes through the stages of designing, data collection, and analysis. The APMT in version 1 and 2 is presented in this chapter, as well as a reflective paper on the process of designing the APMT.

In chapter 5, the study results related to the establishment of reliability and validity are presented.

A discussion of the research questions, using the results presented on chapter 5, is the focus point of chapter 6. Connections are made through the different results and possible rationale behind the results is also included. By the end of the chapter, the reader should have an idea of the thinking process of the researcher, and how she

interpreted the results of the research study. Towards the end of the document, directions for future research are discussed in chapter 7.

CHAPTER 2. LITERATURE REVIEW

Four main keywords have been used to construct the literature review chapter: attention, neuropsychology, music therapy and assessment. Different combinations of the keywords are presented in the text, with the purpose of examining relevant literature in these areas.

The chapter includes a broad range of information. It includes the process of attention, the mechanisms and systems involved in its development, within a neuropsychological framework. Fundamental principles in neuropsychology, neuropsychological assessment, and assessment of attention will be presented as one of the basis for assessment design of the Attention Profile in Music Therapy (APMT). Some of the fundamental research on music processing related to neuropsychological processes in general and to attention in particular, as well as findings regarding innate and trained musicality, is also included. This section provides ways of relating the areas of neuropsychology, attention and music processing and building a rationale for assessing attention in music therapy. In the last part of the literature review, general features of assessment in music therapy, as well as the specific validation processes used in music therapy assessment tools are presented. The importance of assessment practices in music therapy, and the validity and reliability procedures for music therapy assessment tools, constitutes an additional basis for the design of the APMT. A detailed report of music therapy and attention, assessment and intervention practices is found at the end of the literature review, as part of the rationale for assessing attention in a music therapy setting, and for some of the design choices of the APMT. Given that the current study takes place in Latin America, for Latin American populations, and looks for clinical relevance for settings in the region, the literature review includes references to Latin American authors, as well as perspectives that influence research and clinical practice in the region.

2.1. ATTENTION, NEUROPSYCHOLOGY AND ASSESSMENT

2.1.1. DEFINITION AND CHARACTERISTICS OF ATTENTION

Attention is without doubt a highly important process in terms of cognitive functioning. When searching for definitions of attention, many are found. The field of cognitive psychology has studied attention in depth, especially since the 1970's when cognition became an increasingly important topic for research in psychology (Cohen, 2014). For the purpose of the current study, definitions constructed under the paradigm of neuropsychology are taken into account.

Early theories conceptualized attention as a unitary process. However, recent studies have shifted this conception so that attention is understood as a domain of processes. Spikman and Van Zomeren (2010), while stating that there is no unitary concept for

attention, have proposed a definition for it: the state of a processing system that is optimally tuned in terms of selectivity and intensity. Cohen (2014) emphasizes the need to understand attention, not only in terms of the neural mechanisms allowing the selection, focusing, persistence and switching of resources, but also in terms of the behavioral responses, as both processes are vital in the neuropsychology of attention.

An initial researcher interested in attention as a brain system was Alexander Luria. Even today, his theories are relevant when understanding attentional processes, especially within a historical-cultural neuropsychological framework. He proposed two different attentional mechanisms. The first mechanism, involuntary in nature, requires little cognitive development and consists of an orienting response to a stimulus. This mechanism is developed early in life. The second mechanism requires further cognitive development and involves internally-directed attention. In the second mechanism, the term "volitional attention" refers to the ability to interpret a situation and direct attention according to the person's goals. In the historic-cultural framework, Luria's perspective of attention is presented according to the functions of blocks (1973). In his model, there are three blocks, and each one has distinct functions. A contribution from all blocks is necessary in attention tasks. Block one is responsible for arousal. It provides an appropriate level of arousal, so that alert, selective and directed attention can take place. According to Luria, only when there is an appropriate arousal, can more complex processes of attention occur. Block two involves simultaneous and successive processes, whereas block three is linked to voluntary programming, regulation and verification (Naglieri & Das, 1994).

Luria's function of arousal (block 1), was also the focal point of other studies in the earlier research on attention; these studies suggested that arousal determines attentional capacity (Heilman, Schwartz & Watson, 1978). Other researchers, such as Pribram and McGuinness (1975), studied both arousal and activation, concluding that together they produce effort, thus causing sensory integration and a consequent response. In their work, intention is included as a component of attentional control. (Pribram & McGuinness, 1975).

As mentioned before, when analyzing the issue of attention, it is very relevant to differentiate between voluntary and involuntary attention and their working mechanisms. Hopfinger and Parks (in Mangun, Ed., 2012), refer to involuntary attention as effortless attention. One that enhances perception and affects processing much faster than voluntary attention. Through research using event-related potentials, they state that while interacting in complex and variable manners, voluntary and involuntary attention are separable systems. They have distinctive functions and their mechanisms are activated in different ways. The same authors highlight the key role of hold of attention, as the ability to not only capture the attention, but to be able to remain focus on it. They state that while the capture of the stimuli is important, it does not necessarily have a consequent behavior. Therefore, it is the hold of attention (that requires item memory and memory context) that is critical to moving from the reflex to the action, even to an action without conscious effort.

In his proposed model of attention, Cohen (2014) has identified 4 elements of attention that must always be present for attention to take place: 1. sensory selective attention, 2. focus and capacity, 3. executive–attention (response selection and control), and 4. sustained attention (pp.265). The processes are not considered sequential in nature, but rather processes occurring in parallel. According to the author, even though these elements share some common mechanisms, each has a distinctive role in different situations and relies on different sets of component processes. Even though some of the processes might relate more to certain brain structures, attention is not a process occurring in a single localization in the brain. Rather, it is a complex interaction of different systems.

In another well-known model of attention, Allan Mirsky (1989) focuses on anatomical systems underlying attention elements. His work is also congruent with the idea that attention is not a function occurring in a single area of the brain, but a multilayer process implying mechanisms in different areas for the different functions. After reviewing data from research in neurosciences, neuropsychological assessments and the most used batteries for attention assessment, Mirsky, Anthony, Duncan, Ahearn, and Kellam (1991) identified 4 attention functions: focus, sustain, shift and encode. Mirsky, Fanty and Tatman (1995) suggest that the items used for assessing attention in neuropsychological assessment tests, can be placed under one of these 4 factors. The assessment of attention for children was also examined using these factors to classify each assessment under the factors (Mirsky & Duncan, 2004). Years after the publication of the first model, a revision was made and changes were introduced in the model. To the focus function, execution was integrated, given the difficulty to separate the process of attending from the process of executing an action in response. Additionally, a new function was included: stability. Currently, the model includes 5 functions: focus/execute, sustain, shift, encode and stability (Koziol, Joyce, &Wurglitz, 2014).

The definitions for each process is included in the following table:

Table 1 Attention Functions. Mirsky Model

FUNCTION	**DEFINITION**
Focus/Execute	Capacity to focus in a task and execute motor or verbal responses, while screening out distracting stimuli
Sustain	Capacity to maintain attentional focus on some aspect for a considerable period of time, in order to successfully completing the task
Shift	Capacity to change attentional focus from one salient feature of the stimuli to a different one
Encode	Initial registration of information. Capacity to maintain information in memory for a short period of time, while performing mental operations with the information. Recall, and hold of information while performing action or cognitive operation
Stability	It's been vaguely described. Coherence of response . Reliability of attentional effort. Supposedly reflected in variability of response reaction times and commission of errors on Continuous performance tests.

Note: Based upon Koziol et al. (2014) and Fernandez (2014)

In addition to the attention processes, Mirsky et al (1994) also proposed a Taxonomy of attention. Cohen (2014) summarized this taxonomy including functions of attention and the brain systems involved in each function:

Table 2 Mirsky's taxonomy of attention

Attentional function	Brain system
Maintenance of consciousness and attention	Reticular formation
Transfer of reticular activation to cortical regions	Thalamic nuclei

Gating of information and response control	Corpus striatum
Memory encoding and consolidation/ Mediation of salience and affective	Limbic
Executive control	Prefrontal
Sensory selection	Parietal
Integration of heteromodal associative information	Superior Temporal

Based upon Cohen, 2014, pp. 700-705

Referring to the types of attention, many classifications are found in the literature. Most of the classifications are similar in their titles and definition of the types of attention.

For the purpose of this literature review, two perspectives: Cohen's as a North American author and Soprano's as a Latin American, are presented in the table below.

Table 3 Types of attention. Cohen, 2014-Soprano, 2009

Type of attention	Definition	Author proposing
Focused	The amount of information selected at a given time relative to the temporal–spatial constraints of the situation	Cohen, 2014 (pp. 5-7). Soprano, 2009 (pp.20)
Selective	Process by which some informational elements are given priority over others	Cohen, 2014 (pp. 5-7). Soprano, 2009 (pp.20)
Divided	Ability to attend a stimulus with the interference of a competing stimulus	Cohen, 2014 (pp.5-7). Soprano, 2009 (pp. 20)
Sustained	Attentional persistence over a relatively long period of time	Cohen, 2014 (pp. 5-7). Soprano, 2009 (pp. 20)

Effortful	Tasks require control processing, require greater effort	Cohen, 2014 (pp. 5-7).
Alert	Minimum energy mobilized allowing the nervous system to be receptive to information	Soprano, 2009 (pp. 20)
Shift	Ability to change the attentional focus, alternating between different stimuli	Soprano, 2009 (pp.20)

In the results section of the study, it will be found that not all these categories were included in the Attention Profile of Music Therapy (APMT). The rationale for such decision was based upon current research on music therapy assessment of attention, and on categories of neuropsychological assessment of attention.

Having reviewed the fundamental concept of attention, its components, and its classification, an overview of the topic of Neuropsychology is in place to allow for a full understanding of the proposed framework for the Attention Profile of Music Therapy (APMT).

2.1.2. **NEUROPSYCHOLOGY: DEFINITIONS, RELEVANT APPROACHES AND CONSTRUCTS**

In congruence with the clinical experience of the researcher, neuropsychology was chosen as the framework for understanding brain systems and processes, and for designing the Attention Profile of Music Therapy (APMT). In the previous section, attention was the focal point. The information included in that section was searched for under the scope of neuropsychological framework. In this section, an exploration of definitions, schools of thought and constructs relevant for this study will be presented.

The American Psychology Association (APA) defines neuropsychology as "a specialty in professional psychology that applies principles of assessment and intervention based upon the scientific study of human behavior as it relates to normal and abnormal functioning of brain-behavior relationships and the application of such knowledge to human problems" (APA, 2017). Stuss and Levine (2002) define neuropsychology as the clinical application of the understanding of brain-behavior relations. Contrasting with the governing interest in behavioral neurology for localization of brain activity during performance of different operations, neuropsychology builds bridges between the unilateral, sometimes considered simplistic logic of localization, and a more complex understanding of development.

In such a view, localization is not the only important feature. Issues such as the involvement of areas of the brain in multiple simultaneous processes, what Riccio (2012) called pluripotentiality, and size of injury when speaking of rehabilitation, called equipotentiality by Riccio (2012) come into play. The idea that no single anatomical structure can be responsible for complex functions is derived from studies with multiple variables including biological components, developmental accounts, and cultural components.

Many consider Paul Broca to be the father of neuropsychology, and the pivotal moment for the surge of the discipline is deemed to the publication, in 1861 of his report on a man with a language disorder (which he called aphemia). Even though some of his conclusions in that work have been proven to be wrong, the methodological approach he proposed to study cognitive processes is the reason why, many give him the title of founder of neuropsychology (Cubelli & De Bastiani, 2011).

Without a doubt, the works of Vigotsky and Luria were of outmost importance for the development of neuropsychology. At a time when access to the Russian literature in western countries was difficult, these authors were already building a theoretical framework for understanding cognitive processes. Their ideas pointed to an interaction between biological and cultural factors for cognitive development. What would come to be known as the historical-cultural approach looked at human social life, and not only at anatomical structures as the base for all cognitive processes in every person (Glozman, 2007). It is important to mention that already in the 70's, Luria had proposed the ideas of networks and systems, which present-day access to imagery has confirmed.

Cubelli (2007) has described 5 different periods in the development of neuropsychology linked to the study of aphasia, and characterized by giving more relevance to either the cerebral basis of behaviors or to the psychological theories of human cognition. 1. Associationism, characterized by the construction of schematic models that suggested the existence of networks that associated single components. 2. The second period (the holistic approach), was characterized by a growing interest in studying disorders from a psychological perspective, and by the incorporation of knowledge from other disciplines such as anthropology, philosophy and linguistics. 3. The experimental period, which coincides with the end of the Second World War, saw research that again studied the brain-behaviors relationships using methods from experimental psychology. 4. During the cognitive period, the study of individuals with brain damage allowed for hypothesis regarding cognition in neurologically intact individuals. In this period, anatomical and cerebral basis were mostly ignored. 5. Brain imaging studies. In this period, there is the possibility of observing brain functioning while individuals are performing cognitive tasks. This allows the identification of networks, reinforcing Luria's proposition of functional systems, opposing theories of brain structures as independent centers. Glozman (2007), when referring specifically to Russian neuropsychology, identifies three overlapping and

coexisting phases of development of neuropsychology. During the first phase, the focal point was the brain and its relationship to behaviors. The second phase, in turn, focused on the structure of mental activity with localization ideas coming afterwards. The third phase incorporated data from real life. In this period, the diagnostic purpose of assessment was not considered the main task, but rather the prognosis and the suggestions for rehabilitation were. An emphasis was made on individual strengths as resources for rehabilitation.

Neuropsychology, just like every other discipline, has different approaches. From the researcher's experience and the review of congress programs in the Latin American region, there have been special interests and developments in three main neuropsychological approaches: the neurophysiological, the historical-cultural, and the cognitive. A brief explanation of these approaches and their main elements and constructs with relevance to the research study is presented below.

2.1.2.1 The Neurophysiological Approach

The neurophysiological approach was constructed by Argentinian neurologist Juan Azcoaga. He was of great influence on the continent and was one of the founders of the Latin American Society of Neuropsychology. Influenced by Benton, Ingram, Luria and Vygotsky (among others) he proposed learning and the learning process as the unit of analysis for his approach. In such a process, there are four recognizable elements: 1. Basic displays (motivation, attention, memory and sensory perception); 2. Higher nervous activity (balance between excitatory and inhibitory processes); 3. affective/emotional balance; and 4. Higher brain functions (gnosias, praxias) (Azcoaga, 1997; Azcoaga & Peña, 2008). As can be seen in this approach, attention is considered one of the basic displays required for learning. The author identifies stages of the diagnostic process in this approach: a stage of clinical diagnosis which should respond to the question of what the patient has; a stage of physio-pathological diagnosis, where an explanation should be given as to why the patient has these abnormalities; a stage of recovery diagnosis where the potential of the patient to achieve progress must be identified; and finally, a stage of prognosis, where an analysis of the variables in place and the importance of rehabilitation for the patient's life perspective occurs.

2.1.2.2 The Historic-Cultural approach

Some details regarding the historic-cultural approach were presented above in this text when discussing the works of Luria. The basic element in this approach is the importance of cultural factors within the context of cognitive development. As such, there is an important role for the environment and the interactions with the person's culture in development. The constructs of complex functional systems, factors, and

functional blocks are an important part of this approach, and an invitation to go beyond localization theories, into understanding brain function as network mechanisms (Luria, 1974). Even though Luria proposed these constructs many decades ago, techniques of neuroimaging have provided the data to confirm many of his ideas. By proposing the construct of *complex functional systems*, Luria summarized his ideas on the relationship between psychological functions and the brain. He proposed that psychological functions cannot be localized in reduced brain centers, nor in all of the brain, but that each psychological function has different components that occur in different brain areas. Luria indicated that localization is dynamic, meaning that changes can occur between childhood and adulthood according to the degree of automatization (Quintanar, Solovieva & Lazaro, 2008).

Complex functional systems refers to the organized work of multiple brain areas in order to achieve a task. The systems are formed throughout life, evolve from simple systems into more sophisticated systems, and are characterized by relative stability, compensatory capacity, reorganization facility, and systemic and dynamic localization (Quintanar & Solovieva, 2003). *Complex functional systems* operate through working mechanisms named: factors. As defined by Xomskaya (2002), the most relevant factors for attention processes would be the non-specific factors (kinetic melody, dynamic, neurodynamic factor; related to the work of deep structures of the brain), the inter-hemispheric factors (global perceptive, analytic perceptive, synthesis factor; related to the work of a hemisphere) and the associative factors (control and programming factor; related to interaction processes). Even though there are brain sectors associated with some of these factors, the action is what constitutes the factor, as it is in the action that the result of the coordinated work of the brain sectors takes place. In terms of rehabilitation, the optimization of the work of a factor in one *complex functional system*, will result in a better functioning within other complex functional systems.

The last relevant construct from the historic-cultural school of thought would be the concept of functional blocks or units. When thinking of complex functional systems, the units would be brain areas with specific functions as related to the system. The first block located in the brainstem would be responsible for regulating the activation of cortical tone providing a stable base for organization. The second block would be responsible for receiving, analyzing, and storing information. The third block would be responsible for programming, regulating, and verifying activity (Quintanar, Solovieva, Lazaro & Bonilla, 2008). Attention processes are related to all blocks, with a close link to the first one.

2.1.2.3 The cognitive approach

Without a doubt, cognitive neuropsychology has dominated the interest and the literature in the field. Cognitive neuropsychology relies on experimental designs to verify hypotheses regarding cognitive processes. Within this approach, models for explaining cognitive processing are constructed through empirical data. The elements of the cognitive approach that would be relevant for this study include the considerations for differences in the processing models between children and adults, the constructs of associations and dissociations, and the findings from cognitive neuropsychology regarding attention processing.

As Castles, Kohnen, Nickels, & Brock (2014) point out, there are key differences between adult models and developmental models of cognitive neuropsychology. The adult models should be considered in the developmental perspective as a way to understand a final stage of what optimal development of the function would be. As the authors state, "The cognitive models specify what children need to learn, and the developmental theories specify how they learn it. These are two separate enterprises, but each can and should complement the other" (pp. 7). This perspective must be considered when designing tools for neuropsychological assessment of children. Instead of using the adult model (built from the deficit perspective) as the starting point, there is a need to use the developmental theories as the starting point.

The last construct to be presented from cognitive neuropsychology, would be dissociations and associations. Dissociations are found when an individual has different performance levels in tasks. It can be that the person performs very well in one particular task and very badly in another. Regardless of achieving "normal" performance, such different patterns point to a dissociation. This allows neuropsychologists to build hypotheses regarding independent processing systems for both tasks or different levels of difficulty in the tasks (Reigosa, Yañez & Uribe, 2008). Associations occur when difficulties in performing two different tasks are found. It is then hypothesized that both tasks rely on the same processing network or on two malfunctioning networks. Dissociations have been the fundamental way to describe symptoms and differentiate modules for operations (Caramazza & Coltheart, 2006). However, as Castles et al. (2014) have discussed, there is also a role for associations in understanding processing models. In the case of attention, an understanding of the processing and the individual differences that may point towards a better understanding of neuropsychological processing in music therapy would be important.

2.1.3. NEUROPSYCHOLOGICAL ASSESSMENT OF CHILDREN DEVELOPMENT

Having reviewed the fundamentals of neuropsychology, an examination of the purposes and methods of neuropsychological assessment of children is presented in this section.

For many years, intelligence tests were considered the standard in child psychology to identify problems with children's development. However, already in 1995 Vigotsky pointed out limitations of intelligence tests, as those only presented characteristics of a syndrome, without being able to provide a complete profile of the person. He then proposed an inter-functional or systems assessment to better understand interactions in a particular task and possible disorders. Over the years a more comprehensive approach has been used whereby other types of tests, including neuropsychological tests, are included in the assessment of children.

Currently, two types of classifications of neuropsychological assessments can be found in the literature. One is framed solely on the decision to use quantitative or qualitative types of tools, and the other one refers to the use of fixed or flexible designs. These classifications are also often found when speaking of research in general (Robson & McCartan, 2016).

Glozman (2002) describes the quantitative and qualitative types. The quantitative approach uses psychometric tests oriented towards the performance of a number of pre-determined tasks for every child within a given period of time. In the qualitative approach on the other hand, the tasks may vary according to the interests and needs of the child, and the tests are oriented towards the process of assessment itself, not necessarily to the results in the form of scores. According to Bittencourt-Chastinet, Morais, Solovieva, and Quintanar (2012) in the qualitative approach, all parts of the assessment process are taken into account (quality of the execution, amount of support required to complete the task, type of mistakes, responses to making mistakes, etc). Even though these factors may be quantified, there is no interest in making these factors a standard measure, as they are meant to be more descriptive in nature, in order to portray the individual in an accurate manner. The qualitative approach relates more often to the theories and constructs of Luria (Xomskaya, 2002), aiming not only at identifying a syndrome, but truly being able to provide a complete profile of the child, including difficulties, strengths, and ways in which external aid may be helpful to a child's performance.

Leany, Benuto, and Thaler (2013) have also discussed the use of a fixed versus flexible design in neuropsychological assessment. The fixed design relates to a more quantitative approach, whereas the flexible relates to the qualitative approach. Both approaches assess similar domains: "The fixed battery assesses all domains as a comprehensive rule-out/rule-in for diagnostic and prognostic determinations. The

flexible battery either uses a battery which contains standardized assessments that complement each other as a unified battery (such as the D-KEFS or the RBANS) or is made up of various assessments picked by the individual clinician to assess the relevant domains of a neuropsychological battery" (pp. 353). The fixed battery design uses only a previously established standard neuropsychological battery, whereas the flexible design makes adaptations according to the child's condition identified at the referral and interview. The flexible design is regarded as a child-centered approach (Matute, Rosselli & Ardila, 2010).

Within this framework, some proposed a mixed approach where both the quantitative methods and the qualitative approach are taken into account. According to Riccio (2012, pp. 28), clinicians often chose a combination of both approaches to balance strengths and weaknesses. For diagnostic purposes, the standardized assessments are more accepted and may be more appropriate to use. However, from the clinical point of view, the standardized do not give enough valuable information to the clinician to customize a treatment plan. Glozman (2002), elaborating on the issue of qualitative assessment, states that due to the complexity of the subject in neuropsychology, is important that new forms of interpretation of qualitative assessment are being proposed.

The important concept to keep in mind, is that neuropsychological assessment should not only be diagnostic-driven in terms of identifying a specific difficulty or failure in performance, but also should inform the clinician's perspective in terms of individual strengths and weaknesses. The result of a neuropsychological assessment should point to materials to be used in treatment processes, as well as types of support that could be more useful with an individual. Black and Stefanatos (2000) would refer to this type of assessment as process-oriented, falling under the category of flexible design assessments. As the authors state: "the way in which a problem or task is solved may be as useful and sometimes even more important for understanding neuropsychological functioning than any actual score achieved" (pp. 433). By making the needs of the child the basis of the decision of which test to use, the assessment is far more responsive to its purpose.

2.1.3.1 Areas of neuropsychological assessment

Areas evaluated in neuropsychological assessments typically include: sensory-perceptual input, verbal/language, non-verbal/visuospatial, executive function, response output, and interaction with memory in terms of attention, concentration, motivation, and arousal (Vanderploeg, 2009 pp. 18). The names of the areas may vary from one author to another.

Diverse authors have identified the areas evaluated in neuropsychological assessments. As the current study refers to neuropsychological tests and theory from

a Latin American perspective, Matute et al. (2010, pp. 71-119) are the chosen authors of reference for the names and descriptions of these areas:

- *Global cognitive assessment*: An area linked to the cognitive approach, and where the establishment of the general mental capacity is measured mainly through IQ tests. Authors highlight the importance of establishing the IQ not as an isolated measure, but as a basis for understanding results in other areas, as they relate to the general impairment of cognitive function.

- *Perceptual skills*: Relates to association areas in the brain sensory cortex, responsible for an adequate visual, auditory, hearing and tactile perception. Includes recognition of objects, recognition of phonemes, some non-verbal stimuli, and visual recognition of objects.

- *Language skills*: Relates to the levels of expressive and receptive skills, both in oral and writing tasks. Observes five functioning levels: phonological, morphological, syntax, semantic, and pragmatic.

- *Visuospatial skills*: "Determines presence of a normal analysis of visual information" (pp. 94). Includes two types of recognition: what is being looked at, and the location of the object. Construction skills are also assessed.

- *Executive function*: It is a wide concept and cannot be measured in one single test. Refers to a series of cognitive operations involved in the achievement of a goal. Includes operations usually linked to the frontal lobe, such as: operational memory, selectivity of stimuli, abstraction, planning, flexibility, and self-control.

- *Attention skills:* Refers to both the inhibition of irrelevant information and the focus on relevant information for long periods. Attention difficulties could originate in neurobiological problems or as a consequence of emotional disorders. As this area is the main focus of the current study, it will be further developed in a following section, including the types of attention.

- *Memory*: Refers to the assessment of the processes of register, storage and recall of stimuli. Assessment of memory includes subareas such as: immediate, short-term and long-term memory. The patterns and learning curves are examined in two input modalities: verbal and nonverbal.

- *Motor skills:* The authors present this area of assessment, stating that difficulties in performance on motor skills tasks can be a reflection of immaturity associated with a developmental disorder or brain injury. Assessment of this area would include soft neurological signs and gross and motor skills depending on the age of the participant.

- *Emotional and social behavior:* Using varying instruments, such as questionnaires and observation, the neuropsychologists describe the emotional and social behavior of the child. Characteristics and adaptive issues in the different contexts of involvement of the child must be assessed.

- *Academic achievement*: The authors present this area since low performance in school is one of the reasons for referral for neuropsychological assessment. Processes of reading, writing and mathematics are included. The purpose is to establish the level of performance and to characterize the difficulties the child is facing.

2.1.3.2 Neuropsychological assessment tests for children

Quintanar and Solovieva (2003), while exploring the topic of neuropsychological assessment of children, pointed out that many of the tests for children are adaptations of adult tests. Few assessments have been designed specifically for use in assessing neuropsychological development in childhood. As mentioned previously, it is fundamental to differentiate child and adult neuropsychological models. Differentiating and specifically targeting children's needs in assessment is relevant. There are tests that were first designed for adults and later validated for children. But, for the purpose of this study, only tools designed specifically for children were chosen.

Taking into account cultural differences, as they play a key role in the ecological validity of assessment processes, for the purpose of this study only those tools that were designed for Spanish-speaking populations or have studies of validity for their Spanish version will be reviewed.

In the *Guide to Psychological assessment* with Hispanics, Rosselli, Matute and Ardila (2013), reviewed several of these neuropsychological assessment tools while examining cognitive assessment tools for Hispanic children in the U.S. Some of the tools they present are shown in the table below. It must be noted that not all assessments included are considered to be neuropsychological tools, but are presented to preserve the integrity of the table. Only assessments without validation studies in Latin American countries were excluded from this table. Some of the tools included are not considered neuropsychological tools per se, but they are presented to preserve the integrity of the table.

Table 4 Neuropsychological assessments for children in Spanish

NAME	ORIGINAL LANGUAGE	TYPE	AGE	COUNTRY OF VALIDATION
Evaluación Neuropsi-cológica Infantil ENI	SPANISH	Neuropsychological battery;	6 TO 16	MEXICO, COLOMBIA, USA
NEUROPSI (Atención y memoria)	SPANISH	Memory and attention Battery	6 TO 85	MEXICO
ECOFÓN	SPANISH	Phonological awareness	7 TO 11	MEXICO
LEE	SPANISH	Reading and writing skills		
BATERIA-R	ENGLISH	Intelligence index, cognitive abilities and academic achievement	2 TO 90	USA, MEXICO, PUERTO RICO, COSTA RICA, SPAIN, ARGENTINA AND PERU
WISC-IV	ENGLISH	Intelligence IQ, perceptual reasoning index	6 TO 16	USA, MEXICO, SPAIN, ARGENTINA
ROCF	FRENCH	Constructional, visual, perceptual integration, visuomotor	4 TO 15	MEXICO, COLOMBIA

Note: From Rosselli et al. (2013)

The focus of Rosselli, Matute and Ardila (2013) was on quantitative assessments from the cognitive neuropsychology approach. As mentioned earlier in the neuropsychology section, the current study seeks to also take into account the historic cultural neuropsychological school of thought, given that is a widely used approach in Latin America, and for theoretical congruence with the process-oriented assessment practices. For this reason, the Evaluación Neuropsicológica Breve de Puebla, and the Puebla-Sevilla test are also included in the analysis. It is also evident in the clinical practices and reviewing the scientific programs of Latin American Neuropsychology Conferences (2011, 2013, 2015), that these other assessments are used frequently for research and clinical practice in the continent. Available information of such tests is included below.

Table 5 Qualitative and quanti/qualitative Neuropsychological Assessment for children

NAME	ORIGINAL LANGUAGE	TYPE	AGE	COUNTRY OF VALIDATION
Evaluación Neuropsi-cológica Infantil Breve Quali	SPANISH	Neuropsy-chological battery;	6 TO 12	NON AVAILABLE
Puebla-Sevilla ONLINE Quali/Quanti	SPANISH	Same as Breve but a computer based version with scoring system	6 TO 12	NON-AVAILABLE

Some of these tests only assess specific aspects of neuropsychological development, while others are more comprehensive in nature. However, it can be concluded that there are some neuropsychological tools available for use in Latin America or at least with norms for this specific population. Taking into account the countries of the region where this research study will take place it should be noted that none of the above-mentioned tools has norms for all countries.

2.1.4. **NEUROPSYCHOLOGICAL ASSESSMENT OF ATTENTION**

When defining attention, it becomes evident that the way to assess such a process is through behaviors that reflect the different operations involved in attention. Even though there has been a growing interest in disorders such as ADHD, an attention assessment does not only have a diagnostic purpose related to such disorders. The differentiation of a clinical population with ADHD and a non-clinical population is indeed very important, but it cannot be the only dimension explored in relation to attention. As mentioned earlier, attention is a process related to other higher processing events. As such, assessing attention skills is important to reveal information about the person's capacities for processing, storing and using information. Processing relies heavily on attention and attention profiles enrich the understanding of a person by providing information on strategies, helpful environmental cues, and selective skills.

Assessment of attention is approached in different ways, and it may include performance-based tests, rating scales (parent, teacher, clinician), and structured interviews (Mahone & Schneider, 2012). The focus of neuropsychology, especially in the area of cognitive neuropsychology, has been on performance-based tests.

In such tests, different types of attention are assessed. In her book on attention assessment, Soprano (p. 21, 2009) presents a summary of the type of tasks used for each type.

Table 6 Types of tasks to assess different types of attention. Soprano, 2009

ALERT	SELECTIVE/ FOCALIZED	DIVIDED/ SIMULTANEOUS	SHIFT	SUSTAINED
Tasks measuring the reaction time	Tasks requiring filtering capacity between auditory-visual stimuli and distracting stimuli.	Double tasks. Subject mentally handles two different sets of information, and process them in a simultaneous manner	Double tasks. Subject mentally manipulates two different sets of information and process them in an alternate manner	Long and monotonous tasks. Subject responds to a certain visual or auditory stimuli differentiated from others, considered distractors

Translated to English by the author. Taken from Soprano (pp. 21, 2009).

In Sopranos's account of attention assessments available in Spanish, the performance-based tests found included:

Table 7 Performance based tests of attention in Spanish

ATTENTION	TYPE OF TESTS	NAME OF TESTS		
Selective attention	Includes typically span tests. A growing amount of information is presented to the subject, and he must retain and immediately repeat according to what he heard or saw.	**Auditory-Verbal Span**	**Visual Span**	**Cancellation tests**
		Digit span, word span, phrases span, VADS by Koppitz	Corsi, Knox, BEM squares, WRAML-2, 40. Visual TOMAL, McCarthy's sequence-	Toulouse-Pieron, D2 Attention test, TPD (faces test), NEPSY Visual attention test (Korkman, Kirk and Kemp, 2007), Symbols search from WISC-III-IV, Magallanes rating scale (EMAv)
Sustained attention	Computerized and non-computerized. Computarized are known as Continuous performance tests, measuring the ability to detect and respond to changes occurring in random intervals during a long period of time, while	**Computarized tests**		**Non-computarized tests**
		CPT-NIMH, CPT-II (Conners), Gordon Diagnostic system, Integrated Visual and auditory Continuous performance test (Sandford and Turner, 1997), Children sustained attention task (Servera and Llabres, 2004), HAM test (Hufty, 2004)		Faces test (Thrurnston and Yela, 1988), Faces test with impulse control (Crespo-Eguilaz, 2006), Magallanes Scale (García Perez, Magaz-Lugo, 2000), Auditory continuous

	inhibiting other stimuli. Measure: detection rate, omissions, commissions, span, and decreased vigilance		performance test (Keith, 1994)
Divided attention	Tests for assessing divided attention are based upon cancellation tasks	Global- Local attention test, T-2-T cancellation test (Zazzo, 1976), Symbol search from WISC III-IV (Wechsler, 2005), L2MA (Chevrie-Muller et al (2002), Trail making test f. Children's Color trail test (Llorente et al, 2003) g. Chipasat (Gronwall, 1977) h. TED (Iglesias, 2001)	

Given that in clinical practice it is rare for attention to be the sole purpose of neuropsychological assessments, the attention tests embedded in general neuropsychological assessments should also be examined. Of special interest for this study, are two assessments: the ENI (Rosselli et al., 2004), and the Evaluación Neuropsicológica de la Atención (Quintanar and Solovieva, 2003) (ENA). The ENI was designed using a cognitive framework and the ENA a historic-cultural framework.

The ENI battery has been used for research purposes, as it is one of the few both with norms, and designed specifically for Spanish-speaking population. The areas assessed in this tool are: attention, constructional skills, memory encoding, perceptual skills, memory recall, language, metalinguistic skills, reading, writing, arithmetic, spatial skills, conceptual skills and executive functions.

The Colombian normative study for the ENI was published in 2004. A randomized sample of 252 children between the ages of 5 and 16 years old, without previous history of school failure or clinical diagnosis, was assessed using the battery. Two MANOVAS were performed using gender and age as independent variables, and scores in the subtests by cognitive blocks as dependent variables.

The first MANOVA included the following subtests: construction skills, spatial skills, conceptual skills, executive functions, attention, memory, perceptual skills, language

skills and metalinguistic skills. The second MANOVA included the academic sub-tests for: reading, writing, calculus, and metalinguistic skills. Level of education was included as a covariate. Using Hotelling's T test, MANOVAS for each subtest were obtained. To control type 1 errors, only statistic values equal or less than 0,01 were considered. To establish validity, the Wechsler Intelligence Test for Children Revised (WISC-R), was administered to 22 children. A correlation analysis of the different sub-tests of ENI and WISC-R was performed. To control type 1 errors, correlations equal or less than 0.01 in two tail distribution were taken into account (pp. 721-722).

The categories and tests included for assessing attention in the ENI are summarized in the following table:

Table 8 ENI attention tasks

CATEGORIES	VISUAL ATTENTION	AUDITORY ATTENTION
TASKS	Drawing cancellation (non-verbal)	Forward digit span
	Letter cancellation (verbal)	Backward digit span

In the domain of qualitative assessment of attention, the ENA test was designed by Quintanar and Solovieva (2003). This is an attention assessment that came along at the same time as the Evaluación Neuropsicológica Breve (ENB) by the same authors. Given the authors' consideration that a child's attention is controlled by actions (language or gestures) of the adult and that the child can use other media for external control, the structure of the assessment includes a series of play activities with the child, where some external regulation is proposed. Keeping in mind the theoretical framework of historic-cultural neuropsychology, these assessments include not only the performance of certain tasks, but also the amount and type of support required by the child to perform the tasks. As a consequence, the results give a description of how the child uses the media for the proposed external regulation. This information is crucial for tailoring a clinical process. For the pilot study of the tool, it was administered to a sample of 210 children with no clinical diagnosis in pre-school and in 1st -6th grades attending state schools in the city of Puebla, Mexico. The sample was divided into three groups according to age and level of education. Results showed significant differences in execution of all tasks (except for auditory gnosias) among school grades from preschool up to third grade. From third to sixth grade, no mistakes were observed in the performance (pp. 115). The most sensitive tasks for differentiating children with and without a diagnosis of attention deficits are the cancellation tasks, the directed play, the march (with language), and the incomplete drawings task.

The categories and tests of the ENA are summarized in the following table:

Table 9 ENA attention tasks

	LUDIC	MOTOR SPHERE	ACOUSTIC GNOSIAS	VOLUNTARY	INVOLUNTARY
TASKS	Free play	Free march	Sound identification	Schultz table	Naming objects with eyes closed
		Clapping march		Incomplete drawings	
	Directed play	March with language		Faces cancellation	
		Follow direction			

As can be seen from the available tests, the assessment of attention relies largely on linguistic and visual skills. Attention to auditory input is sometimes included, but not necessarily framed as music stimuli.

2.2. MUSIC PROCESSING, MUSICALITY, AND ATTENTION

Having already reviewed the topics of attention, neuropsychology and assessment, it is important to present the literature on music processing from a neuropsychological perspective, musicality both innate and trained, and attention in relation to music. Without yet entering into the topic of music therapy, this section's purpose is to provide a rationale for assessing attention within musical activities, relying on evidence from current research.

2.2.1. **MUSIC AND THE BRAIN**

Music and the brain is an extensive topic, encompassing findings regarding processing of the different music elements, under a variety of conditions, across the lifespan, by people with different levels of musical training. To review the entire literature available on the topic would comprise a dissertation. However, some of the most relevant elements of music processing, for this study will be presented in this section.

Research from the past 25 years, has shown that music processing, is a complex function involving multiple brain structures. As opposed to early accounts of music being processed in one hemisphere of the brain, current evidence allows the mapping of several stages of music processing, according to the demands of specific tasks, and demonstrate recruitment of various brain structures in both hemispheres (Levitin &Tirovolas, 2009; Tirovolas & Levitin, 2011). While there is more pronounced participation of the right hemisphere in music processing, it must be noted that abnormalities, dissonances, and deviations from expectations are processed in the left hemisphere. Also, the study of music processing in trained musicians demonstrates a shift in hemispheric processing, due to the learning of theory, and how it impacts the perception by adding other cognitive elements to it. Several networks have been identified for the processing of different musical elements without necessarily defining a "music center" (Levitin, 2012). Neuroimaging techniques have also contributed to the identification of networks and the study of different operations related to music perception and production (Levitin & Tirovolas, 2009; Koelsch, 2011). Such operations include: listening, remembering, performing, learning, composing and less frequently movement and dancing.

Levitin and Tirovolas (2009) have identified eight perceptual attributes including pitch, timbre, tempo, rhythm, loudness, meter, contour and special location. The authors argue that the organization of these perceptual attributes and their particular characteristics are defined by culture, and can be identified as musical grammar. Particularly, the authors present evidence that pitch, rhythm and loudness are processed separately as the stimuli is first perceived and combined later to create the perception of a musical object.

According to Levitin (2012) and Levitin and Tirovolas (2009), this would be some of the anatomical structures involved in the music processing of attributes:

Table 10 Anatomical Brain structures in Music Processing

Musical element or operation	**Brain structure**
Pitch	Cortex
Timbre	Heschl's gyrus and superior temporal sulcus
Tempo and rhythm	Cerebellum and basal ganglia. Premotor cortex and supplemental motor area for rhythm perception
Loudness	Network of circuits beginning at the brain stem and inferior colliculus, extending to the temporal lobes
Listening to music	Reward and pleasure networks on nucleus accumbens, ventral tegmental area, and amygdala
Tracking of musical expectations	Cortical network involving limbic structures, cerebellum, prefrontal regions, anterior and posterior cingulate gyrus.
Tonal relations	Networks in the right temporal region, left frontolateral prefrontal, and right inferior frontal cortex, predominantly

Note: Based upon Levitin (2012) and Levitin and Tirovolas (2009)

Levitin (2012), also proposed musical attention, memory and tracking of temporal and harmonic structures to be higher cognitive functions in music, processed by specific neural networks.

As research has shown, there are neural networks for music processing from birth (Perani et al., 2010). The perceptual abilities of babies for tonal and rhythmic stimuli suggest music perception as an evolutionary trait (Levitin, 2012). However, these abilities also encompass an early adaptation (within the 1st year of life) to cultural

factors and subsequent understanding of the musical grammar of a particular culture (Levitin, 2012). As such, processing of native and non-native music will be different in terms of cognitive operations required for processing (Nan, Knösche, Zysset, Friederici & Friedend, 2008)

Differences in music processing caused by musical training, suggest differences in localization (Levitin, 2012), additional activation of motor areas during rhythm perception (Grahn & Brett 2007), and furthermore deactivation of structure in the prefrontal cortex for jazz musicians while improvising (Limb &Braun, 2008)

In terms of connected networks, one of the most common areas of study over the years has been the study of language and music in terms of evolution and function (Levitin & Tirovolas, 2009). As Lütz (2012) highlights, the understanding of language and music as being processed by separate networks, and each of them, processed in different hemispheres of the brain, has changed in the light of research. Patel (2003) and Peretz, Radeau and Arguin (2004), have proposed the idea of shared circuits for syntax in both music and language. In turn, Schulze and Koelsch (2012), studying working memory in music and language, concluded that such functions required the same mechanisms for both tonal and verbal information, suggesting the same link. Similarly, Tillman (2012) states that the understanding of music cognition not only provides information on music processing, but also on language processing, reaffirming such a connection. In terms of research applied to specific behaviors, both Bolduc and Montesinos-Gélet (2005), and Forgeard, Schlaug and Norton (2008) have concluded in their study of music and phonological awareness, that abilities to discriminate melodies are predictive of phonological awareness, which is considered a pre-requisite for reading ability.

Music and movement have been other areas studied. Evidence from research has shown that brain structures responsible for movement are automatically activated by music, even if the person is not moving (Levitin & Menon, 2003). Another network connection studied has been the relationship between music and emotion. Juslin and Sloboda (2013) have presented a framework for perception and arousal of emotion in music, with evidence from neuroimaging and music in psychology research, highlighting the processes involved in both networks. Koelsch (2009, 2015), explains that evidence from neuroimaging studies suggests that music modulates activity of limbic and paralimbic brain structures implicated in emotional processing; he also summarizes a framework for a theory on music-evoked emotions. This author however, discusses the fact that some of the proposed principles for the framework have not been studied empirically, suggesting further research in the topic.

Generally speaking, the changing trends in research on music and the brain, can be tracked in Tirovolas and Levitin´s review of empirical studies published in the Music Perception Journal (2011). The authors identified several areas of research interest, in the period between 1983 and 2010. While a larger preference for studies in pitch

perception was found for the earlier years analyzed, the later studies show an interest in temporal perception. This could also be paired with the changing trend in terms of stimuli used for studying music perception. While isolated sounds were more common stimuli in the first studies, the use of sequential music has been introduced and used more often in the latter studies. As can be inferred from this evidence, the earlier studies were more concerned with isolated sounds and their processing, while in later years the focus has been shifting to music as stimuli. Most studies have used musicians/adults as participants, while a small number of articles include children as participants (less that 10% of the articles). Interestingly enough (while also associated with the limitation of the study to evaluate articles from the Music Perception Journal), most of the outcome measures in the articles included are perception tasks, while production and memory tasks have been less frequent

2.2.2. **COULD MUSIC BE CONSIDERED A COMPLEX FUNCTIONAL SYSTEM?**

Emerging from the music and the brain section, and in direct relation to the neuropsychology chapter, it should be asked if music can be thought of as a *complex functional system*, previously defined (in section 2.1.2) as the work of different brain areas in a coordinated way to perform a task.

Even though no specific references to music as a complex functional system were found in this literature review, several authors from the field of music psychology have indeed described music processing as a system, with similar features to other complex functional systems. In her review: *The nature of music from a biological perspective*, Peretz (2006) states that humans are musical, therefore have shared core processes and knowledge allowing them to appreciate music. Through music making, more complex knowledge takes place. However, it is not necessary for the functioning of the core system. This infers that perhaps there is not a music "gene," but the brain as with many other human traits, devises a system to be able to develop the capacity of listening to, enjoying, and/or performing music at various levels of complexity. In turn, Levitin and Tirovolas (2009) propose subsystems for music processing, describing it as a complex higher order cognitive process. Such subsystems include attention, categorization, memory and feature detection. Similarly, reinforcing the idea of music as a system, Janata (2009) indicates how different musical tasks recruit components of the system according to the specific demands of such task, emphasizing the multi-faceted character of musical engagement.

Characteristics of *complex functional systems* (as presented in section 2.1.2.) are: evolved through life, relative stability, compensatory capacity, reorganization facility, and systemic/dynamic localization. Reflecting on the available literature, there is

evidence from imaging studies, describing some of these characteristics in music processing.

Regarding the first characteristic: evolved through life, evidence in the literature demonstrates, that there is indeed a brain ability for music processing and that such a system, while maintaining certain stability, changes through life. Studies track existence of the ability for music perception, as early as in newborn babies (Perani et al., 2010). As mentioned in the previous section (2.2.1.), such ability continues to organize and develop according to culture and environmental factors, and differences in processing are found between children and adults, and trained musicians and adults with no musical training (Koelsch, Fritz, Schulze, Alsop &Schlaug, 2005)

Regarding characteristics of relative stability and systemic and dynamic localization, it has become clear through the years that music processing implicates multiple brain areas, left and right hemisphere, and both cortical and subcortical structures (Levitin & Tirovolas, 2009). Other authors (Koelsch, 2009; Peretz and Coltheart, 2003) identified organized networks for the different stages of music perception, speaking not only of such characteristics, but also of identifiable modules for music processing. Studies on amusia (congenital and acquired), also show evidence of different networks for perception of distinct musical elements and involvement in musical operations (Levitin, 2009).

As for the characteristics of compensatory capacity and reorganization facility, evidence from music therapy and music psychology research, shows that the system can be optimized and reorganized following brain injuries (Gilbertson, 2005; Hald, 2012). Literature in the past 5 years has shown important developments regarding the usefulness of music therapy assessments for differential diagnosis and treatment in disorders of consciousness (Lichtensztejn, Machi & Lischinsky, 2014; Magee et al., 2014; Magee & O´Kelly, 2015; O'Kelly, 2013: Schnakers, Magee & Harris, 2016), Authors reinforce the idea of compensatory capacity in music, and adding that music as an auditory stimulus, may be more useful in the treatment of such disorders, due to the characteristics of localization, compensation and reorganization in music processing.

Regarding the construct of neuropsychological factors and the existing premise that strengthening the work of a factor in a complex functional system, would also strengthen the work of the same factor in other systems, it seems relevant to discuss generalization from music to other systems. According to Hegde (2014), generalization could be possible due to recruitment of emotion centers, alternation and regulation of cognitive processes involved in music cognition, and interactions between music and other systems (as explained on the previous section). Research in

music therapy and music psychology supports such an idea, showing the interactions of music making with other system networks, and effects of music therapy and music medicine on several areas such as language, movement, cognitive abilities, emotion, and social skills (Altenmüller & Schlaug, 2013; Christensen, 2012; Hald, 2012; Koelsch, 2009; Peretz & Zatorre, 2005; Wan & Schlaug, 2010).

In the literature review analyzed there was only one study referring specifically to the relationship between neuropsychological development and music development. In 2010 a research team from Colombia evaluated the impact of the Batuta program (a government-funded program bringing music education to children at social high-risk) on neuropsychological development and social behaviors (DNP, Grupo Sinergia, 2010). The study was framed within the evaluation of the public policy program of the Departamento de Planeación Nacional (DNP). The author of this dissertation participated in the study, researching musical development. Besides an evaluation of the music education process to observe curriculum compliance and skills acquisition of the students, the study also examined the impact of program participation on variables such as leadership, resilience and neuropsychological development. The assessment of music skills was designed specifically according to the music curriculum of the program, and the neuropsychological test used to assess neuropsychological development was the ENI (Matute, Rosselli, Ardila & Ostrosky-Solis, 2007). The study showed participation in the program impacted two main areas of neuropsychological development: meta-linguistic and spatial skills. Correlations were found between some areas of evaluation of music skills and some areas of neuropsychological development. Even though this is not a music therapy study and focused on a music education program, the results are encouraging as they relate to the relationship between music development and neuropsychological development, and the idea of music as a complex functional system.

2.2.3. **INNATE AND TRAINED MUSICALITY**

Some musical skills develop quite early in life and even in individuals with no formal music training. There is indeed a process of musical development, not necessarily linear, and there are general characteristics of the process and specific developments that will occur in light of a child's environment (Cross, 2005; Juslin & Sloboda, 2010).

As is the case with other systems, musical skills are also affected by learning processes. When a child or even an adult goes through a process of music learning, the skills and the processes involved in his/her development will become more sophisticated (Altemmüller, 2012).

There is a need to differentiate even in a general manner, the skills that will develop regardless of musical training, from those that could only be developed by those with formal musical training. In other terms, differentiation should be made between *general* and *domain-specific* aspects of musicality.

Of importance for such differentiation, would be the ideas relating musicality with evolutionary tasks. As mentioned in previous sections, Perani et al. (2010) identified abilities for music processing early in life. Malloch and Trevarthen (2009) presented a framework for the idea of musicality from an evolutionary perspective, introducing the concept of *communicative musicality*. According to the authors, musicality has a role in the social interactions of a child, and interaction in music is necessary for the later development of verbal communication. Through acoustical analysis of interactions between babies and their mothers, they identified three parameters defining this construct: pulse, quality and narratives. Such aspects are identified in the early baby-mother interactions, and can also be traced in musical interactions across the life span. Arousal mechanisms linked to music processing that would be later described in the attention and music section, would also be an indication of a fundamental role of music in evolutionary terms.

As early as 1986, Edward Gordon was presenting differentiation of general and specific tasks in musical development. Gordon explored the idea of musical aptitude as innate to every child. However, as a function of contact with musical experience, musical aptitude stabilized. The process of stabilization would occur after the age of 9.

To differentiate the innate and the learned aspects of music, Hannon and Trainor (2007) proposed the terms: *early developing universal constraints*, and *passive and active musical experience*. They proposed that *universal constraints* are those musical aspects that are developed early in life, by every person. Consonance, temporal regularity, and multisensory interactions are considered universal constraints. Afterwards, and through a process of enculturation (passive musical experience), individuals with and without formal musical training develop what they called *domain general processes*, including aspects of: scales, keys, tonality and meter. In relation to individuals with formal musical training (active musical experience), the authors state that *domain specific processes* are developed including: explicit knowledge, music reading and performance. Under these premises “virtually all members of society acquire implicit culture-specific knowledge of the spectral and temporal structure of music” (p. 470).

Exploring further the aspects involved in basic musical development and musical expertise, Hallam’s study on concepts of musical ability (2010) offers a similar

perspective on the issue. The study explores the factors people consider to be central to the concept of musical ability. The author states that the concept of musical ability has been historically linked to aural skills. Responses from a large sample of musicians and non-musicians with a wide age range were examined. Sense of rhythm, the ability to read music and the ability to perform were identified as the factors more related to the concept of musical ability. As mentioned in the previous paragraph, Hannon and Trainor also considered the last two factors as specific to individuals with active musical experience, therefore as *domain specific processes*. However, the sense of rhythm is not considered domain specific by those authors. It is considered both a universal constraint (developed early in life), and an area of development for individuals without formal musical training, therefore a *domain-general process*.

Bamberger (2003, 2006) also refers to aspects developed by individuals with and without formal training. In a 2006 study, the author explored different ways of relating to music tasks by subjects with different degrees of musical training. The author states: "individuals with no formal music instruction spontaneously invoke powerful organizing constraints guiding their apprehension of the familiar music of our culture" (p. 12). This can be related back to the concepts of universal constraints and *domain general processes*. Earlier (2003), Bamberger had studied the process of composition by non-musicians, concluding that there are basic characteristics of tonal structure present in their musical works. This conclusion is congruent with Hannon and Trainor's classification of *domain general processes*, as it refers to the aspect of key and tonality.

Bigand and Poulin-Charronat (2006) compiled various laboratory experiments and concluded that there is a predisposition for music processing, and that exposure to music in the context of everyday life (without formal training) ensures the development of some musical skills. Taking some of the characteristics proposed by Trehub (2003) as universal constraints, and more centered on receptive skills, the authors included: processing of pitch and temporal patterns, melodic contour and interval changes, as universal musical components that will be developed early in life. These authors found that just being exposed to music can develop skills to the point where there is little differentiation between highly trained and untrained listeners in performance of listening tasks.

As a conclusion, it can be stated that there is evidence in the literature from music psychology and music education that there are some music skills which can be considered "universal" and which every person will develop early in life, such as communicative musicality, and that other skills will develop further as a function of the amount and quality of formal music instruction. This is an important aspect to factor into the development of this study, as the focus would be on the more general

aspects of music development, as they relate to attention, instead of the more *domain specific processes*.

2.2.4. **MUSIC AND ATTENTION**

As mentioned earlier, the relationship between music and different cognitive processes has been studied in the literature. Attention is not an exception, and there is literature from the disciplines of cognitive psychology and music psychology. Koelsh (2009) state that music automatically captures attention networks, pointing to a potentially beneficial effect for persons with attention disorders, or in stressful and painful situations.

The relationship between auditory processing, auditory stimuli and attention, has been a subject of some research studies (Ouimet, Foster & Hyde, 2012; Saupe, Widmann, Bendixen, Müller, & Schröger, 2009; Saupe, Widmann, Trujillo-Barreto & Schröger, 2013; Spielmann, Schröger, Kotz & Bendixen, 2014; Strait, Kraus, Parbery-Clark, & Ashley, 2010). An entire area of research is dedicated to the analysis of auditory scenes, where the different components of an auditory environment filled with different sounds (such as tones, phones ringing, etc), are studied to determine the interactions and neural correlates with processes such as attention. These types of studies, use mostly sounds and combinations of sounds as stimuli - not music.

In comparison, studies of music and attention are not as frequent. As Tirovolas and Levitin (2011) stated, for years the trend in music perception research was to study isolated sounds. It has not been until recently that sequential music is also being used. One reason for this could be that the complexity of the music stimuli makes it difficult to isolate the different variables in order to understand the effects and relationships between the stimuli and higher cognitive functions. Given the importance of modularity for cognitive neuropsychology, this issue poses a difficulty for researchers designing studies.

Meltzer, Reichenbach, Braiman, Schiff, Hudspeth, & Reichenbach (2015) studied the response of the cortex to the beat of music. Using EEG, they studied the neural responses to music stimuli of participants with no previous music training. Their results indicate that there is a neural response to the beat of a melody. This response is a steady-state response to familiar music, and a weaker response to nonsensical music. Furthermore, they suggest that attention enhances the cortical response to music stimuli. Also, when including other stimuli modalities, the researchers found that the neural response is larger when participants are cued to focus on the music stimuli, versus when they are cued to ignore the music stimuli. In their study on the use of music to sustain attention of pre-school children, Wolfe and Noguchi (2009) also found that within a music session (versus a spoken presentation of the same story), children scored better on the attention tasks. Even though researchers were not able to point to a single component of music that might cause such an effect, there is

again evidence that music stimuli may have a positive effect on recruitment of attention networks. Similar results were reported by Robb (2003) in a study about group participation, including attentive behaviors of children with visual impairments. When comparing music sessions and play sessions, a significant improvement on attentive behaviors was found for the music sessions.

Some studies can be also found with adults and older adults. Their results are also consistent with those obtained in other studies of attention and inter-modal stimuli, using auditory stimuli other than music (De Jong, Toffanin & Harbers, 2010, Saupe et al., 2009). In such studies, the authors conclude that attention to auditory stimuli enhances the cortical response. In terms of the neuropsychological constructs and referents presented in previous chapters, such response of cortical arousal, would relate to the activity of the first block (proposed by Luria, 1974).

An important conclusion from this group of studies on attention and music would be that familiar music generates a stronger response in terms of cortical arousal (one of the bases for attention), and that focusing on music would cause a larger neural response with a possible positive effect on the sustainment of attention.

Even though it would be then possible to think that these responses to music are due to specialized modules of attention for music processing, several studies, suggest that this is not the case. Janata et al. (2002), in their research studying mechanisms involved in listening to polyphonic music, find that areas recruited in the attentive listening to music are not music specific but rather general areas for a wide range of processes, including attention.

In the line of studies of music training and attention, there is evidence of how trained musicians have better perceptual skills for auditory attention (Strait et al., 2010; Ouimet et al., 2012; Zhu, Xia & Shinn-Cunningham, 2011). The mechanisms underlying such evidence include the development of higher cognitive structures for the music stimuli, and much larger involvement of cortical structures due to mechanisms of long term memory and associations with the amygdala, formed through years of studying music.

2.3. MUSIC THERAPY, ASSESSMENT AND ATTENTION

In the first two parts of this literature review, the concepts of attention within a neuropsychological framework, assessment in neuropsychology, general findings in music processing, musicality, and music and attention were presented. In this final section of the literature review, the specific literature for the field of music therapy is reviewed. The general ideas on music therapy assessment, the procedures for establishing validity and reliability in music therapy assessment tools, as well as the specific music therapy assessments for attention, are included.

2.3.1. **ASSESSMENT IN MUSIC THERAPY**

Assessment in music therapy is an integral part of treatment. However, references to music therapy assessments in the literature are not abundant. Some of the articles on the topic are meta-analysis or reviews of methods of assessment used by music therapists (Chase, 2004; Jacobsen, 2012; Sabatella, 2004; Wigram & Wosch, 2007; Wilson & Smith, 2000). Even though their results are not uniform, most of these reports criticize the lack of systematized assessment in the music therapy profession.

As proposed by Wigram (1999), Wigram and Wosch (2007), and also examined by Jacobsen (2012), this could be due to the fact that music therapists may feel that in systematized assessments, there is no room for flexibility and creativity, two features highly valued in the clinical context. It is clear that there is a need to include assessment processes in the clinical settings, and therefore assessment tools are required. Often clinicians develop assessment strategies for their specific population and setting. There are few assessment tools that are used by a large community of music therapists (Wilson & Smith, 2000; Wigram, Pedersen & Bonde, 2002), and fewer tools have gone through standardization process. In light of the demands of institutions and research environments, the lack of such assessments frequently leads music therapists to use assessments from other professions. Consequently, sometimes music therapy findings and conclusions are being reported based upon non-music therapy assessment data. On such occasions, the data specific to music therapy ends up as descriptive data or anecdotal information. As Wigram (1999) highlighted, the analysis of music is necessary for systematic assessment, and provides a connection between humanistic approaches and natural sciences.

It is also relevant for clinicians to be able to comprehend the many purposes or functions of assessments. Often, assessment is solely related to diagnostic purposes. However, there are many other functions of assessments. A broader understanding of such purposes, could lead to an increased interest in assessment processes.

Bruscia (cited by Meadows, Wheeler, Shultis, & Polen, 2005) and Wigram (1999) proposed different purposes or functions of assessments.

According to Bruscia, there are five main purposes of assessment (Meadows et al., 2005, pp. 31-33):

Table 11 Assessment purposes in Music Therapy

PURPOSE	**DEFINITION (from Bruscia, 1993. Cited by Meadows et al., 2005)**
Diagnosis	"Detect, define, explain and classify the client's pathology, focusing primarily on its causes, symptoms, severity, and prognosis". It is distinct from the diagnostic purpose in other professions, as music therapists in most countries are not allowed to diagnose. However our findings may contribute to the diagnoses in other professions, and mostly gives us an in-depth understanding of the patient.
Interpretation	"Efforts are made to explain the client's problems in terms of a particular theory, construct, or body of knowledge". Two steps: 1. Gather samples of music-making or responses to music. 2. Interpret the responses according to a particular theory or construct.
Description	"Efforts are made to understand the client and the client's world only in reference to him or herself".
Prescription	"Intention is to determine treatment need of the client and to provide a database for formulating goals, placing the client in the appropriate programs, and identifying the most effective methods of treatment".
Evaluation	"To establish a basis for determining progress". Uses the initial data as baseline for recording results of treatment

From a similar perspective, Wigram (1999) proposed forms of assessment and data gathering.

Table 12 Assessment purposes in Music Therapy. Wigram (1999)

Assessment model	**Function**
Diagnostic assessment	To obtain evidence to support a diagnostic hypothesis
General assessment	To obtain information on general needs, strengths and weaknesses
Music Therapy assessment	To obtain evidence supporting the value of music therapy as an intervention
Initial period of clinical assessment in music therapy	To determine in the first two to three sessions a therapeutic approach relevant to the client
Long-term music therapy assessment	To evaluate over time the effectiveness of music therapy

Note: Taken from Wigram (1999) (p.8)

Given that both perspectives (Bruscia and Wigram) have been influencial, and are highly valuable to the field of assessment in music therapy, an interesting exercise is to highlight similarities from both perspectives, to define what will be named: Defining features of music therapy assessment.

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Table 13 Defining Features of Music Therapy assessment

DEFINING FEATURES	**BRUSCIA**	**WIGRAM**
Gathers information for the purpose of diagnoses	Diagnostic assessment	Diagnostic assessment
General information of the client in relation to him-herself	Descriptive assessment	General assessment
Gather data from music-making and interpret it in light of a distinctive theory	Interpretive assessment	
Obtain evidence supporting value of Music Therapy as an intervention		Music Therapy assessment
Determine treatment priorities and relevant methods	Prescriptive assessment	Initial period of clinical assessment in music therapy
Establish a baseline to determine treatment progress	Evaluative assessment	Long-term music therapy assessment

Note: Based upon Bruscia (1993) and Wigram (1999)

Research should be carried out to establish the kinds of assessments music therapists perform most often. From the studies that have been done on the use of assessment, it could be implied that assessment is being used mainly in the clinical day-to-day setting to determine treatment priorities and to establish baselines to determine progress ((Chase, 2004; Sabatella, 2004; Wigram & Wosch, 2007; Wilson & Smith, 2000).

Also, it would be important to understand the domains of assessment primarily addressed by music therapists in their tools. Meadows et al. (2005) describe the domains of assessment proposed by Bruscia, summarized in Table 14. He stresses

that some music therapy assessments center on just one of the domains, while others deal with more categories or all of the domains.

Table 14 Assessment Domains proposed by Bruscia

DOMAIN	**SUMMARY OF DEFINING FUNCTION**
Biographical	Gathering background information
Somatic	Record physiological and psychophysiological responses to music
Behavioral	Data from observable behaviors during the session
Skills	Information about musical and nonmusical skills displayed during the session
Personality or sense of self	Gathering information of the self including aspects of self-awareness, self-esteem, identity formation and unconscious aspects of personality
Affective	Emotional responses to music and listening and range of emotional expression through music.
Interactional	Gathers information about communicativeness and interactions between client-therapist, peers in group settings, and family members

Note: Based upon Meadow et al. (2005)

In terms of data gathering, many authors have stated the importance of gathering data from the music in music therapy assessments. Even though it sounds like the logical thing to do, some checklists used as assessments focused on non-musical events and/or behaviors, more than on those related to music-making and music listening.

Bruscia, in contrast, proposed the sources of musical information. These categories correspond to each one of the methods of music therapy: improvising assessments, re-creating assessments, listening assessments and composing assessments.

Wigram (1999) and Wigram et al. (2002) state that music therapists should collect one or more types of data.

Table 15 Types of music therapy assessment data

Musical data	**Examples of musical events/musical characteristics**
Musical behavioral data	Examples of clients' behavior without musical description
Behavioural data	Characteristics of general behavior in music therapy
Interpretative data	Interpretation of clients' musical and general behavior supported or not supported by musical or behavioral data
Comparative data	Comparison of clients' behavior in music therapy with information from other situations.

Note: Based upon Wigram (1999), and Wigram et al. (2002)

As mentioned before, many music therapists use assessment tools from other disciplines in their assessment process. By doing so, there is a failure, or at least a lack of congruence, as the process of gathering data would be detached from the data sources available for music therapists.

Another important issue to examine is the use of quantitative versus qualitative assessment in music therapy. Even though the reported use of quantitative tools from other disciplines to validate music therapists' work is quite widespread, when it comes to music therapy assessments, there are few that could fall under the quantitative category. Furthermore, the information about the validity and reliability of some tools, as well as the systematic instructions for application, are not reported, and the theory guiding the construction of the measure sometimes remains unclear (Wilson & Smith, 2000; Wigram & Wosch, 2007). However, as Jacobsen (2012) reports there has been a shift in assessment research over the past few years, acknowledging the importance of standardization. As a result, a small number of assessments have been tested for some type of validation and reliability using different procedures, and the results have been published.

In what some consider a more congruent way of doing assessment in music therapy, there is the dimension of the qualitative assessment. Wigram and Wosch (2007) proposed the idea that this type of assessment is used more widely in music therapy because somehow there is a sense that it provides more flexibility, which is key in music therapy treatment. Loewy (2000) defends the use of descriptive results to explore the complexities of the person and the music therapy processes and calls it explicit descriptive writing.

This may be true but – be it qualitative or quantitative – music therapists must bear in mind the call of Sabatella (2004) to strive for a more scientific approach to music therapy assessment, and Wigram's ideas on standardization of music therapy assessment protocols, as way of bridging the humanistic model of music therapy and the natural sciences.

2.3.2. VALIDATION AND RELIABILITY IN MUSIC THERAPY ASSESSMENTS

Validity and reliability are key concepts for assessment design. According to Prickett (2005), and Maroof (2012), validity pre-supposes reliability. As such, considerations for reliability precede those for establishing validity. Reliability deals with the need for a measure to give consistent results under similar circumstances (Prickett, 2005).

After reliability is established, validity must be also established, as reliability does not ensure validity in any way. As defined by Maroof (2012), "validity is a process of establishing a test's clinical utility in describing, explaining, and predicting phenomena. Validity is not a function of a test per se, but is inextricably entwined with the context in which a test is applied." (pp. 16). Prickett (2005) establishes different types of validity: content (items measured in a comprehensive manner), criterion-related (extent to which a test serves as a predictor of a behavior or criterion) and construct validity (items measure what they were designed to measure) as well as internal and external validity. Maroof also explains other two types of validity: incremental (the extent to which adding certain aids help to explain variations, or if adding a new measure improves understanding, or measures in a better way a proposed construct) and ecological (the extent to which the measure relates to how the person performs in the tasks of everyday life).

Going through a rigorous process of validation presents many challenges. But it should not discourage this type of research, as it is fundamental for the development of the discipline and the profession (Wigram & Wosch, 2007). Since 2002, standardization processes of music therapy assessments are found in the ltierature. Even though research-based, validated assessment tools are not too common (and not widely used clinically), interest in the area has been growing. In 2016, the International Music Therapy Assessment Consortium was created by a group of music

therapists, with the purpose of continuing to work on development and standardization of assessment tools, increasing awareness of use of assessment, and strengthening clinical applications (Jacobsen et al., 2016).

In this section, music therapy assessment tools published in the last 10 years, with available data on their processes for establishing reliability, and in some cases also validity, are presented. An overview of their design, population, and methods for establishing reliability and validity is included. Even though there are other music therapy assessments in the literature (Jacobsen, 2012. p-53-55), a decision has been made not to include those assessments without available data on their validity and reliability, as it is the topic of this section.

One of the tools that has undergone a fairly large process of standardization is the Music Therapy Assessment Tool for Low Awareness States (MATLAS) (Daveson, Magee, Crewe, Beaumont, & Kenealy, 2007). The name of the assessment was later changed to Music Therapy Assessment Tool for Awareness in Disorders of Consciousness (MATADOC) (Magee, W. Personal communication, February 3rd/2013). The purpose of the tool is three-fold involving: diagnostic purposes (along with information from the multi-disciplinary team), evaluation of treatment by providing a baseline to report results of the process, and to inform the music therapy treatment. The tool establishes 14 behavior response categories (BRC's). The assessment is meant to be administered by a trained music therapist in 4 sessions over a period of 8-10 days. This assessment tool went through two research studies aimed at establishing different types of validation. In the first stage, clinical records of patients were audited over a 4-month period. Results on 3 scales used in the institutions' routines were monitored. The scales were the Wessex Head Injury Matrix Main Scale (WHIM), the Sensory Modality Assessment Rehabilitation Technique (SMART) and the MATLAS. Some variables related to administrators' professions, patients' profiles, duration of the assessment, and number of completed assessments, were taken into account. Using correlational statistical methods, concurrent validity (a type of criterion validity) of the tool was established. Following the pilot study, further research has been conducted, regarding validation and reliability of the tool. With a sample of 21 subjects, inter-rater reliability, internal consistency and dimensionality of the test were studied. The assessment sessions were rated by two raters who had received training in the use of the MATLAS. Statistical methods used include intra-class correlations, Cronbach's alpha, Principal Component Analysis, and Rash Analysis. Results indicate the assessment is a reliable and unidimensional tool that can be used in music therapy treatment and research. The strength of the tool is its sensitivity on the auditory domain, which could be very useful in interdisciplinary assessment of Low Awareness States. In a later study, Magee, Siegert, Daveson, Lenton-Smith, and Taylor (2014) reported results establishing the

reliability and the validity of the principal subscale of the MATADOC. This subscale examines 5 areas: responses to visual stimuli, responses to auditory stimuli, awareness of musical stimuli, responses to verbal commands, and arousal. These areas are also part of other assessment tools for people with disorders of consciousness. In 2016, the researchers reported results for inter-rater reliability and test-retest reliability, of the two subscales of the assessment (Magee, Siegert, Taylor, Daveson, Lenton-Smith, 2016). As stated by the authors, these subscales have a more clinical utility, rather than a diagnostic purpose. The second subscale is intended to inform intervention planning, and deals with behavioral responses to music, and music responses in two items. The third subscale informs goal setting and clinical care through seven items. In this scale, aspects of behaviors that go beyond basic perception, into operations mediated by cognition, are examined. Results of the study were mixed in reference to the inter-rater reliability and the test-retest reliability of the scales. More specifically, the item assessing musical responses has poor reliability. The authors present their arguments for not taking the item out of the scale because of its clinical usefulness, and also because there might be underlying reasons for the poor results on this item.

Another study, focusing on the diagnostic outcomes and sensitivity of SMART and MATADOC tools, reports that while there is strong agreement regarding diagnoses between the two tools, the sensitivity is contrasting (O'Kelly & Magee, 2013). While the MATADOC has higher sensitivity in the auditory and visual domains, the SMART has higher sensitivity in the motor domain. It is relevant to note that the authors highlight that further research is required to validate information about diagnostic outcomes, as results from SMART and MATADOC were not contrasted with a validated tool. Also, the results should be taken with caution, as the scoring system of both scales is different. As a result, MATADOC could appear more sensitive as the scale offers smaller variation on its rating.

Another music therapy assessment that went through a rigorous testing process for validity and reliability is the Assessment of Parental Competencies-APC (Jacobsen & Wigram, 2007). In her PhD dissertation, Jacobsen (2012) examined these issues, as well as the effect of a Music Therapy process on parenting competencies and parent-child interaction measured by the APC and two standardized questionnaires. The study had two groups divided according to clinical and non-clinical populations and a multiple strategy sequential design. The clinical group was divided based on two conditions: music therapy treatment and regular treatment. Scores included an overall parent-child interaction in music score, autonomy score, turn analysis score, negative response, and positive response score.

In terms of determining reliability, pre-treatment scores were analyzed for inter-rater agreement, test-retest reliability and internal consistency. Also, concurrent, content, and construct validity were examined, using data gathered from scores of clinical and non-clinical populations, as well as correlations between scores of the clinical

population on APC and standardized questionnaires of parental competencies. Statistical methods used in this study included Pearson's correlation for inter-rater agreement, internal consistency, and establishing correlations with the standardized questionnaires. The Bland-Altman plot was also employed to measure limits of inter-rater agreement. For test, retest reliability, Intraclass correlation coefficient was used, using data gathered from the first and the second pre-treatment assessment session. Results established reliability and validity of the tool.

The Music Interaction Rating Scale (Schizophrenia; MIR-S) was designed to be used with adults suffering from chronic schizophrenia (Pavlicevic, 2007), in the context of improvisational music therapy. Pavlicevic is concerned with the musical and relational aspects within musical co-improvisation in the music therapy setting. The use of the scale requires microanalysis of improvisations. However, it can also be used as a macro- analysis tool. For the scale, nine levels of musical interaction are established, and the administrator rates specific moments of the improvisation (time units) or a complete improvisation. The levels range from no musical contact to musical partnership. The author conducted research on inter-rater agreement of the scale, using as raters both trained music therapists and professional musicians. Results showed high correspondence in raters' scores.

A different assessment, this one with diagnostic purposes, is Oldfield's Music Therapy Diagnostic assessment-MTDA (2006). This assessment was developed for use at a particular institution with the aim of assisting to differentiate between three diagnoses. It is administered in two half-hour sessions, including different types of music engagements and interactions, maintaining however a somewhat flexible design. When during clinical practice it became apparent that MTDA seemed to be useful in assisting diagnosis, the author decided to perform research to establish some degree of validity of the tool. Data were gathered from the MTDA and the ADOS (Autistic Diagnostic Observation Schedule) from a total sample of 30 verbal children with a possible diagnosis of autism spectrum disorder. Questionnaires for the tools' administrators and interviews with children also served as data sources. The ADOS was chosen as the tool for statistical correlation because of its interactive nature and the fact that it does not rely on quantification of the social behavior, but on the quality of it. A scoring system establishing cut-off points for the different diagnosis for the MTDA, similar to the ADOS, was designed for the study in order to be able to establish comparisons. Correlations between MTDA and ADOS were run using non-parametric statistical tests (Kruskal-Wallis test and Wilcoxon signed-ranks test). Results indicated a strong agreement on the diagnosis between the tools. Differences in the type of information on the children that each assessment gathered were established. Oldfield strives for further research with larger sample, to be able to look into further validation of her assessment.

In another study, Moreau, Ellgring, Goth, Poutska and Aldridge (2009), established psychometric results of the Music Therapy Rating Scale (MAKS). The MAKS was designed as an evaluative or long-term music therapy assessment to be able to establish a baseline to measure treatment results in terms of expression and communication. This interval scaled-rated tool has two sub-scales. The expression scale, focusing on solo improvisations, has 14 items. The communication scale, focusing on improvisations between therapist and patient, has 13 items. After a first study researching inter-rater agreement on the use of the scale in 1996, recommendations were made on the importance of rater's training in the use of the tool. Based upon the results, the scale was revised, and this version was used for the 2009 study. In the study, music therapists with 3-5 years of experience used the scale to rate six video excerpts from each child of the sample engaging in solo and duo improvisations during the assessment session. Information from personality and psychopathology questionnaires was gathered, but its use within the design was not reported in the article. The sample of the study included both clinical population (38 patients from a university hospital for child and adolescent psychiatry), and non-clinical population (24 healthy children from several schools in the area). Inter-rater agreement, objectivity using Pearson's inter-rater correlation, reliability using Cronbach's alpha, and sensitivity for change using MANOVA, were tested. Authors concluded that once the weak items were taken out, the MAKS fulfilled psychometric standards of objectivity, reliability, and sensitivity to change.

A music therapy scale used as an assessment tool is Nordoff-Robbins Client-Therapist Relationship in Musical Activity Scale. Even though the scale has been used in music therapy for many decades, the first report of validity and reliability was published on 2009 (Mahoney, 2009). The purpose of the scale is evaluative/long term music therapy assessment. Within the context of improvisational music therapy, the original scale established 10 levels of participatory behaviors along with ten corresponding behaviors of described "resistive" behaviors to assess capacity for interpersonal relating through music. In further revisions, three levels were taken out, leaving seven levels in total with 14 items. As mentioned by Wigram et al. (2002), the scale has been widely used for many years within the Creative Music Therapy model, and even music therapists working outside of the model sometimes use it. The aim of the Mahoney study was to establish inter-rater agreement of the reviewed version of the scale and to determine whether the level of music therapist training on the use of the scale could affect inter-rater reliability. Participants of the study were 34 music therapists from four different countries. Of these, 21 were trained in the NR approach, while the remaining music therapists had been trained in other approaches. All had at least three years of experience with populations exhibiting developmental delays or autism. Each participant rated ten video excerpts of music therapy sessions. Inter-rater agreement was tested using Cohen's Kappa statistic to respond to the subtlety of the type of rating

of the scale. 78% of the total sample obtained scores within 1 point of the total group mean score (established as the statistically acceptable range of agreement) with a significance level of $p < .05$. Results of the study showed consistent inter-rater agreement, suggesting a strong reliability of the scale. However, differences were found between groups of music therapists trained in the Nordoff Robbins approach and those trained in other approaches, suggesting that even though the scale may be used by all clinicians, additional training on its use may result in better application.

It is important to mention, that in the studies of the MATADOC, the MAKS, and the Nordoff Robbins client-therapist scale, the researchers found that the music therapist's level of training in the use of the scale was of paramount importance. This again affirms the necessity of training both music therapy students, as well as practicing clinicians, in administering and evaluating music therapy assessments.

Another music therapy assessment grounded in Nordoff-Robbins' improvisational approach is the Individual Music-Centered Assessment Profile for Neurodevelopmental Disorders (IMCAP-ND) (Carpente, 2014). In addition to the Nordoff-Robbins approach, it is also informed by various child development theories, and the Developmental, Individual-Difference, Relationship (DIR)/Floortime model by Stanley Greenspan. The tool's purpose is to assess musical play interactions with individuals with neurodevelopmental delays, serving as a baseline for determining course of treatment, and also to serve as a pre-post treatment measure. The tool has three quantitative scales. Scale I: Musical Emotional Assessment Rating Scale (MEARS), Scale II: Musical Cognitive/ Perception Scale (MCPS), Scale III: Musical Responsiveness Scale (MRS). In all three scales, therapists report on the frequency of each response using a scoring system from 1 to 5 (1 being: exhibits musical response rarely, if ever, and 5: consistently exhibits musical response) and the type of media (vocal, instrumental, movement) in which the target response is expressed. Scale I (MEARS) contains 5 sub-scales, dealing with the abilities in musical play to: Level 1- attend, Level 2- respond affectively, Level 3 - adapt, Level 4 - engage, and Level 5 - interrelate. On each level, target responses are established. Most of the levels contain 4 target responses, with the exception of Level 5, with eight target responses. In addition to reporting the frequency and type of media of the target response, the therapist reports the type of support, using a scoring system from 1 to 5 (1 being maximum/full physical, and 5 no support/independent). In Scale II (MCPS), responses to five musical elements (rhythm, melody, dynamic, phrase, and timbre) are reported. The therapist reports the frequency and media used in the following categories: react, focus, recall, follow, and initiative. On Scale III (MRS), musical preferences, perceptual efficiency, and ability to self-regulate in musical-play are assessed. The therapist reports the efficiency, preference and self-regulation in tempo, dynamic, pitch range, and attack. When reporting self-regulation, a + or – sign is added to the

number according to either hyperreactivity (+) or hyporeactivity (-). Reliability data of the tool for populations with Autism Spectrum Disorders has been submitted for publication, but not yet published. The author has granted permission to share the information. (Personal communication with John Carpente, January 10, 2017). Inter-rater agreement was chosen as the procedure for establishing reliability. Two music therapists, both with experience in improvisational music therapy, but with different amounts of professional experience (one and three years of experience), observed and rated 30 videos of the administration of the tool. No information on whether or not the therapists were trained in the Nordoff-Robbins method is provided in the article. The music therapists underwent a three day, fifteen hour training, providing detailed preparation for using and scoring the assessment. The age range of the participants was from 4 to 15 years old. Using weighted kappa (for nominal data) and intraclass correlation (for interval data), results showed a high level of inter-rater reliability for all three scales. Moreover, according to the strength of reliability interpretive standards for weighted kappa, 100% of the results for Scales II and III, and 98% for scale I, are "almost perfect." Studies to establish validation data for the tool are being implemented (Personal communication with John Carpente, January 10, 2017).

Another music therapy assessment that has been studied for validity and reliability is the Category System for Music Therapy (KAMUTHE). Christine Plahl developed this scale to be used with a population on the autism spectrum. It is an instrument to assess the non-verbal communication of children with ASD in music interactions. The first version of the scale was in German, and then a second version in English was developed. From this version, Gattino (2012) created a Portuguese version and performed the validation study of the scale for Brazil.

The KAMUTHE scale uses video microanalysis to assess both the duration and the repetitions of a behavior within the music interaction. It includes ratings of behaviors for the music therapist and the child. For the music therapist, categories of musical, verbal and non-verbal behaviors are rated. Under each category, there are four types of behavior to choose from. For the child, the categories are: direct or look, play, vocalize, and gestures. Under each category, there are between two and six types of behaviors. For the validation study, Gattino followed a five-step sequence: translation, protocol development, administration of the assessment to a sample of children with ASD, data analysis, and verification of validity evidence. Content validation was established by sending the tool to two experts in music therapy for children with ASD. They rated the clarity and relevance of each item, using a Likert scale. No major changes to the scale resulted from this procedure, as experts' ratings were above those expected for almost every item. Following this procedure, the protocol for application of the instrument was developed. Six-part, 30 minute sessions were designed for use in the study. As part of the protocol, each subject participated in three sessions.

The protocol was administered to 39 participants. Given the amount of data, the researcher decided to focus on ratings of some of the children's behaviors, leaving out the therapist's behaviors categories. The behaviors chosen as more relevant were: vocalizing, gaze to therapists face, rhythmic movement, and creating sound with instrument-body. Videos were analyzed by two evaluators to establish inter-rater agreement. Evaluators rated 18% of the videos together to ensure reliability. Results from Intraclass correlation established inter-rater agreement. For convergent validity, the rated behaviors were compared using Spearman Correlation coefficient, with scores on the Children Communication Checklist (CCC) and the Childhood Autism Rating scale (Brazilian version of the CARS). Correlation was established with results on the CARS, but results didn't support correlation between the KAMUTHE and the Children Communication checklist. Authors discussed the accuracy of the CCC, given the possible assessment biases of parents and teachers. Discriminant validity was also established using Spearman correlation coefficient, and analyzed the results for two behaviors: gaze to therapists face, and create sounds with instrument/body. The second is purely related to music making, but the first one refers to a social interaction, providing the contrast needed for discriminant validity. Even though the authors state that the construct, convergent, and discriminant validity established enable the tool for use in Brazil, further studies should be performed to assess the tool as a whole, including all child behaviors and therapist behaviors.

Working with a different population, the Music in Dementia Assessment Scales (MiDAS) is an observational assessment tool developed to measure the engagement in musical experience of dementia patients (McDermott, Orell, Ridder, 2014). The tool consists of five visual analogue scales (VAS), with the two extremes labeled as: none at all on one end, and highest on the other end. The VAS corresponds to the following identified areas of the impact of music: levels of interest, response, initiation, involvement, and enjoyment. For each area, questions regarding behaviors and moods are provided in a MiDAS form (McDermott, Orell & Rider, 2014). The maximum score in each area is 100, for a total score on the MiDAS of 500. An independent supplementary checklist with six reactions (agitation/aggression, withdrawn/low in mood, restless/anxious, relaxed mood, attentive/interested, and cheerful/smiling) is also provided. The preliminary psychometric evaluation of the tool included processes for reliability, content, and construct validity. The participants of the study were nineteen residents with Alzheimer's disease attending music therapy groups in two different care homes. The music therapy groups were run by music therapists with over ten years of experience in the field. Before-and-after ratings from the staff were gathered, as well as before-and-during ratings from the music therapist. To establish inter-rater reliability, the author of the assessment attended three music therapy sessions in one of the care homes and rated the participants independently from the music therapist leading the group. Only 7 participants attended all the

sessions where the second rater was present. The data for the seven participants were included in the analysis. Using Intra- Class Correlation (ICC), a high level of therapist inter-rater reliability was established. High correlations between the five VAS were found. From the staff data, low inter-rater reliability was found, possibly due to differences in knowledge of the patients from staff members. Good test-retest reliability among ratings from staff was also found. To establish concurrent validity, the Quality of Life in Alzheimer's disease test was administered at baseline, mid-treatment and end-of-treatment. The scores were combined for an overall correlation, using Spearman's rank correlation which found adequate concurrent validity. To establish construct validity, factor analysis was run on the results of the 19 participants. Despite the small sample, the results from the factor analysis were acceptable, resulting in good construct validity. Further evaluation of the tool with a larger sample has been suggested by the author.

More recently, and following the arising interest in studying Music Therapy assessments and interventions for people with disorders of consciousness, O'Kelly and Bodak (2016) published a pilot study of the Music Therapy Assessment tool for Advanced Huntington's Disease (MATA-HD). The study included three phases of development of the tool, including a first phase using focus groups, a second phase for field testing of the tool, and a third phase to establish psychometric properties of the tool. The convenience sample included 19 adult participants (15 female, 4 male) from three residential wards, with known diagnosis of Huntington's disease, and receiving group music therapy or referred to it. In the first phase of the study, a group of experts (music therapists and professionals from other disciplines) evaluated the first version of the tool for user friendly characteristics, and inclusivity as an assessment tool. The expert music therapists, also added musical responses to be included in the musical subscale. The drafted version of the tool, included 20 items, divided in 6 subscales: Arousal/Attention (4 items), Physical Presentation (3 items), Communication (3 items), Musical (2 items), Cognition (2 items), and Psychological/Behavioral (6 items). Such version was used with a development sample of patients to evaluate the measure in terms of validity and internal consistency. Following statistical analysis using Spearman's rank correlation, the final version of the assessment was designed including 15 items divided in subscales as follow: Arousal/Attention (3 items), Physical Presentation (2 items), Communication (2 items), Musical (2 items), Cognition (1 item), and Psychological/Behavioral (5 items). In the third phase, the reviewed version of the tool, was used for 10 music therapy sessions, to establish validity and internal consistency. Scoring of the test, included bi-directional scores, and uni-directional scores. The scales were designed in line with the tools used for comparison in construct validation.

To establish construct validity two tailed Spearman's correlation was used calculating the relationships between scores. Good construct validity (higher than 0,7) was found for items related to mood, communication level, communication effectiveness, choice,

social behavior, arousal, and attention. To establish internal consistency, Cronbach's Alpha was applied to the data set showing good internal consistency in 11 of the 15 items related to engagement in therapy. The remaining 4 items, are the ones using a scale measuring a bi-directional continuum (from -2 to 2) violating assumptions of the Cronbach's Alpha test. However, the researchers argued that those particular items are the ones, closely related to pathology specific issues on Huntington's disease (involuntary movement, mood over time, aggression, and agitation). Authors suggest a further refinement of the tool, to separate these subsets.

As for establishing inter-rater reliability, the 10 sessions of phase 3 were assessed by two music therapists (one of them the lead clinician), who independently provided ratings for each patient following each session. Intra-class correlation (ICC) averaged 0,65. Following further training and retesting, after identifying differences in rating concepts across raters, 5 additional group sessions were performed and the analyzed data provides an ICC of 0,7, considered to be adequate Inter-rater reliability. Intra-rater reliability was also established, using videos of 10 sessions of one patient (provided by a different clinician), and reviewing therapist scores at two different points in time (immediately after the session, and 3-5 months later while watching the video of the session). A mean intra-rater intra-class correlation of 0,68 was obtained, suggesting average to good intra-rater reliability. Four tools were used for running correlations to the MATA-HD, aiming at establishing construct validity: the Neuropsychiatry Inventory, the unified Huntington's disease rating scale, the UHDRS for advanced patients and the Behavior Observation Scale for Huntington. While authors were unable to establish construct validity of the MATA-HD using the above mentioned tools in general, certain considerations are highlighted. A focus on relevant items, might indicate validity of the assessment for mood, communication, cognition and social behavior. Similar patterns on data regarding aggression and agitation on MATA-HD and the other tools, suggest that the construct measured is indeed the same, but that such behaviors are absent at an advanced stage of the disease. MATA-HD scores of arousal, attention and eye contact, are also reliable when compared to data from the other tools. Even though it was not possible to establish construct validity of the tool, results of internal consistency, inter-rater reliability and intra-rater reliability, suggest MATA-HD is a reliable assessment tool for patients with Advanced Huntington's Disease.

In addition to the already mentioned assessments, a couple of music therapy assessments dealing with the issue of attention, have been designed and tested for reliability and validity: the Music Based Attention Assessment (MAA-R) (Jeung, 2013), and the Music Attentiveness screening assessment (MASA-R) (Waldon, Lesser, Weeden & Messick, 2016). Given its relevance for the topic of this study, the validity and reliability procedures for these assessments will be presented in a separate section, in the Music, Music Therapy and Attention section (2.3.3.).

In the following table, the summarized information on music therapy assessments with reliability and/or validity data available is presented along with the authors, types of reliability and validity procedures, and years of publication of the results.

Table 16 Music Therapy assessments. Reliability and Validity

Name ot the Assessment	**Authors of the articles (year of publication)**	**Reliability**	**Validity**
Music Therapy Diagnostic assessment	Oldfield, A. (2006)		Criterion/ concurrent
MATADOC (former MATLAS)	Daveson, B., Magee, W. Crewe, L., Beaumont, G., and Kenealy, P. (2007). Magee, W., Lenton-Smith, Siegert, R., Daveson, B., and O'Kelly, J. (2012). Magee, W., Siegert, R., Daveson, B., Lenton-Smith, G., and Taylor, S. (2014). O'Kelly, J. and Magee, W. (2013). Magge, W., Siegert, R., Taylor, S., Daveson, B., Lenton-Smith, G. (2016).	Inter-rater reliability, test-retest (of two subscales)	Criterion/ concurrent
Music Interaction Rating Scale	Pavlicevic, M. (2007)	Inter-rater agreement	
Music Therapy Rating Scale (MAKS)	Moreau, D., Ellgring, H., Goth, K., Poustka, F., Aldridge, D. (2009)	Inter-rater agreement	
Nordoff Robbins client-therapist relationship in musical activity scale	Mahoney, J. (2009)	Inter-rater agreement	
Assessment of Parental Competencies	Jacobsen, S. (2012)	Inter-rater agreement, test-retest reliability, internal consistency	Criterion/ Concurrent, Content and Construct

Category System for Music Therapy (KAMUTHE. Plahl, C)	Gattino, G. (2012)	Inter-rater agreement	Content (expert evaluation), construct/ convergent and discriminant
Music Based Attention Assessment	Jung, E. (2013)	Internal consistency	Construct (factor analysis)
Music in Dementia Assessment Scales (MiDAS)	McDermott, O., Orgetta, V., Ridder, H.M., Orell, M. (2014)	Inter-rater agreement, test-retest reliability	Content (expert consultatio) Criterion (concurrent) Construct (Factor analysis)
Music Attentiveness Screening Assessment (MASA-R)	Waldon, E., Lesser, A., Weeden, L., Messik, E. (2016)	Test-retest, interobserver agreement	Construct
Individual Music-Centered Assessment Profile for Neurodevelopmental Disorders (IMCAP-ND)	Carpente, J. (Submitted for publication, 2016)	Inter-rater agreement	Not available yet
Music Therapy Assessment tool for Advanced Huntington's Disease	O, Kelly, J., Bodak, R. (2016)	Internal consistency, inter-rater agreement, intra-rater agreement	Concurrent Content /expert consultation

From the information available in the music therapy literature, it can be concluded that even though there are few assessment tools in the field that have undergone validity and reliability procedures, interest in assessment has been growing since 2005. The current literature contains valuable information regarding research-based design and validation procedures. These findings can support both the need and the feasibility of designing an Attention Profile in Music Therapy (APMT). It is also clear that while psychometric procedures are vital to establish validity and reliability, there are also clinical considerations that need to be taken into account when the assessment tools are not designed with diagnostic purposes, but with evaluative, prescriptive, and interpretive purposes.

2.3.3. **MUSIC THERAPY ASSESSMENT AND INTERVENTION ON ATTENTION**

In this section, literature on music therapy assessment and protocols for rehabilitation of attention through music therapy are presented.

Specifically in the field of studies of ADD and ADHD, music therapy interventions have been examined for their effectiveness (Pratt, Abel & Skidmore, 1996; Jackson, 2003; Rickson, 2006). These studies have concluded that music therapy interventions improve the attention span of children with these diagnoses. However, the mechanisms underlying such effects are not presented in the findings of these studies.

In the area of clinical interventions for attention rehabilitation, Thaut and Gardiner (2014) have presented a Musical Attention Control Training Program. The program provides "structured active or receptive musical exercises involving pre-composed performance or improvisation in which musical elements cue different musical responses" (pp. 196). Taking as a starting point the fact that music can provide a frame for focusing, maintaining, and shifting attention, the program includes seven clinical protocols designed for the enhancement of different types of attention. Activities were designed following the same general thinking of neuropsychological tests. General features of the protocols are presented in the table below. Some features, such as the brief description of the activity, do not include detailed information, nor the step-by-step process here, only the parts considered relevant for this paper. For the complete protocol, refer to "*Handbook of Neurologic Music Therapy*" (Thaut & Hoemberg, 2014), chapter on Musical Attention Control training (Thaut and Gardiner, Eds. 2014)

Table 17 Clinical Protocol of Musical Attention Control Training Program (Thaut)

Name of protocol	**Brain System and function targeted**	**Goal of exercise**	**Activities. Brief description**
Auditory perception (Selective and sustained attention)	Attention system (including frontal lobes and brainstem); auditory perception system (including right temporal and parietal areas)	To be able to continue to focus attention on a given stimulus and correctly interpret the nature of information they perceive	Individual or group setting. Different recorded music is used. Songs with words, a band recording and a symphony recording. Song with words: Listen and note every time a target word is sung. Repeat with two words. Band and symphony recording: Listen and write every musical instrument they hear. Play back and identify.

In the here and now (sustained attention)	Attention system, bilateral frontal lobes, brainstem	To continue focusing attention on a stimulus from the environment	Individual or group setting. Following a relaxation activity with music in the background, the therapist establishes a rhythm appropriate for chanting, and leads the participants into chanting, describing the activities they are doing in the here and now. All procedures to an action.
Select and focus	Attention system, bilateral frontal lobes	To select a stimulus from the environment, remain focused on that stimulus, respond appropriately and ignore competing stimuli	Group setting. More than 4 participants. Using percussion instruments, participants will be assigned a number (1 or 2). Therapist leads the number 1s in playing 4/4 beats. Then, the number 2s in playing ¾ beats. Then all participants play together. Each participant must sustain the assigned beat. After a while, the beats are switched.

Sustained attention: Therapeutic music exercise for attention improvement	Attention system, bilateral frontal lobes, brainstem	To maintain attention to and follow changes in a sustained auditory stimulus	Ideal for individual setting. Can be done in groups. Using pitched and non-pitched instruments, therapist and client play together. Client must follow variations introduced by the therapist. Proposed variations are: play/rest, tempo changes, rhythmic pattern changes, changes in note duration, changes in loudness, changes in pitch/register. Instructions are given to begin with the basic: play/rest variation.
Selective attention: therapeutic music exercise for attention improvement	Attention system, bilateral frontal lobes and brainstem	To select and respond to auditory target stimulus, from an array of continuous stimuli	Ideal for individual setting. Can be done in groups. Therapist presents a musical cue to the client. Whenever the client listens to the cue during an improvisation, he should respond with a specific signal (such as stopping playing).

Alternating attention	Attention system, bilateral frontal lobes, brainstem	To alternate attention between two or more auditory stimuli and follow each stimulus when it is presented	It is more feasible in group settings. Two leaders are appointed. Each leader will be in different parts of the room. Each leader will clap a brief rhythmic pattern. Participants follow the leader. Leaders alternate turns in random durations. It can be done with eyes closed.
Divided attention	Attention system, bilateral frontal lobes, brainstem	To track and respond to two or more auditory stimuli simultaneously	Group or individual setting. In individual settings, therapist will play two instruments simultaneously. In group settings, a "target client" is designated and the other 2 clients participate cuing. Each cuing player plays in a way that gives a message to the "target client" to play in a certain way. The "target client" must respond to both musical cues.

Note: Based upon Thaut and Gardiner, 2014 (pp. 260-268)

Few studies are found in the literature reporting on outcomes of the Musical Attention Control training program. One of the studies, by Thaut et al. (2009), focused on the effect of therapeutic music techniques on the executive function of patients with acquired brain dysfunction. Four different 30-minute music therapy sessions were designed and implemented with patients. Each session targeted a particular function (i.e., attention, memory, etc.). Neuropsychological measures were taken prior to the session and after the session was over. For attention, the chosen measure was the digit span from the Wechsler Adult Intelligence Scale-III. The authors described the musical attention control exercises, including rhythmic synchronization, and modulation of patterns by tempo, loudness and rhythmic pattern, which was linked to sustained and focused attention, and related to the concept of paced attention. Even though the results for other areas of executive function, such as mental flexibility, were positive, this was not the case for the results of the attention area. Furthermore, the fact that the participants were not randomly assigned to the control and experimental groups, produced differences in the groups that prevented the generalization of the results. The researchers suggested that future studies should include randomized control trials and a series of music therapy interventions, as opposed to a single intervention, to establish effects of different conditions on attention and memory, the areas where positive effects were not encountered.

More recently, Pasiali, La Gasse and Penn (2014) evaluated the feasibility and effects of the Musical Attention Control Training with adolescents diagnosed with autism or other developmental delays. The protocol included 8 group music therapy sessions, and used TEA-CH as the scale to measure attention. TEA-CH consists of 9 tasks that measure sustained, selective, and attentional control/switching attention. The researchers designed experiences in music-making that would train skills in each attention type. Not all protocols included in the MACT were used. This is a brief description of the music activities related to the different attention types:

Sustained attention. Activities requiring the participants to focus on changing musical stimulus (changes on elements such as dynamics, tempo, and rhythmic patterns).

Selective attention. Activities requiring the participants to focus on one musical cue while ignoring others. Maintaining self, while others play differently, switching instruments or patterns when given a specific musical cue (it could be a discordant chord)

Attentional control/switching attention. Complex activities requiring participants to focus on two auditory sources at the same time. It could involve the participant chanting and playing at the same time, or playing parts of a musical arrangement.

Due to the sample size, the results are limited to the participants of the study. However, the results are promising, indicating positive trends regarding scores on selective and attentional control/switching attention.

The music attentiveness screening assessment (MASA-R) (Waldon, Lesser, Weeden & Messick, 2016) was recently evaluated to establish its validity and reliability. Originally designed by Wolf and Waldon (2009), the assessment's goal is to establish the extent to which children, attend to musical stimuli. Even though the scale has been designed for use in the medical setting, it has only been tested for use with non-clinical populations. Authors discuss the importance of obtaining this information, to be able to design interventions for use with children in hospital settings undergoing painful procedures. Based upon existent research, the authors argue that both active passive distraction techniques, may be useful to reduce pain during procedures. However, to be able to design the most appropriate intervention for each child, it is necessary to establish their ability to attend to music. Following the first pilot study of the MASA (Waldon & Broadhurst, 2014), changes were suggested for the tool, and for further studies of the MASA. The MASA-R is the revised version of the tool. The assessment consists of two items, involving the child in a motor action, while listening to popular children's music. In Item 1, the child must point to a picture of a cookie, every time he hears the word cookie in a popular American children's song. Authors describe this item, as the item for selective attention. In Item 2, the child must point to pictures of a male or female singer, according to who is singing during a CD record of a popular children's song from a movie. This is consider a task of divided attention.
The study tested construct validity, test-retest reliability and inter-observer reliability (Waldon et al, 2016) to establish the technical adequacy of the tool. The sample had 69 children between the ages of 4 and 9 years. To establish construct validity, the auditory attention subtests of two neuropsychological assessments were used: The NEPSY II for children 5-9 years old, and the Woodcock Johnson tests of Cognitive abilities. For the statistical analysis, authors converted raw scores on the Neuropsychological assessments into *z scores* (a standard metric tthat will allow comparisons between different tests). Multiple regression analysis were performed between the combination of scores (item 1 and 2 combined) and the neuropsychological instruments, and Pearson's correlation for each item and the neuropsychological instruments. Results showed evidence that the MASA-R is indeed measuring auditory attention, and that the combination of items is a better predictor of auditory attention, than the isolated items.
To establish test, re-test reliability the assessment was administered within two weeks of difference to all participants. Intraclass correlation results showed acceptable ICC, with an ICC of 88.95% for Item 1, and 91,95% for item 2. To establish inter-observer reliability, the examiner and an observer provided scores for a convenience sample of

49 children, in both the initial and the re-test administration of the MASA-R. An ICC of .99,95% for item 1, and .98,95% were found.
Results from the study, suggest that the MASA-R can be a reliable and valid measure of attentiveness to music. However, the assessment has not been tested for its validity and reliability with clinical populations. The authors point that, as the next step in research of the tool. Authors also suggest to further explore the effect of music preference on results of the MASA-R.

Continuing with the topic of Music Therapy and assessment of attention, Jeung (2013) published the Music-Based Attention Assessment for patients with traumatic brain injury. Advocating for the inclusion of music therapy in the assessment of attention, the researcher states that the current procedures for assessing auditory attention do not resemble the world's acoustic environment. The researcher originally presented a tool with a 54 multiple-choice items scale, providing scores for sustained, selective and divided auditory attention. The tasks were designed with processing and identification of melodic contour as the primary construct. This variable has been used previously in research on auditory attention (Ouimet et al, 2012), and the evidence indicates that tasks involving melodic contour identification activate different types of attention. The stimuli are presented in different conditions including: with and without environmental noise, and two contours played by different instruments. The items are presented to the patients using a computer device. After listening to the stimuli, the client must identify the direction of the melodic contour without and with distraction, and of two simultaneous stimuli. The average time of administration of the test is 20 minutes.

For the study of validation and reliability, a total of 187 participants were asked to take the assessment. Both clinical and non-clinical populations were included. Exploratory factor analysis was used to identify constructs underlying the items. It determined the factors in which the test is divided: selective/divided, sustained/short, divided/long, sustained/medium to long, and selective/noise. From the total of 54 items, 9 items were taken out of the assessment for having factor loadings less than the critical value. As a result, the assessment in the review version is a 45-item scale. Confirmatory factor analysis (i.e., exploratory factor analysis re-performed with a restriction) on the 45-item MAA-R demonstrated statistical stability and satisfied the minimum requirements of the subject-to-variable ratio

Looking at the final distribution of the items among the factors, the sustained short factor has 4 items, the sustained-medium to long factor has 13 items, the selective-noise factor has 6 items, the selective divided factor has 16 items, and the divided long factor has 6 items. The characteristics of the items included on each factor, and the

correspondent activated structures and processes, point to a specific type of attention. The table below elaborates on such characteristics.

Table 18 Music Based Assessment of Attention Factors and Types of Attention

FACTOR	**Description of item**	**Type of attention/mechanism**
sustained short	5 tone melodic countours on piano (3 seconds)	Alert/Arousal
sustained-med to long	Single 10-15 tone melodic contours on piano, flute or guitar (5-10 seconds)	Sustained/Maintenance of attention
selective-noise	single, 5-15 tone melodic contours presented with environmental noise.	Selective auditory attention/focus
selective divided	Two sets of items. 1.Identifying directions of 5-15 tone melodic contours presented with differently-timbred melodic distractors 2.Identifying directions of double-layered, 5-10 tone melodic contours presented simultaneously by the same or different instrument timbres	Selective/divided
divided long	double-layered, fifteen-tone melodic contours presented simultaneously by	Divided attention/ relationship with working memory

	different or identical instrument timbres.	

The properties of the items were established finding good item to total correlations for all items. Confirmatory factor analysis reinforced the five factors identified in the exploratory factor analysis. High test-reliability was established using Cronbach's alpha, and Spearman Brown.

Overall, the Music Based Attention Assessment tool has shown to be a valid and reliable tool. However, in terms of target population and ecological validity for the clinical settings that the Attention Profile In Music Therapy attempts to serve, the procedures and materials would be difficult to use. Once again, it is fundamental to take into account all variables when designing assessment tools.

Even though the literature on Assessment of Attention in Music Therapy is not extended, the results from the validated assessments in the topic, suggest that the function of attention can be in fact observed and measured in music therapy. However, the nature of the items designed for that goal has been varied. Even though both assessments are research based, they serve different target populations, and present auditory attention in different ways, choosing to focus on different attentional components. While the Music Attention Control Protocol includes other tasks, more similar to a music therapy session, it is not designed as a baseline assessment of attention in music therapy, but as an intervention designed to promote positive changes in the attentional function. The Attention Profile in Music Therapy, aims to be able to find an approach to item design related to the regular music therapy setting, while striving for maintaining the nature of the tasks.

2.4. SUMMARY

In the course of the literature review, several issues have been examined.

First and foremost, key concepts of attention, such as its definition and characteristics were presented. Given that the theoretical framework under which the function of attention and the music therapy approach are being looked at is neuropsychology, the fundamental definitions, approaches, and constructs, such as *complex functional system* and *blocks* were introduced in a second section. Methods for neuropsychological assessment and assessment of attention were examined, exploring the dilemma between using quantitative or qualitative tools. The key issue of purpose of the assessment as the fundamental parameter is discussed, to favor a mixed approach. Current available neuropsychological assessments for Hispanic populations

were presented, including the assessment that will be used in the pilot study of the music therapy assessment tool.

Overall, there was a presentation of the theoretical framework for the main topic of study of the assessment tool: attention, and a review of the assessment practices in Latin America. Following this, a brief presentation of general findings regarding music cognition, music and language, and music and emotion, emphasizing the fact that music processing is an activity that involves more areas of the brain that was originally thought is found. Having reviewed this evidence, research findings are included that could support the author's premise of music being a complex functional system. Differences between innate and trained musicality, in terms of the general versus the domain specific musical abilities are presented, to highlight the fact that even without formal musical training, there are some musical abilities that are innate, and can be displayed by every person. In the final section of the chapter, the evidence linking music, music processing, and attention processes is examined. Even though there is a body of literature on the topic, it should be noted that while auditory processing has been studied widely, studies using music stimuli specifically are less frequent, leading to less available information regarding music processing and attention. The information available in this chapter points to the feasibility of exploring attentional processes in music.

Afterwards, assessment theory and practices in music therapy are presented. The first part presents general information on purposes and types of assessments in the field. The importance of relying on music as the main material for assessment in music therapy, and the need for building a body of knowledge in music therapy assessment that could reinforce the validity of music therapy as a discipline and a profession, are discussed. Then, detailed information on music therapy assessment tools that have been validated is shared. Even though the number of validated tools is small, it is evident that the interest in this area has been growing over the past years. From the validation studies, it can be concluded that there is not a unique way to approach psychometric validation. Issues such as the characteristics of the tool, the populations, and the tools used for establishing correlations, are all factors that must be taken into account when deciding on a research method. The method must respond to the specific needs of each study. This idea was a guiding point of reference in the design of the current study. Towards the end of the literature review, studies closely related to the topic of music therapy assessment of attention were presented in detail. Those studies and protocols presented designs of music tasks related to different types of attention, and the rationale for design of the tasks. Even though none of the studies in this section have the same population or neuropsychological approach as the proposed designed tool, their ideas and designs were important for the construction of this tool. All of

these research studies are recent, showing a growing interest in the issue of attention assessment in music therapy.

CHAPTER 3. RESEARCH QUESTIONS

As mentioned several times on the previous chapters, part of the rationale for the design of the APMT, is the need in music therapy to have valid and reliable assessment tools. Being so, validity and reliability are main areas of interest for this study.

The research questions addressed the need for establishing certain types of validity and reliability through a pilot study of the APMT

Main question: Can a music therapy assessment designed to provide a profile of the attention of a child, do so in a reliable and valid manner?

Sub-question 1: Is it possible to establish inter-rater reliability of the proposed assessment?

Sub-question 2. Will there be correlations between results from standardized neuropsychological assessment of attention and the proposed music therapy assessment supporting criterion/concurrent validity of the music therapy assessment?

Sub-question 3. Can factor analysis be used to support construct and content validity of the music therapy assessment?

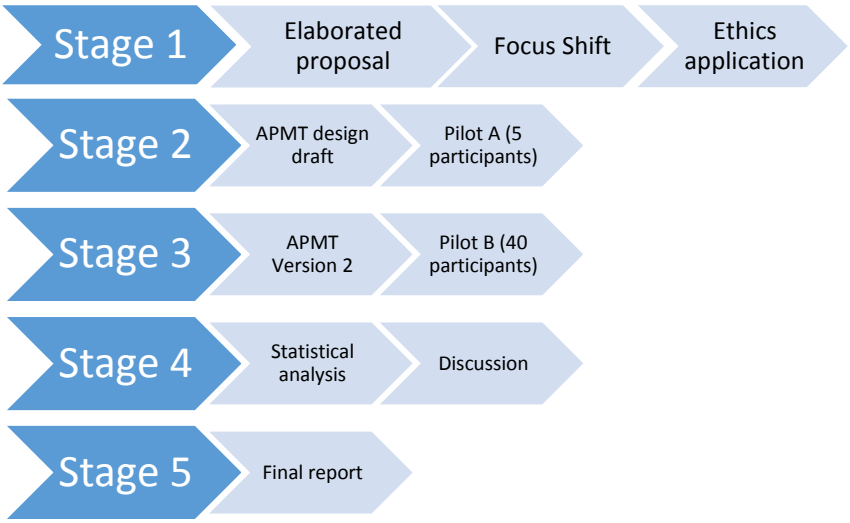
CHAPTER 4. METHODOLOGY AND DESIGN

Taking into account that the APMT is a new assessment tool, and that the assessment of attention in music therapy for children population has not been studied thoroughly in music therapy research before, the research process included stages for the design of the tool, and pilot studies. The analysis of the results is framed under the quantitative approach, given that validity and reliability research questions, called for such type of analysis.

It is important to note that at first, the topic chosen for the research study was general children development. Therefore, during stage 1, the first two tasks were built around the idea of designing a tool, for assessing children's general development, instead of an assessment of attention. The topic shifted as a result of the analysis of the evidence arising from the literature review and the preliminary methodology, and feedback from evaluators, professors and fellow students. It became evident that given the complexity of children's general development, the evidence found in research, and the time frame, it would be difficult to complete and validate a research based tool, on that topic. At that moment, it was decided to choose only one dimension of general development: attention. The rationale for the decision was based upon the information gathered up to that point on the literature review and clinical reasoning reviewing reasons for referral to music therapy in the researcher's clinical practice.

The study followed a five-stages design.

Figure 1 Research Stages



4.1. STAGE 1

This stage was dedicated to preparation, and consisted of three processes: Writing the Elaborated Proposal, Focus shift and adjustments, and Ethics application

4.1.1. **ELABORATED PROPOSAL**

The Elaborated Proposal (a requirement from the PhD Music Therapy Program at Aalborg's University), is a document in which the researcher presents the research study including at least the literature on the topic of interest, and the chosen research methodology. The Elaborated Proposal is presented to the PhD Music Therapy program, evaluated and approved by independent reviewers, including their comments. The process of writing the Elaborated Proposal consisted of two distinctive writing tasks: literature review and methodology.

For the first task, a literature search was performed using as keywords: music therapy, music therapy and assessment design, music psychology, neuropsychology and neuropsychological assessment. Search was performed through Aalborg University's library databases, and Google Scholar. Since the study takes place in Latin America, and there was little literature in Spanish or based on Latin America, the website of the Latin American Society of Neuropsychology, and the library at the Instituto Colombiano de Neurociencias were also searched.

The second task was to work on the first draft of the methodology design. The five-stage model presented above, and most of the different processes included in each

stage were proposed. Given that the assessment tool was going to be evaluated for validation, there was a need to decide which neuropsychological tool would be used to drawn correlations with the Music Therapy assessment. With that purpose in mind, a survey was sent to ten clinical institutions in Colombia, Argentina and Chile (as these were the countries initially thought to be included in the research study). The short survey was sent via e-mail requesting the head neuropsychologist to list (ranks 1-3): a) assessment tools they consider to be the most complete and appropriate to assess neuropsychological development on children ages 6 to 9. b) neuropsychological assessment tools, they used more often in clinical practice. Results informed the choice of tool.

4.1.2. **FOCUS SHIFT**

The second process consisted of a focus shift, which derived from the elaborated proposal presentation. As was mentioned before, the first research topic was the assessment of children's general development in music therapy. The first version of the literature review, and the methodology were built around that topic. However, following the presentation of the Elaborated Proposal, the evaluation of the documents and discussions with supervisors, professors and fellow PhD students, led to a decision to further narrow the topic of the assessment so that it would be realistic to build and pilot the research based tool. At that time, the decision to shift the focus to the assessment of attention was made based upon the promising evidence on music processing and attention (presented in sections 2.2.1, 2.2.3 and 2.2.4), and the fact that in the clinical work of the researcher, attention is one of the major reasons for referral. It is important to mention that at that time, none of the music therapy tools for assessment of attention presented on section 2.3.3, had yet been published.

As a consequence of the shift in topic, a complementary literature search was conducted, including other keywords: attention, attention assessment, assessment of attention in music therapy. The proposed research methodology for the study was also adjusted for the new topic. No other changes of the research focus occurred. However, the literature review was updated during stages 3 and 4, to include more recent literature, and respond to issues arising from the design and administration of the APMT.

4.1.3. **ETHICS APPLICATION**

The third and last process during this stage was the ethics application for the study. Following the focus shift, the ethics application was presented and approval granted by the ethics committee of the Faculty of Humanities at Aalborg University in December 2014 (Appendix A). Considering the population and characteristics of the research design the study was considered a low risk project.

Several issues had to be defined during this process and included in the ethics application.

Two pilot studies were included in the design, with the idea of building two different phases of the process. The Pilot A was designed to be a small pilot study (5 participants) in Colombia to field test the first draft of the tool. For Pilot A, expert consultation was used as the method for analysis. Pilot B was designed to be a larger pilot study (55- 75 participants), to be performed with the second version of the APMT. Reliability and validity of the APMT was studied using results from Pilot B. The Pilot B study was going to take place in three countries: Colombia, Argentina and Chile. Unfortunately due to time constraints, one country had to be excluded from the sample, and therefore Pilot B was developed in Colombia and Argentina and the sample size was reduced from 60 to 40 children participants.

Since the study was planned to take place in several collaborating institutions, it was decided that Aalborg's ethics committee would be regarded as the primary ethics committee. However, the collaborating institutions could request additional approval, while respecting the procedures already approved by Aalborg's ethics committee. The collaborating institutions were defined after the approval of the ethics application (further information section 4.3).

Since administrations of the APMT were to be recorded and shared with PhD supervisors and raters, a decision was made to use the option of YouTube unlisted videos to share videos. This option allows the researcher to upload the video to her private YouTube account (using codes for participants, not names) in a way that the video is not public, and therefore can only be accessed by people with the specific link to the video. Research materials including the videos and written results are to be disposed 4 years and 11 months after the completion of the research study. following guidelines from the Danish code of conduct for research integrity http://ufm.dk/publikationer/2014/filer-2014/the-danish-code-of-conduct-for-research-integrity.pdf

Considerations regarding participation in the study are a major part of the ethics application, and are detailed bellow in three sub-sections according to the type of participant. Given the design of the study, there are three types of participants: child participants, music therapist administrators, and music therapist raters.

4.1.3.1. Participants: Children

The children participating in the study, were assessed using the APMT tool. The participants had already been referred to neuropsychological assessment and were not referred to music therapy treatment as a direct result of the research study. For the child, enrollment in the study implicated the participation in one session of music therapy assessment using APMT. However if child became tired or blocked, a second

session was scheduled to finish the assessment. The administration sessions were video recorded.

There were two different moments during which children were recruited for participation: Pilot A for evaluation of the first version of the APMT, and Pilot B for evaluation of a second version of the tool.

In both cases, the identification of potential participants was made by neuropsychologists at the collaborating institutions. Parents or legal guardians received information about the research study, and child's participation was requested. Informed consent (Appendix B) was signed by parents or legal guardians authorizing: the release of the results of the neuropsychological assessment, the collection of information from the clinical record regarding demographic information, and the administration, video recording, and use of results of the APMT. Verbal assent from the child was obtained as well, with a brief explanation of the purpose of the study, the type of activities the child would be engaged during the assessment, the benefits and risks, and the time commitment. Both the consent form and the procedure for obtaining child's assent explained that the sessions were going to be recorded.

Confidentiality of all personal information of child participants was ensured by the use of a coding system throughout the study. Following recruitment, the participant was assigned a numerical code of 4 digits. From that moment on, all data from the participant was handled using the code, removing their identity. The list containing the codes and names of the participants was kept on a USB in a locked cabinet at the researcher's office

Videos were recorded using computer video programs and labeled using the participant's code. Videos from Pilot A, and selected videos from Pilot B (only those selected for a procedure of inter-rater agreement to be presented later) were uploaded to YouTube, using the unlisted setting. Links to the YouTube videos were only made available to PhD supervisors and selected videos from Pilot B, to music therapists serving as raters (only after they provided informed consent). Further explanation of the role of the raters, and the ethical implications of their participation will be presented later.

Benefits for the participants and their family included: additional information on the participant made available to the family; a new point of view or way of describing the participant's attention from the music therapy perspective. The results have been made available for the families during the study and will remain available through the researcher for 4 years after its completion. The researcher explained to the parents or legal guardians that the APMT was still undergoing procedures for validation and reliability, and therefore the results were only a presentation of the observations made during the session.

The following inclusion and exclusion criteria were determined for children participants.

Inclusion criteria: Children between the ages of 6-9 attending schools in Colombia and Argentina, and referred for neuropsychological assessment by their pediatrician, neurologist, and/or school psychologist at the collaborating institutions. The neuropsychologists at the collaborating institutions identified the children.

Exclusion criteria: (1) Previous diagnosis of Autism, Cerebral Palsy, Down Syndrome, Cognitive delay, or Mental Retardation as reported by the parents to the neuropsychologists as part of the neuropsychological assessment process. (2) Previous neuropsychological assessments. (3) Prior participation in neuropsychological or music therapy treatments. Previous enrollment in music instruction programs as reported by parents during the process of informed consent was not an exclusion criteria, but it was included as background information for the statistical analysis.

The age range for participation was chosen based upon research describing the developmental path for attentional functions. As Pozuelos, Paz-Alonso, Castillo, Fuentes and Rueda (2014) found, attentional skills develop gradually between middle and late childhood. The age of 6 was chosen as the lowest age for participation taking into account that it is at this age, that the development of basic fundamental attention and executive function skills has been reached (Poutanen, Berg, Kangas, Peltomaa, Lahti-Nuuttila & Hokkanen, 2016). It is at this age also, that children tipically begin attending school. The age limit for participation was set at 9 years old, considering that between the ages of 8 and 9, there is an inflection on the developmental curve of attention, and that by the age of 10, most attentional functions appear to reach a "*developmental plateau"* (Wassenberg, Hendriksen, Hurks, Feron, Keulers, Vles, & Jolles, J, 2008; Malegiannaki and Metallidou, 2017). The previously mentioned age evidence will correspond to children between 1st and 3rd/4th grades of elementary school in Latin America.

Some difference, and possibly improvement of attentional skills could be observed between the younger and the oldest participants. However, they were not at very different moments of development in terms of attention development. Furthermore, since the APMT is a baseline assessment and a tool to provide a profile of attention skills, such differences are taken into account and highlighted within the frame of individual performance.

Mirroring the natural procedure in clinical sites for referral decisions to therapeutic services, the recruitment was made upon referral to neuropsychological assessment and therefore is a sample of the population universe in the natural context. Additionally such condition for recruitment implies that the conclusion of the neuropsychological assessment might be that the child has a "typical" development,

or an atypical development in which attentional difficulties are or are not observed. An intentional decision was made to design the sample this way, so that it could include both clinical (considering population with attention deficit disorder) and non-clinical populations. Such decision implies lack of homogeneity of the sample. However, in this case, it is a desired heterogeneity. Given that the purpose of the assessment tool is baseline for treatment process and not diagnostic, and that individual differences are a central point of the design, to be able to have heterogeneity actually enriches the information obtained in the data.

4.1.3.2 Music Therapist administrators.
While in the process of designing the method, it was decided that the researcher would not carry out all the APMT sessions with the participants. Additional music therapists were contacted and their participation as APMT administrators was requested.

The word administrator in the field of assessment is often related to the natural science approach (Aschieri, 2012). Fischer (1973) criticized such a role for clinicians expressing that when tests are "administered", they often produce "generalized, overencompassing, and stereotypical profiles" (Aschieri, 2012, pp. 352). However, in the context of this research, administrator would be defined as the professional sharing the assessment process with the participant. Even though the APMT protocol is fixed, and therefore spaces for collaboration are not as ample, the child's voice is important in the APMT process, and they chose the songs, and instruments (most of the time).

Administrators conditions for participation included being recognized as Music Therapists by associations in their countries, and having a minimum of 2 years of experience with child populations, learning disabilities and education.

Participation in the study for music therapist administrators involved receiving and studying the APMT materials (share questions and thoughts with the researcher, hold virtual meetings with the researcher), receiving the referrals and administering the APMT (to a maximum of 20 participants), share APMT results with the researcher via e-mail. Music therapists administrators received a fee of 20 USD per administration session.

The music therapist administrators signed an informed consent form (Appendix C), providing consent for the use of APMT results and video recordings, and the use of their general professional information (country of origin, years of clinical experience, and level of education) as data. Additionally, and since the administrators had access to the identity information of participants, they committed to protect the confidentiality of the participants, in adherence to ethical standards. The consent form also includes the procedures for protecting confidentiality of the music therapists administrators. However, it is noted that since music therapy is not such a large community, some of the information, could lead others to deduce their identity. Administrators are assigned a code with the letter A and one number. From that

moment on, data from the administrator participant was handled using the code, taking out their identity. The list containing the codes and names of the administrator participants was kept in a USB drive in a locked cabinet at the researcher's office

4.1.3.3 Music therapists raters
Given that one of the research questions of the study refers to establishing inter-rater agreement for APMT, music therapists were contacted to participate in the study as raters.

Conditions for participation as raters, were the same as for the music therapist administrators. Participation in the study as a rater involved: receiving and studying APMT materials (share questions, and thoughts with the researcher via e-mail, Skype or other virtual media), receiving links to YouTube unlisted videos of administrations of the APMT (maximum of 5 videos), provide ratings using APMT protocol, share results with the researcher via e-mail. Raters did not received a fee for their participation.

Music therapists raters signed an informed consent form (Appendix D) providing consent for the use of their general professional information (country of origin, years of clinical experience, level of education), and the assessment results. They also committed to protect the confidentiality of the participants, and correctly handle the video and written materials. Raters were instructed to delete files after sending the ratings to the researcher. To protect the confidentiality of the raters, a numerical code was assigned to each rater in a random manner, and the codes were used in all databases excluding their identities. The list with the names and codes of the raters were kept in a USB drive in a locked cabinet in the researcher's office.

4.2. STAGE 2

This stage was dedicated to assessment design, pilot A and corrections.

4.2.1. **ASSESSMENT DESIGN. FIRST VERSION**

The process of designing the first version of the Attention Profile of Music Therapy (APMT) took over a year. The research found in the literature review was used as the base, including the general structure, and the item design. During the process, the researcher had constant feedback from neuropsychologists and music therapists. In this stage, instructions for the administration of APMT were written and reviewed several times. For the process of designing the first version, formal and informal feedback from several sources was taken into account. Consultation with PhD supervisors and participation in Aalborg's University PhD seminars were a first source. A second source were experts from the field of neuropsychology working at the collaborating institutions in Colombia (CENPI and Instituto Colombiano de Neurociencias). The third and last source of feedback, were music therapists from

Latin America. Once the first version was completed, it was sent to three music therapists (chosen by the researcher according to their professional background and accessibility) requesting written feedback regarding the tasks and the scoring system. The first version of the APMT included detailed instruction of the included tasks, and a response sheet to record the children's responses.

The structure of APMT was always conceived of to mirror the course of a music therapy session, especially taking into account that it is the first encounter of the music therapist and the child. For many children in Latin America, such an encounter could also be the first encounter with several of the music instruments in the setting. The sessions were organized in 4 sections called Moments of the session. The first section used as musical material a hello song composed by the researcher for the assessment. The second section used a familiar song chosen by the child from a list of 5 options made by the researcher. Tasks included singing, playing an accompaniment and marching. The third section also used a familiar song chosen by the child from the list, but the tasks required the child to respond in different ways to "mistakes" in the song introduced by the therapists. The last section, an instrument setting was presented to the child, and they were asked to explore the instruments. Afterwards, they were invited to participate in a turn taking task and in a good bye improvisation.

Tasks using children familiar songs were included on the assessment, given that neural responses to familiar music are stronger, and attention to musical stimuli enhances such response (Meltzer et al. 2015). The hello song was included as a form of introducing the session, for the child to get more comfortable with the therapist, singing or speaking short responses, and for the therapist to begin building the relationship, while getting a first idea of the child's attentional skills.

The design of the tasks was based on the type of tasks included for the attention domain in neuropsychological assessments. A more in-depth explanation will be presented in section 4.3.1.

The proposed structure and description of the tasks on this first version was:

Table 19 Structure of APMT. Version 1

Moment of the session	Task1	Task 2	Task 3
Moment 1. Hello song	Task 1. Fill in the blanks. Target responses: hello, child's name, therapist's name. Task is repeated if child is unable to perform	Task 2. Imitate and sustain movements. Recall movements.	Task 3. Recall movements and Propose new movements
Moment 2. Familiar song: sing, play, move. Child chooses the song and sing alone first	Task 1. Use an instrument to accompany the song. Instructions are given to sing and play simultaneously throughout the song	Task 2. Children march synchronizing with the tempo of the therapist. Therapist changes the tempo every 8 beats	
Moment 3. Familiar song. Respond to changes. Child chooses song and sing alone first	Task 1. Therapists sings the song and introduces changes in lyrics, melody or rhythm. Child raises hand when recognizing a change.	Task 2. Therapists presents rhythmic patterns that increase in number of beats (from 1 beat up to 7 beats). Child imitates each pattern.	
Moment 4. Improvisation. Child explores instruments freely first.	Task 1. Dialogue with instruments. Child and therapist used instruments to improvise, using a dialogue structure	Task 2. Good bye improvisation. Child and therapist use instruments, voice and body to improvise a good bye song.	

Most of the items had two choices for rating the performance: 1 (able to perform), 0 (not able to respond). Other items were rated using three choices: always, sometimes, never. The dichotomous type of scoring was based upon the type of scoring of several neuropsychological assessments. The polytomous type of scoring was included in response to those moments when an intermediate category was thought to be useful.

Additionally, at the end of each *Moment of the session* an overall performance scale was presented. The scale comprises 6 choices ranging from 1 to 6, describing the level of independence in the performance, and the amount of support provided by the therapist. The administrator also describes the type of support required on each task. This scale is included taking into account the scoring system for the Evaluación Neurológica de la Atención (Quintanar & Solovieva, 2003), which gives relevance not only to the performance, but also to the independence and support.

At the end of the APMT, two other scores were presented: a motivation score for each task using 4 criteria: not motivated, a little motivated, motivated and highly motivated; and a relationship score using a scale from 1 to 4 to describe the ability of the child and the therapist to establish an empathic relationship throughout the assessment. Motivation ratings were not found in the neuropsychological assessments reviewed. However, it was included to incorporate new elements that arose from evidence referring to motivation and relationship-building as factors influencing attention performance.

Scoring takes place during the administration of the assessment, using the printed response sheet.

4.2.2. **PILOT A**

Once the first version of the APMT was ready, Pilot A took place. The pilot included the administration of the APMT to 5 participants from Colombia (3 girls-ages 6,7 and 9- and two boys-ages 6 and 8). The current place of work of the researcher in Medellin and a clinical institution in Bogotá agreed to collaborate with the recruitment process, and provide spaces to perform the APMT administration. Inclusion criteria for children participants was presented in chapter 4.1.3.1. The neuropsychologists identified the potential participants, and presented initial general information about the research study. If parents expressed interest in participation, the neuropsychologists provided their contact information to the researcher. The researcher contacted the parents, met with them and requested informed consent. Once informed consent was granted, the administration appointment was set. Before the appointment, the child's assent was requested, and when granted, the session took place. As explained in section 4.1.3, sessions were video recorded.

The flow diagram for recruitment of participants for Pilot A is presented below following CONSORT guidelines.

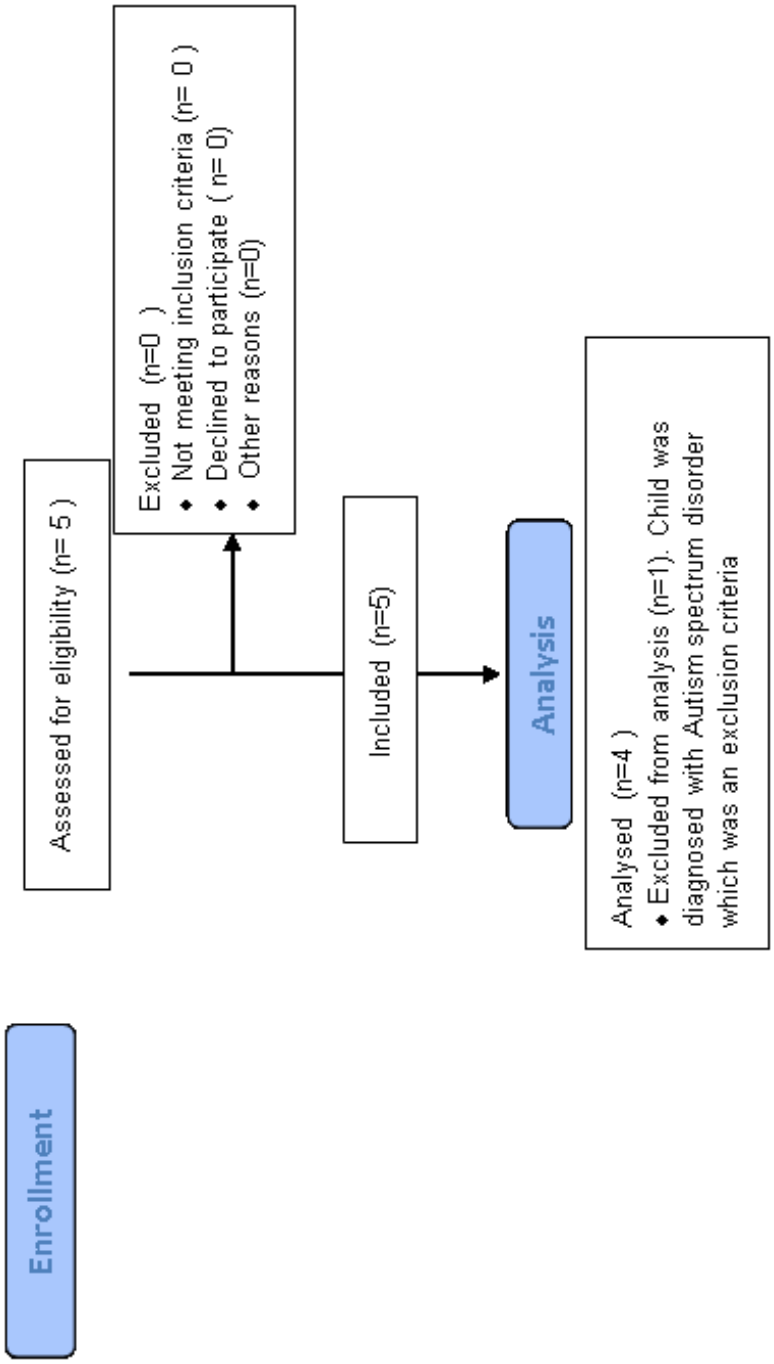


Figure 2 Pilot A children participants flow diagram

The children participated in one AMPT administration session with the researcher acting as administrator. The sessions were video taped and used as the starting point for discussing APMT's procedures and constructs. Selected parts of the video recordings, were shared during Aalborg's PhD seminar. The researcher's experience in administrating the assessment to the participants, and feedback from PhD supervisors and fellow students, and colleagues was used to make adjustments, decide on exclusion of several tasks, and the inclusion of others, thus leading to a second version of the APMT. The evolution from the first to the second version of the tool is presented in Appendix E. APMT's second version is presented in detail in section 4.3.1

4.3. STAGE 3

The third stage of the study was dedicated to the process of designing the second version of the tool, Pilot B and the inter-rater agreement process.

4.3.1. **APMT VERSION 2**

As was mentioned before, the second version of the APMT resulted from the information and feedback provided on Pilot A.

The process of designing the second version of APMT, included the adjustments made to several tasks both in language and content, the exclusion of a few tasks and several items, and revisions to the categories of each item.

After the general structure, the tasks and the items were defined, the APMT manual was written in both Spanish and English (Appendix F). For length limitations in the document, the Spanish manual could not be included but the researcher can be contacted to gain access to the document The translation was done by the researcher who is bilingual with Spanish being her first language. For the manual, previous feedback from supervisors and fellow students was taken into account, as well as the experience acquired from Pilot A. The document includes a rationale for the development of the tool, thorough instructions for the tasks, video excerpts, and anticipation of circumstances that may occur during the administration.

A list of 10 songs to be used as choices for tasks requiring the use of familiar songs (there is a song list for Colombia and a different one for Argentina) is also included in the manual. In light of previously presented research (Section 2.2.4), it is important to include songs familiar to the participant. The processing and response to the familiar songs, provides information regarding attentional skills, different to when the participant is presented with novel music stimuli, or involved in music improvisation. The possibilities of predicting what comes next, and the assessment of recall functions, are a potential when using familiar music. Understanding that not every child will be familiar with the songs, and providing that musical preferences are a key

point in music therapy practice, therapists can use different songs not included on the list. However, common song characteristics are included in the manual to provide a certain homogeneity regarding repertoire (especially including considerations for length and structure of the songs). In clinical practice (and related with the issue of ecological validity), it would be difficult to make sure that the same repertoire is always used. However, in order to provide a standard procedure for the assessment tool, there is a need for such common ground.

Along with the manual, a response sheet was also designed. While the manual contains more detailed information, the response sheet has a shorter version of the task, and some important points to take into account during the administration. The response sheet is what administrators take into the session, to record the responses during the session. Along with these materials, an information sheet was written so that neuropsychologists in the collaborating institutions could provide initial information about the study to parents of children meeting the inclusion criteria.

Detailed information of the second version of APMT is presented in the manual of the tool (Appendix F). However, some general elements are presented here, to facilitate understanding on sections 4.3, 4.4, and 4.5.

4.3.1.1. Structure and scoring of APMT

The APMT has been designed, so that it can be administered in a session of approximately 45-50 minutes. However, if child exhibits tiredness, or is blocked, another session is scheduled.

The general structure of the session kept the same form 4-section form it had on the first version of APMT. A total of 9 tasks were included in the second version. Each task contains several items.

The following table presents the general structure and the tasks numbers included on each Moment of the session.

Table 20 APMT structure and tasks numbers. Version 2

MOMENT OF THE SESSION	NAME OF SECTION	Task number
Moment 1	Hello song	Task 1 (A,B), 2 (A,B)
Moment 2	Sing and accompany familiar songs	Task 3 , 4
Moment 3	Respond to changes in familiar songs, and imitation.	Task 5, 6, 7

Moment 4	Playing with instruments	Task 8, 9

There are four types of scoring on the assessment: Item score, motivation score, overall score, and relationship score. The score system was kept from the first to the second version, even though some tasks and items were adjusted. Each scoring type serves a function within the assessment. The following table presents each type of scoring, the frequency, function and the rating criteria.

Table 21 APMT types of scoring

TYPE	FUNCTION	CRITERIA
Item score. Each task contains several items. Presented right below the description of the item. On the response sheet, right below the summary of the item	Characterized the performance on a target response.	Numeric (dichotomous): 1/0 Word: dichotomous (yes/no), polytomous (always, sometimes, never)
Motivation score. Presented after each task	Reflects the observation of the administrator regarding the motivation displayed by the child during the performance of an item.	Scale from 1 to 4. 1: not motivated 2. Little motivated 3. Adequately motivated 4. Highly motivated
Overall performance score. Presented at the end of a Moment of the Session	Reflects the observation of the administrator regarding the performance on a set of items that constitute a section of the assessment session. Accounts for the performance, and the level of support provided by the administrator.	Scale from 1 to 6. 1. Could not perform 2. Performed with support of therapists 3. Performed independently with mistakes 4. Performed independently with self-

		verification but without correction 5. Performed independently with self-verification and correction. 6. Performed correctly and independently *self-verification: child notices when making a mistake ** correction: child is able to correct himself when making a mistake
Relationship score. Presented at the end of the assessment.	Reflects the observation of the administrator regarding the therapist's and the child's ability to establish a therapeutic relationship during the session.	Scale 1-4 1. Very difficult 2. A little bit difficult 3. Easy 4. Very easy

In the design of the APMT, each type of scoring, and the scoring criteria have a rationale.

For the item score, the dichotomous criteria, resemble the type of scoring in some neuropsychological assessments, rating either a correct (1 point) or incorrect response (0 points). However, in designing the tool and when consulting experts, it was evident that not all performances respond to this criteria of able or not able. Therefore, it was important to include other types of criteria that were easy to use during an administration, and that were at the same time, more responsive to the reality of the session. The rating criteria using three choices (always, sometimes, never) was then introduced.

The rationale for including a motivation scale is twofold. There is a research-based rationale, and a clinical practice rationale. Research included in the literature review,

shows that motivation plays an important role in attentional skills. A motivation scale provides important information on the preferences of the participant, and could account for low scores in particular items. Low motivation could be a confounding variable in results of assessment of attention. A child with general low motivation throughout the assessment could have a profile showing difficulties in all attention types, when perhaps the problem is not only attention related, but an interaction between low motivation and attention. None of the assessment tools reviewed in the literature include this type of scoring criteria (refer to section 2.1.4, and 2.3.3). As for the clinical practice rationale for including a motivation scale, since APMT is designed to serve as a baseline for treatment, is important to identify the type of activities that motivate the child the most. The motivation score also provides the clinician with a first sense of the rapport-building with the child, and it could serve as a differential factor from other assessments, providing new information about the child. Being that motivation is such a key point in attentional function, it should be reported all along the assessment process. In contrast to the first version of APMT, the motivation scale on the second version is included for each task, instead of at the end of each *Moment of the session*.

The overall score should be regarded as a complementary score. It provides information not only about the quality of the performance, but also about the level of independence and self-monitoring on the performance. Even though as with most assessments, the administrator is instructed to allow the child to perform on his own, it is also important to offer support when the child is not able to perform causing nervousness, frustration or blocking. Furthermore, there are times, when it is noticeable that the child has not understood an instruction and it is important to explain and clarify. For those situations, a record of the type of support provided by the therapist (verbal, gestural, prompting), is included along with the overall score. The overall score is presented at the end of each *moment of the session*. It was not included for every item, considering that it would take time away from the therapist to continue with the flow of the session, and in consultation with different music therapists it was perceived as a difficulty to remain in the here and now of the process with the child.

As for the relationship score, it is a one time score presented at the end of the assessment. It is a record of how easy or difficult it was for both the child and the therapist to build the relationship. It is a relevant score, as it is a way of ensuring that the results of the child in the assessment, are more a reflection of the child's skills, rather than a response to difficulties in building rapport (by child and/or therapist).

4.3.1.2. APMT categories

In the manual and the score sheet, the responses to each item were related to a category being observed. In such a way, a profile of performance, including all categories, was built for every child as a result of the assessment. The categories included in the profile are: alert, selective attention, divided attention, sustained attention, impulsivity, motivation, overall performance, and support.

The first four categories are types of attention. The selection of the types of attention to include in the assessment was based upon research in music processing and attention (section 2.2.4), and also took into account rationale from other attention assessments in music therapy (section 2.3.3).

As a fundamental focal point for the APMT, the definition of the categories of attention and the type of tasks (taken from Soprano, 2009) used in neuropsychology to assess them, are presented below.

Alert: minimum energy mobilized allowing the nervous system to be receptive to information. Type of tasks: Tasks measuring reaction time.

Selective attention: Process that prioritizes some informational elements over others (Cohen, 2014). Type of tasks: Tasks requiring filtering capacity between auditory-visual stimuli and distracting stimuli. Span tests. A growing amount of information is presented to the subject, and the child must retain and immediately repeat according to what he heard or saw (Sopranos 2009).

Divided attention: Ability to attend to a stimulus with the interference of a competing stimulus (Cohen, 2014). Type of tasks: Double tasks, where the child must mentally handle two different sets of information and process it in a simultaneous manner. Tests for assessing divided attention are based upon cancellation tasks (Soprano, 2009)

Sustained: Attentional persistence over a relatively long period of time (Cohen, 2014). Type of tasks: Tasks that are generally long and monotonous, where the child must respond to a certain visual or auditory stimuli differentiated from other, considered distractors. Measure the ability to detect and respond to changes occurring in random intervals during a long period of time (Soprano, 2009)

The music therapy assessments of attention analyzed in the literature review (section 2.3.3), included some of the categories. The MASA-R (Waldon et al, 2016) focuses on selective and divided attention. It should be noted that their focus is to assess the ability of children to attend to auditory stimuli. The Music Based Attention Assessment (Jeung, 2013) designed to assess performance in attentional tasks by patients with Traumatic Brain injury included sustained, selective and divided attention.

APMT includes the category of alert (Soprano, 2009) not included in the previously mentioned assessment. Without alert, is not possible for the nervous system to be receptive to information possibly affecting performance in attention tasks. To exclude this category, would be to leave out a possible confounding variable.

In addition to the attention types, some complementary categories were considered relevant for inclusion in the assessment.

The category of impulsivity was included to be able to record information regarding the child's ability to control impulses. Poutanen et al (2016) give inhibition a key role in the development of attentional skills through childhood. Therefore, it is important to be able to observe and record information about this category.

The last categories (motivation, performance and support) include the information arising from the motivation scales, and the overall performance scale. This information does not relate to any type of attention but it includes aspects of the assessment process: emotional aspects (motivation and relationship), and independence and support aspects. The rationale presented in the previous section for including motivation, relationship and overall performance scores, is also the rationale for including these categories on the Profile.

Other items were categorized as musical data. While there is not enough evidence in the literature to associate such music making traits with specific attention categories, it is important for clinicians to gather such information about the child.

4.3.1.3 APMT tasks

Even though the detailed description of the tasks that the administrator received is included on the APMT Manual (Appendix F), a summary of the instructions for each task, and the corresponding items is included below to facilitate understanding of the results and discussion chapter.

Items are highlighted in color, according to the categorization used in the APMT. Yellow: Alert. Purple: Selective. Blue: Sustained. Green: Divided

Moment 1. Hello song.

Task 1 (A and B): The therapist, will sing the APMT hello song with the child (using guitar accompaniment). Instructions are given to the child to sing or say the appropriate response according to the song's lyrics (choices are: hello, his/her name, therapist's name). Part B: if child is not able to respond to the three targets, the part A is repeated, including only the sections of the song that the child had difficulty with. In the first part of the task, the administrator does not provide any kind of support during the song, beyond the singing.

Items

Child gave a response on the space left in the song?		
Always	Sometimes	Never

TARGET RESPONSE	SCORE (1= correct response, 0=incorrect response)
Child's name	
Therapist's name	
Hello	
TOTAL ITEM SCORE	

Task 2 A: Using the same hello song, the therapist will make a movement for each verse of the song. Instructions are given to the child to first observe the movements. On a second repetition, the child is ask to do the same movements the therapist is doing. (1 for correct response, 0 for incorrect)

Items:

TARGET RESPONSE	SCORE	MOVEMENT WAS SUSTAINED DURING THE ENTIRE VERSE? Yes/no
Tapping with one hand		
Clapping		
tapping with both hands		

Task 2B. Immediately after finishing task 2A, child is ask to recall the movements used, in the same order of presentation. Score: 1 point per each movement recalled in the correct order (Max. 3 points). YES/NO on the second and third question

Items

TARGET RESPONSE	SCORE

Show movements in the order previously performed	
Child showed the movements in a different order?	
Child forgot any movement?	

***Moment 2*:**

Prelude: Child is presented with the song choices of the list. Child is asked to choose a song he knows well. The therapist asks the child to sing the complete song solo, so that the therapist can verify that the child actually knows the song, and the way the child has learned it (lyrics, melody, rhythmic aspects).

Items on the prelude belong to the musical data category.

Was child able to sing the song?	Complete song	Partially and/or making changes	Not able
Melodic contour	SAME	SIMILAR	DIFFERENT
Rhythmic patterns	SAME	SIMILAR	DIFFERENT
Sustained beat	YES	NO	SOMETIMES
Lyrics	SAME	SIMILAR	DIFFERENT

Task 3: Child chooses an instrument from the setting to accompany himself while singing the chosen song. Therapist uses the guitar for accompaniment. Instructions are given to the child to listen to the therapists instructions during the song, as the therapist will ask him to stop singing or playing (while continuing the second action), and later to resume.

Items:

TARGET RESPONSE	SCORE			
Stop singing or playing according to instruction	ALWAYS	SOMETIMES	NEVER	
Response was immediate?	ALWAYS	SOMETIMES	NEVER	
Type of child's accompaniment	PULSE	MELODIC RHYTHM	NEITHER	BOTH
Did the voice and the playing had a synchronized tempo	ALWAYS	SOMETIMES	NEVER	

Task 4: Same song as in task 3. Child and therapist each has a hand drum. Using the hands to play (not mallets), the therapist models to the child what it is to play a pulse. The therapist will play the song and change the tempo every verse. Instructions are given to the child to be attentive to the changes of tempo and follow the new tempo (demonstrations of what is change of tempo are given previous to the task performance).

Items:

TARGET RESPONSE	SCORE		
Attempt to synchronize with tempo change	ALWAYS	SOMETIMES	NEVER

Moment 3:

Task 5: The therapist asks the child for a song he knows. Without giving any instructions, the therapist must begin to sing the song and introduce an evident mistake (change of a key word, or melodic element representative of the song)

Items:

Child notices the mistake?	YES	NO	
How did he reacted to the mistake?	MAKING GESTURE	VERBALLY	BOTH

Task 6: The therapist asks the child to choose a song he knows very well from the list of songs. If the child is not familiar with the song choices, he may suggest a different song. If the song fits the characteristics explained in the manual, the song may be used for the task.

During the task, the therapist will sing the song introducing mistakes of various types: lyrics, melody, rhythm. To minimize guessing due to habituation, each type of mistake is presented in three variations: at the beginning of a verse, in the middle of a verse, at the end of the verse. Instructions are given to the child to raise his hand each time he identifies the therapist is making a mistake.

Given the age of the participants, and the fact that often children are more used to identify word mistakes (in association with daily tasks), control items are introduced for the rhythmic and melodic mistakes. Children could be actually attentive to the music, but not notice a mistake of melodic or rhythmic nature.

Items:

TYPE OF MISTAKE	RAISE HAND		OTHER REACTION	WHICH
CHANGE OF WORDS	YES	NO		
Change word at the end of the verse				
Change word in the midst of the verse				
Change a word in the beginning of the verse				

CHANGE OF RHYTHM				
In the beginning of the verse				
In the middle of the verse				
In the end of the verse				
CONTROL				
Change word on the end of the verse				
CHANGE OF MELODY				
In the beginning of the verse				
In the middle of the verse				
In the end of the verse				
CONTROL				
Change word on the end of the verse				

Task 7. The therapist will clap an increasing number of beats (without rhythm, just pulses) and instructions are given to the child to listen to the model presented by the therapists and imitate it. The therapist begins with 1 beat, and the last model consists of 7 beats. If child has troubles imitating one of the models, the model is presented a second time providing another chance. If child is not able to imitate one model, the therapist does not present the rest of the models. Score: able=1, not able=0. Required second attempt: yes/no. Impulsive response: yes/no

TARGET RESPONSE	SCORE	REQUIRED 2nd ATTEMPT	IMPULSIVE RESPONSE
1 beat			
2 beats			
3 beats			
4 beats			
5 beats			
6 beats			
7 beats			

Moment 4:

Prelude: Before presenting tasks 8 and 9, the instrument setting is placed on the floor. Therapist asks the child to explore the instruments freely and measures the time length of the exploration.

Items:

TOTAL DURATION OF EXPLORATION	1 minute or less	Between 2 and 4 minutes	More than 4 minutes
WAS CHILD MOTIVATED TO EXPLORE INSTRUMENTS?	YES	NO	
Preferred instrument			

Task 8: Child and therapist will be taking turns to play the instruments. The therapist takes the first turn. It is explained to the child that he does not necessarily needs to

imitate the therapist. Just play, as if they were dialoguing, but using instruments. Score criteria: yes/no

	CHILD WAIT FOR TURN?	CHILD PLAY DURING TURN?	
TURN 1			
TURN 2			
TURN 3			
TURN 4			
TURN 5			
Child's musical materials were similar to the therapists'?	ALWAYS	SOMETIMES	NEVER

Task 9. Therapists explains to the child that the session is about to be over, and that they will improvise a good bye song. They can use body percussion, voice and instruments to make the music creation.

Items

Child was able to participate in the music making?	YES	SOMETIMES	NO
Musical materials of the child were similar to the therapist's?	ALWAYS	SOMETIMES	NEVER

After completion of the session, the administrator must provide a score for the relationship scale:

On a scale from 1 to 4, rate how easy was it for the child to establish a relationship with the therapist			
1. Very difficult	2. Difficult	3. Easy	4. Very easy
SCORE			

On a scale from 1 to 4, rate how easy was it for you to establish a relationship with the child?			
1. Very difficult	2.Difficult	3. Easy	4. Very easy
SCORE			

4.3.2. **PILOT B**

Once the APMT materials were ready, Pilot B took place.

Three institutions collaborated with recruitment for the study in Colombia (CENPI in Medellin and Instituto Colombiano de Neurociencias in Bogota) and Argentina (Victor Feld's neuropsychology consultation clinic in Lujan, Argentina). CENPI in Medellin is the researcher's current workplace. None of the collaborating institutions required further ethics application.

Following acceptance to collaborate, the study was presented to the neuropsychologists from the institutions, with the purpose of clarifying doubts regarding the recruitment process. The head neuropsychologist at the institutions (all university professors, and renowned clinicians) were the main contact for the study.

Since Pilot B includes a larger sample and takes place in different cities, two music therapists (one in each country) participated as administrators of the APMT in

addition to the researcher. The music therapists were chosen because they are knowledgeable clinicians working with children in the fields of learning disabilities and education, and the researcher knows them professionally facilitating accessibility to them.

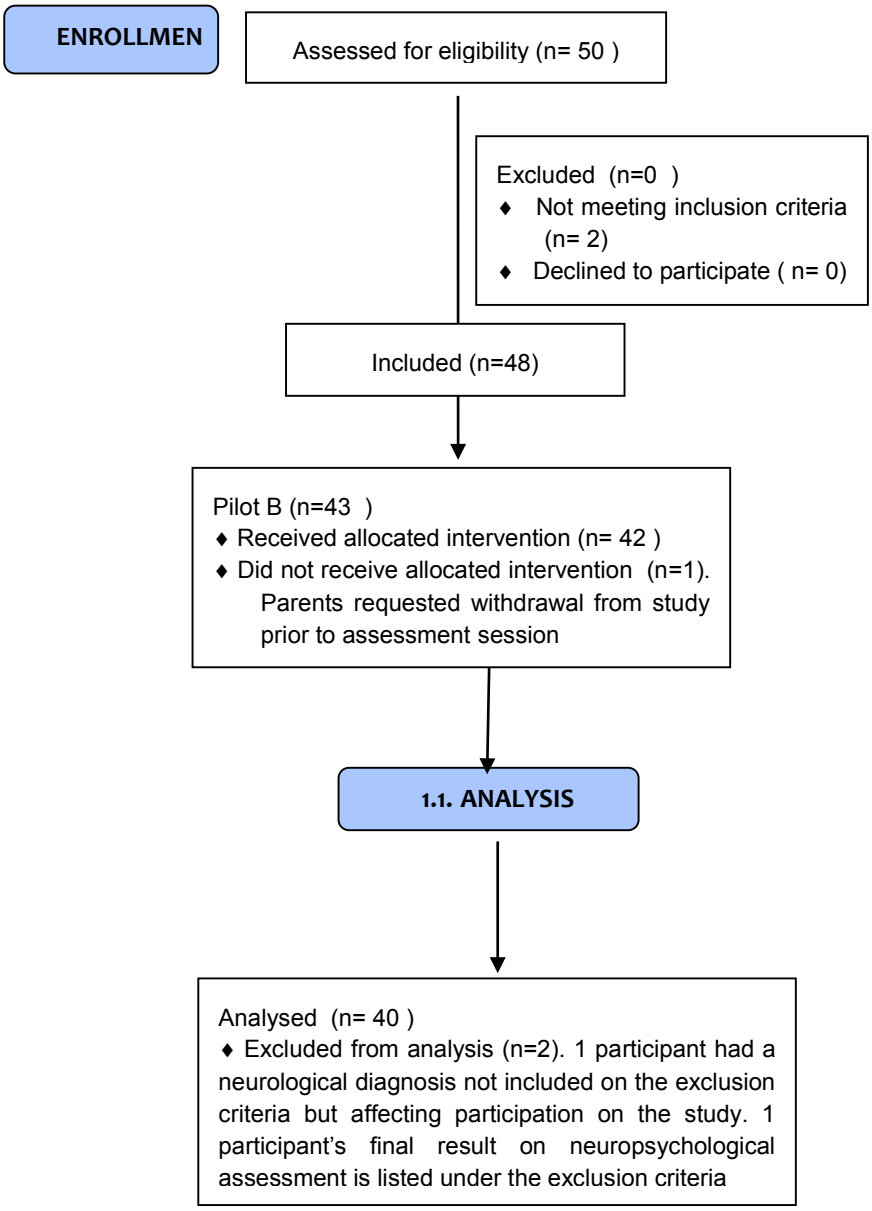
In each institution, the neuropsychologists first identified participants meeting the inclusion criteria, and then the neuropsychologists used the general information sheet designed to inform parents about the study. If parents expressed further interest, the neuropsychologist provided the researcher their contact information. The researcher (and for Argentina the music therapist administrator) provided parents with more detailed information and delivered the informed consent form. If parents signed the informed consent form, the child was included in the recruitment process and the administration appointment was set for within 10 days.

4.3.2.1. Children Participants Pilot B

As was mentioned when speaking about the ethics application (section 4.1.3), the number of participants had initially been set at 60 participants (Pilot A: n=5; Pilot B: n=55). However, for time constraints, one country (Chile) had to be taken out of Pilot B, lowering the sample size for Pilot B from 55 to 40 participants. The sample is considered a non-probabilistic consecutive sample.

The flow diagram of participants is presented according to CONSORT guidelines

Figure 3 Pilot B Children participants. Flow diagram



As can be seen, from the total of participants, n=42 were included for the administration of the APMT. Some data was not used in the analysis (Pilot B: n=2) due to final results on the neuropsychological assessment meeting the exclusion criteria, or due to children having with other neurological diagnosis not included on the exclusion criteria, but affecting participation in APMT. In the last case, a music making session was tailored for the child, as it was not considered ethical to use the APMT protocol at the moment.

For informative purposes, the characteristics of the sample are presented on the following table

Table 22 Sample Characteristics

Age	*n*	Clinical (ADD, ADHD)	Clinical other diagnosis	Non-Clinical
Six years old	12	10	1	1
Seven years old	10	6	2	1
Eight years old	12	2	8	2
Nine years old	6	2	4	0
Gender	*n*	*n*	*n*	*n*
Female	20	9	9	2
Male	20	11	6	2

The demographic characteristics of the sample were not used as variables in the study, according to the research questions.

4.3.2.2. Participants: Music therapists administrators

As mentioned in section 4.3.2, since Pilot B took place in different centers, two music therapists were contacted to participate as administrators of APMT (one in Colombia and one in Argentina). The researcher also participated as an administrator.

Following criteria included in the ethics application (section 4.1.3) the administrators are recognized music therapists in their countries with at least two years of experience working with child populations in the area of learning disabilities.

Clinical expertise was the main criteria for choosing the administrators. Location was a condition for participation. The researcher knows both administrators from the professional field, facilitating contact and further communication.

Their general professional information was gathered as part of the data, and is presented in Table 23.

Table 23 Administrators information

Code	Country of origin	Education level	Clinical experience in years
A1	Colombia	PhD student	Over 10 years
A2	Colombia	Master	Over 10 years
A3	Argentina	Undergraduate	Between 5 and 10 years

It is important to recall that in Colombia there is not an undergraduate program in Music Therapy.

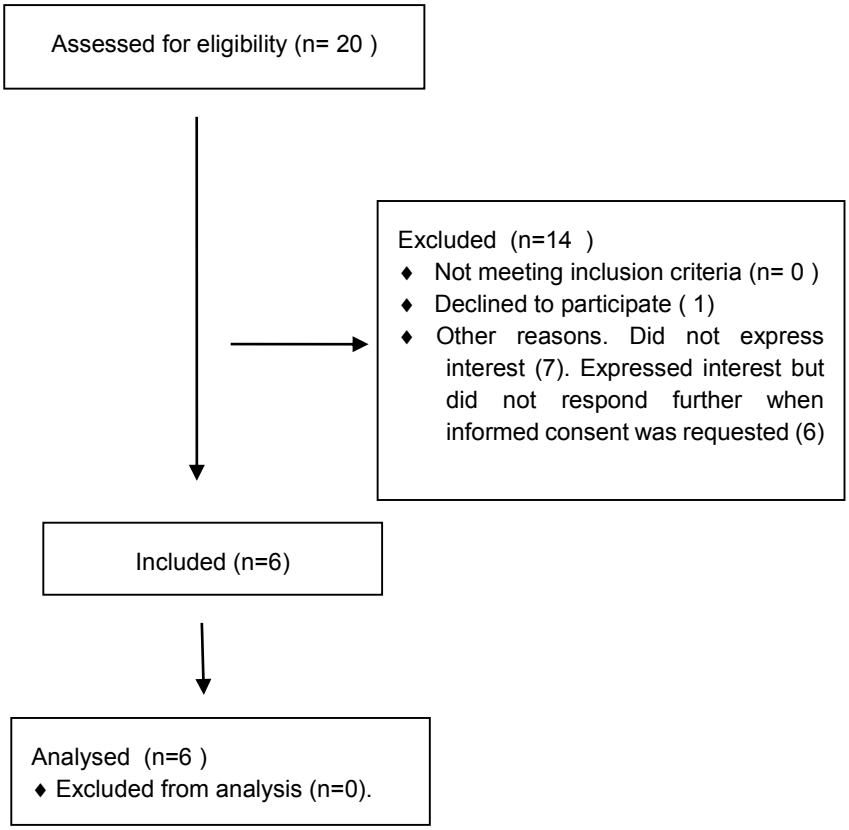
4.3.2.3. Participants: Raters

For the purpose of establishing inter-rater agreement for Pilot B results, qualified music therapists in Argentina and Colombia, with minimum two years of clinical experience with child populations, and experience with learning disabilities and education, were contacted.

All the contacted music therapists have had previous professional contact with the researcher, or were referred by an experienced music therapist. In a first instance, 10 music therapists were contacted and two provided informed consent. Due to such a low rate of response, a new recruitment effort was launched sending the information to 10 other music therapists. In this new attempt, 4 music therapists agreed to

participate and provided informed consent. A total of six music therapists were included as raters for the Pilot B study. A flow chart of the raters' recruitment process is presented below.

Figure 4 Pilot B raters Flow Chart



General information of the raters was gathered as part of the research protocol.

Table 24 Raters General Information

Rater	Country of practice	Level of education	Clinical experience in years
1	Colombia	Master	5-10 years
2	Argentina	PhD	Over 10 years
3	Colombia	Master	2-5 years
4	Colombia	Master	2-5 years
5	Colombia	Master	5-10 years
6	Colombia	Master	5-10 years

4.3.2.4. APMT Administration Protocol

A protocol for music therapist administrators including procedures to follow prior and during the APMT administration, is part of the manual. Along with the manual, administrators received a link to an informational mock video of an APMT administration.

The steps included in the protocol, are presented on Table 25.

Table 25 Administration Protocol Pilot B

Step	Function
Read the manual several times	To clearly understand the structure and instructions. E-mail questions to clear doubts. Study the list of song choices
Review the score sheet	Understand the response sheet and get familiar with it.
Perform a mock session	To have a first experience with APMT. Identify difficulties, clarify other issues
Administration sessions	Administer the APMT with Pilot B participants

Send results	To forward the results to the researcher for data processing and analysis

The following procedure instructions were included for the administration sessions.

1. Print the score sheet. (remember to set up printer to print horizontally). Mark the sheet with participant's code
2. Organize setting. Have instruments at hand
3. Remember to record the session.
4. Perform the administration session as presented in the manual. Make sure to follow the established order.
5. Record responses item by item on the score sheet during the session. Use pencil. When response is a number, write the number on the corresponding box. When response is a word, put an X right next to the word, or circle the word on the box.
6. After the session, review the score sheet. Take a picture or scan it, and send it via e-mail to the researcher. Keep a back up of the file.
7. Remember all confidentiality precautions stated in the consent form.

4.3.2.5 APMT raters protocol

In order to gather data to establish inter-rater agreement, data was collected from music therapists serving as raters Videos of 4 participants were randomly chosen using the random generator program from www.random.org (due to low quality of some videos presenting delay between image and voice, 10 videos were not included in the randomization list).

Raters received the same materials as Administrators (Manual, video of an APMT administration, Response sheet). Additionally and according to the protocol, they received the links to the unlisted YouTube videos of the 4 randomly selected participants. After the rater accepted to participate in the study, and signed the informed consent form, the following protocol was used.

Table 26 Raters protocol Pilot B

Step	Function
Read manual several times. Watch video	To clearly understand the structure and instructions. Send questions to clear doubts.
Watch and rate videos	To rate the videos of 4 participants

Send results	To collect data for establishing inter-rater agreement
Erase files	To protect confidentiality of data

Raters received the following procedure instructions for the moment of rating

1. Have in hand the response sheet. Mark the sheet with the participant's code.
2. Watch the video in a private place to protect confidentiality of participants
3. Record responses item by item on the score sheet during the session. When response is a number, write the number on the corresponding box. When response is a word, put an X right next to the word, or circle the word on the box.
4. Watch each task only once. You may stop in between the tasks to mark your response.
5. Review the score sheet. Take a picture or scan it, and send it via e-mail to the researcher.
6. Once the researcher has confirmed to have received the materials, erase all files

Step 4 of the procedure instructions is highly important, as it is a way to mirror (to the possible extent) the rating process of the administrators who provided their ratings during the session, and immediately after each task was performed. If raters were provided with additional opportunities to watch the child's performance, rating conditions for administrators and raters would be different, posing a methodological difficulty for establishing inter-rater agreement.

4.4. STAGE 4

This stage on the research process was dedicated to the process of analyzing the data collected in Pilot B. The statistical analysis process was done in conjunction with a consultant statistician. This was included in the PhD plan from the beginning of the process, as it was considered crucial to have expert advice to choose and perform adequate statistical procedures.

In addition to the APMT data, results on the neuropsychological assessments (NPA) were also included for the statistical analysis. NPA data was sent directly by the neuropsychologists to the researcher via e-mail.

As written in section 4.2.2. the neuropsychological assessment to be used for correlation was established beforehand and a presentation of the research study was made to the neuropsychology staff at the collaborating institutions. However, it was difficult to ensure the administration of the attention tasks of the specific neuropsychological assessment to all the participants as part of the assessment process

of the children, due to institutional and health system related limitations, and clinical rationale. Given that the tool was chosen taking into account a survey sent to institutions, and the fact that the Evaluación Neuropsicológica Infantil (ENI) have norms for Colombian population, such complication was not anticipated. Considering that the neuropsychological assessment was not a procedure included on the research protocol but an inclusion criteria, the decisions not to administered the ENI tasks needed to be respected. Therefore, data for establishing correlations with neuropsychological assessments, only includes part of the sample. However, as included on the research protocol, the reports from the neuropsychological assessment of all the participants were gathered to collect demographic information.

4.4.1. **VALIDITY AND RELIABILITY**

Based upon the research questions, it is relevant to understand the concepts of reliability and validity and how they were incorporated into the research study. Since there are several methods that could be used for establishing reliability and validity, researchers must choose carefully the methods for data analysis, taking into account the design of the assessment (scoring system, types of data), and the chosen methodology (sample characteristics, protocols).

Of relevance to this study's areas of research, the work of Prickett (2005) concerning validity and reliability in music therapy, and Maroof (2012) regarding research concepts in neuropsychology references are central on this section.

According to Prickett (2005), reliability deals with the need for a measure to give consistent results under similar circumstances. Both Prickett (2005) and Maroof (2012), explain that considerations for establishing reliability, precede those for establishing validity.

Methods for establishing reliability include: calculating internal consistency reliability, inter-rater agreement, test,re-test reliability, and intra-rater reliability.

From the music therapy assessments examined on section 2.3.2. ten out of twelve tools used inter-rater agreement as the chosen method to determine reliability (Pavlicevic, 2007; Moreau et al, 2009; Mahoney, 2009; Jacobsen, 2012; Gattino, 2012; Mcdermott, et al. 2014; Magee, 2016; Waldon, 2016; Carpente, 2016, O'Kelly, 2017) In five cases, researchers also established test-retest reliability (Jacobson, 2012; McDermott, 2014; Waldon, 2016; Magee, 2016; O'Kelly, 2016). Only one assessment used the intra-rater agreement procedure (O'Kelly, 2017).

For the purpose of this study, the reliability of the APMT tool was established using coefficients of internal consistency (Cronbach's alpha and polychoric correlation coefficients), and inter-rater reliability. A choice was made, not to include a test-retest procedure in the design. The reason is that children are referred to multiple therapies,

which could affect results on a retest procedure. To account for such impact, an extra administration of the neuropsychological assessment would have been necessary, when the second APMT was performed, and there would be ethical implications as it would be an unnecessary procedure for the child. In looking for alternatives to avoid the difficulty, the procedure could have then included the retest administration within few days, or even in the same day as the first administration, but there might be an effect on the results, from the child's habituation to the test.

Maroof (2012) defines validity as "the process of establishing a test's utility to describe, explain and predict phenomena" (pp. 5). Prickett (2005), when speaking of categories of validity, mentions two types of classification. One classification includes: internal and external validity. Internal validity relates to the criteria used by the researcher in designing the study, so that situations that might influence the results of the study are controlled. External validity in turn, relates to the possible generalization of the research results. Even though such concepts are most commonly found on experimental research, they are always relevant in research.

The second classification mentioned by Prickett (2005) includes: content, construct, and criterion validity. Maroof (2012) emphasized that validity is a process and relates each type of validity to a quality of a test. In this way content validity relates to how well the items included in an assessment tool, capture all aspects of the construct. Consultation with experts (as a subjective method) as well as factor analysis (as an objective method) are ways of ensuring content validity. Continuing with the process, construct validity relates to determine whether items measured what they were intended to measure. Maroof (2012), includes convergent and divergent validity as types of construct validity. Convergent validity, examines if measures assessing the same underlying concept, are in agreement or converge. Divergent validity on turn, deals with establishing if measures of different or dissimilar constructs show no obvious relationship. Convergent and divergent construct validity may also be established using factor analysis, as items referring to one hypothetical construct should load into a single factor, and those of different constructs should load into different factors. However, the author speaks of the difficulty to establish divergent construct validity in neuropsychology, given that constructs are often correlated. Finally, the extent to which a test serves as a predictor of a behavior, is referred to as criterion validity. According to the temporal ordering of the measurement, postdictive, predictive or concurrent validity may be established.

Maroof also mentions ecological validity, referring to the extent to which the measure relates to the person's everyday life, as an important category in validity.

For the purpose of this study, content validity, as well as construct and criterion validity are evaluated. Expert consultation (prior to Pilot A) was used for establishing content validity. Exploratory Factor analysis was used to establish content and

construct validity. Correlations with a standardized neuropsychological assessment was used to establish criterion concurrent validity.

Regarding ecological validity the design of the APMT takes into consideration the ways a child relates to music in their everyday life. Singing and making movements to music, are common uses of music in childhood, especially when children attend schools. When invited to play instruments that the child might not be familiar with, there is time for exploration offering the possibility to make choices based upon personal preferences. When thinking about the ecological validity in terms of the administrator of the assessment, several issues were taken into account. The structure of the session follows the flow of regular music therapy sessions (with the exception of sessions using only improvisational approaches), and does not require additional equipment apart from the musical instruments commonly used in music therapy. The scoring of the assessment is done in paper, during the session.

The APMT structure takes into account the importance of the relationship building between the participant and the administrator and motivation, which are fundamental issues in Music Therapy. These considerations are included in the discussion section.

4.4.2. **DATA ANALYSIS PROCEDURES**

Upon collection of the APMT results, statistical analysis using the R software version 3.4.0 was performed. The software was selected by the statistician consultant highlighting the robustness of its design, and its open code. The PSYCH package was used for factor analysis and polychoric correlations, and the IRR package was used for analysis of inter-rater reliability.

The first process in the data analysis, involved the establishment of reliability of the results. There are several procedures used to establish reliability of instruments. For the purpose of this study, internal consistency and inter-rater agreement were selected.

The internal consistency of the instrument was calculated using Cronbach's alpha, a coefficient examining agreement between all items results, to establish if the instrument in effect measures the proposed construct. However, since there are multiple scoring systems on APMT, calculating the Cronbach's alpha would not constitute a complete picture of the internal consistency of the instrument.

Following Meyer's (2010) recommendations for establishing reliability, polychoric correlation coefficients are used, as well as analysis following the thinking of the testlet model (Wainer, Bradlow, & Wang, 2007). The main characteristic of testlet, is that it should consist of parts of the data with common characteristics, such as same type of items, or items around a common factor. For the APMT, the assessment session has four distinctive moments. Each moment has common factors such as the song used, or the type of activity. Therefore the *Moments of the session* were used as

a subset of data for analysis. The description of the APMT *Moments of the session* is presented on chapter 4.3.1. The categories of attention were also used as subsets of data for establishing reliability.

An important component of reliability is to establish whether or not, different evaluators provide the same scores to the administration of the assessment. After results of the sample were collected, 4 videos of participants were randomly selected and sent to six music therapists serving as raters. The music therapist raters were all clinicians with experience working with children populations, learning disabilities and education. The raters have different levels of education and years of experience, and those variables were included in the analysis. The procedures involving the participation of the raters were described on section 4.3.2.3.

Providing the different types of items included in the assessment, two different procedures were used to establish interrater reliability. Fleiss Kappa was used for nominal data and Krippendorff's (often referred to as Kripp) kappa, for ordinal data.

Content and construct validity was examined using Exploratory and Factor analysis. Such analysis allows for the identification of the items that should definitively be included in the final version of the assessment, and for those that should be taken out of the assessment due to the statistical evidence.

Concurrent criterion validity is established analyzing correlations between results on attention tasks on a standardized neuropsychological assessment and the APMT. Spearman correlation was chosen for testing the correlations.

Table 27 Statistical Procedures

Purpose	Procedure
Internal consistency Reliability	Cronbach's Alpha: All results Cronbach's alpha: Sub sets of results. Moments of the session. Polychoric correlation coefficients: Exploratory Factor Analysis
Inter-rater Reliability	Fleiss Kappa for nominal data Krippendorff Kappa for ordinal and nominal data.
Content validity	Exploratory Factor Analysis

Construct validity (convergent/divergent, concurrent)	Correlations with results on neuropsychological assessments. Spearman correlation (15 participants) Exploratory Factor Analysis

4.5. STAGE 5

The final stage of the study was dedicated to writing the final report of the research study. It included the final revision of all the previously written chapters, and writing the last three chapters (results, discussion and limitations and suggestions for future research).

4.6. SUMMARY OF METHODOLOGY AND DESIGN

Chapter 4 includes a thorough description of each of the five stages organizing the research process. The first stage, considered a preparation stage, is divided into three processes: the writing of the Elaborated Proposal, which is the guiding document of the research, a focus shift on the topic of research from assessment of general child development in music therapy to attention assessment in music therapy, and the ethics application including all the ethics considerations for the research study. The second stage is divided in two processes. The designing exercise for the APMT is the first process, and a small pilot study called Pilot A is the second. Pilot A had 5 participants and was carried out in two Colombian cities (Medellin and Bogota). Analysis of the design and the implementation resulted in corrections to the initial version of APMT.

The third stage of research presents the process of designing the second version of APMT, and a larger pilot study (n=40) carried out in Medellin and Bogota (Colombia), and Lujan (Argentina). In addition to the researcher, two other music therapists participated in the APMT sessions. Four randomly selected videos of APMT administrations were sent to 6 music therapists who agreed to participate as raters for the study. Stage four presents the concepts of reliability and validity, and details the procedures used in the research for establishing reliability and validity of APMT under Pilot B conditions. Finishing the chapter, stage 5 refers to the moment of writing the final research document.

CHAPTER 5. RESULTS

The research study had two main purposes. The first one was to design the APMT (Attention Profile in Music Therapy), and the second was to establish reliability and validity of the tool.

The main research question was: Can a music therapy assessment designed to provide a profile of the attention of a child, do so in a reliable and valid manner?

To be able to respond to the main research question, the sub-questions regarding reliability and validity, must be addressed first.

5.1. RELIABILITY RESULTS

The first sub-question of the research study deals with the reliability of the APMT.

Sub-question 1: Is it possible to establish inter-rater reliability of the proposed assessment?

As it was mentioned on chapter 4, two types of reliability were established for the APMT results using data from Pilot B: Internal consistency reliability and Inter-Rater Reliability. Looking into inter-rater reliability without including an analysis of internal consistency would not be correct from a methodological standpoint.

5.1.1. **INTERNAL CONSISTENCY RELIABILITY**

Internal consistency, deals with the extent to which items of a test measure the same construct. The relation between item scores is evaluated. The most commonly used statistical method to establish internal consistency is Cronbach's Alpha. As Green, Chen, Helms and Henze (2011) recommended, the Cronbach's Alpha results will be presented only in relation to the sample of Pilot B (n=40), as reliability is tested in direct relation to the sample of the study, and therefore it should not be assumed that other samples will share the same Cronbach's Alpha.

The total number of items for the APMT is 110 items. Cronbach's Alpha for Pilot B data (n=40), was calculated using the PSY package of the R software.

Table 28 Cronbach's alpha complete data set

Number of elements	Number of participants (*N*)	Cronbach's alpha
110	40	0.83

There are several items on the complete data set, which are scored differently than the majority of the items. While in most of the items with choices 1/0, the 1 indicates the better performance, there were other items where the score 0 represents the better performance. For example in task 7, following the response of being able to imitate the beat span, there is an item for recording if the child's response was impulsive. If the answer is yes (which is coded: 1), the highest score indicates lack of inhibitory control which affects the performance on the task (there were 21 items with these characteristics)

Other items are descriptive in nature. For example the song choice of the child. The name of the chosen song is important information for the clinician to build a repertoire of known songs for the child. But the information will not correlate with other scores, because the song choice does not belong in any attention category. There are other items referring to characteristics of the music making of the child. In task 3 for example, the "prelude" items describe melodic contour, rhythmic patterns and lyrics as compared to the original song. Such information again, is relevant for the clinician, but cannot be categorized in the attention categories (there are thirteen items with these characteristics).

Given these characteristics, a second Cronbach's Alpha was calculated excluding the above mentioned variables (song choice, items with reverse score criteria, and musical data). The second Cronbach's Alpha used 76 items, and the calculation result was α=.88. Both results can be interpreted as showing good internal consistency. However, since Cronbach's alpha is a measure of the correlations among items, excluding items thought not to be correlated (descriptions, and reverse scorings), should improve the coefficient's value. However, the increase on the value was discrete. This could be explained by the decrease on the number of items used for the calculations as the length of a test affects the alpha coefficient (Tavakol & Dennick, 2011).

As Tang, Cui and Babenko (2014) explain, Cronbach's alpha results do not necessarily provide complete information about the internal consistency reliability of a data set. Therefore, other methods were used to further examine internal consistency. Following Tavakol and Dennik´s (2011) recommendations, and considering that the data set could be multidimensional, the first method was to calculate Cronbach's alpha for subsets of the data.

Polychoric correlations between items identified in Factor Analysis, were used to examine correlations between items, accounting for different scoring systems. The third method, was to examine internal consistency, for the item pool after Factor Analysis.

The first step was to calculate Cronbach's alpha on subsets of data. The four *Moments of the session,* that build the structure of the APMT, were the base for the first data subset. Cronbach's alpha was calculated for each *moment of the session.* Mirroring the procedure followed when calculating the Cronbach's alpha for the complete data set, a first alpha was calculated using all variables from the *moment of the session.* Afterwards, variables with reverse scoring criteria, uncorrelated musical data, and song choice were excluded and a second Cronbach's alpha was calculated. The second Cronbach's alpha can be identified on the table with the words: with exclusions. Results are highlighted with colors according to the interpretation of the result: 0.5 or less= Unacceptable (red), between 0.5 and 0.59= Poor (pink), between 0.60 and 0.69=Questionable (yellow), between 0.70 and 0.79=Acceptable (blue), between 0.80 and 0.9= Good (light blue), above 0.9= Excellent (green).

Table 29 Cronbach's alpha Moments of the session

Moment of the session	Number of items	Cronbach's Alpha	Moment of the session with exclusions	Number of items	Cronbach's Alpha
Moment 1 (task 1 and 2)	22	**0.56**	Moment1 with exclusions	17	**0.73**
Moment 2 (task 3 and 4)	16	**0.73**	Moment2 with exclusions	11	**0.67**
Moment 3 (task 5, 6, 7)	50	**0.47**	Moment3 with exclusions	26	**0.70**
Moment 4 (task 8 and 9)	22	**0.71**	Moment4 with exclusions	19	**0.73**

Even though Cronbach's alpha formula gives importance to the number of items analyzed, it can be seen that the exclusion of variables with reverse scoring criteria, song choice variables, and musical data variables, increase the consistency of the data in most subsets of data, excluding Moment 2. The consistency of the second moment of the session is consider questionable on the version with exclusions. For moments 1, 3 and 4, the alpha is considered acceptable.

A second Cronbach's Alpha was calculated using the categories of attention as subsets of data. All APMT items are classified into categories of attention and complementary scales (impulsivity, motivation, overall performance, relationship). The complementary scales are meant to provide additional information, regarding the child's performance. Only two musical data items were included in the attention categories. The remaining 10 items were not included in the categories, nor the complementary scales.

Cronbach's Alpha for the attention categories and the complementary categories, was calculated first for all the items classified on the category and afterwards excluding the items with reverse scoring. On the categories of Alert, Motivation, and Overall performance, no items had reverse scoring. The alpha for the category of divided attention is reported, but given that the category only has two items, it violates assumptions for analysis and should not be analyzed according to Cronbach's alpha results. In the impulsivity category, no items were excluded, but the codes for the response choices were corrected to match the same relationship (better performance= higher score for all items in the category) Results are also highlighted in colors according to the criteria presented for table 29 (0.5 or less= Unacceptable (red), between 0.5 and 0.59= Poor (pink), between 0.60 and 0.69=Questionable (yellow), between 0.70 and 0.79=Acceptable (blue), between 0.80 and 0.9= Good (light blue), above 0.9= Excellent (green)).

Table 30 Cronbach's alpha categories

Category	Items	Cronbach's Alpha	Categorywith exclusions	Items	Cronbach's Alpha
Alert	4	**0.30**			
Divided	2	**0.30**			
Selective	26	**0.26**	Selective withexc.	16	**0.71**
Sustained	33	**0.75**	Sustained withexc.	24	**0.80**
Impulsivity	12	**0,37**	Impulsivity withexc.	12	**0.64**
Motivation	9	**0.85**			
Overall performance	4	**0.77**			

The alpha on the second version (when items of reverse scoring were excluded), presents better results. The results for the categories of selective attention and overall performance are acceptable, for the sustained attention and motivation categories are good, and for the impulsivity category are questionable. The lowest coefficient score was found for the alert category, interpreted as unacceptable.

Following analysis of Cronbach's Alpha, and according to the previously mentioned recommendations, (Tang et al. 2014), factor analysis was conducted. Results are used to determine multidimensionality or unidimensionality of the data, to reduce data when needed, and to identify themes connecting items. Since the factor analysis are also part of the validity analysis, the results will be presented in section 5.2.2 to avoid confusion and repetition.

5.1.2. **INTER-RATER RELIABILITY RESULTS**

To establish inter-rater reliability of the APMT, four videos of APMT administrations were sent to 6 music therapist raters. Participant raters, used the APMT response sheet to send their ratings. Raters received the same amount of training as administrators, except for the fact that administrators had to perform a mock session before using the APMT protocol with participants from the study. The general information of the raters can be found on section 4.3.2.

The results of inter-rater reliability that will be presented, were calculated with and without including the ratings of the music therapist administering the assessment. In this way, the role of the administrator on the agreement results can be differentiated. Whenever 6 raters are listed, the administrator's rating has not been included in the calculation. When 7 raters are listed, the administrator's ratings were also included.

Following guidelines for reporting inter-rater reliability, the results in terms of percentage of agreement are presented prior to results with other statistical methods.

The participants are coded here as Participant 1, 2, 3, 4, to further protect the confidentiality of their data.

The following figure explain the methods used for establishing inter-rater reliability for the complete data set (group level statistics), and for pairs of raters' results (individual level statistics).

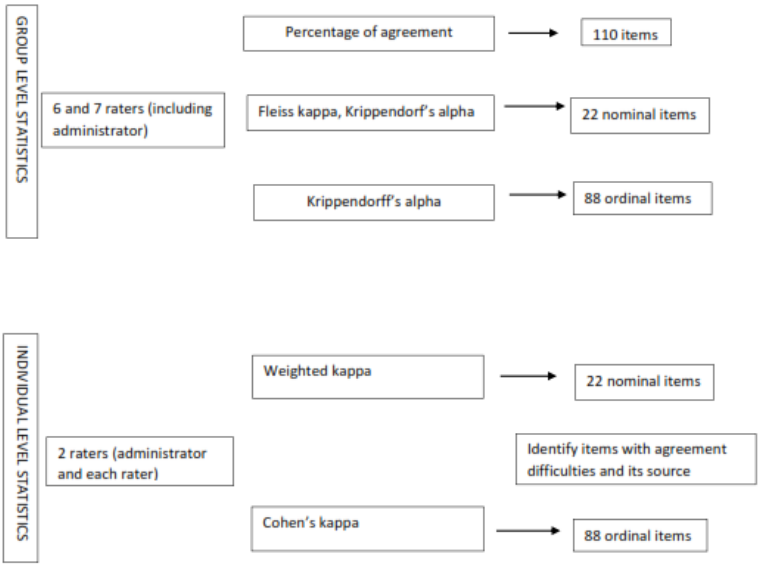


Figure 5 Statistical methods for establishing inter-rater reliability

As the figure shows, the first method used to establish inter-rater agreement was the percentage of agreement. The results, using an item pool of 110, are shown on table 31.

Table 31 Percentage of agreement with and without administrator

Raters	Participant 1	Participant 2	Participant 3	Participant 4
6 raters	91.7	97.3	93.6	92.7
7 raters	91.7	95.5	92.7	91.8

Note: 110 items

Considering that percentage of agreement does not take into account other considerations for inter-rater agreement (such as chance of random agreement) other statistical methods complemented the agreement analysis.

Given that there are several types of data on the APMT (dichotomous/polytomous ratings, and ordinal/nominal variables), two different methods were chosen. Both coefficients can be used for dichotomous and polytomous data. Fleiss Kappa was used for establishing inter-rater reliability of the nominal items, and Krippendorff's Alpha for the ordinal items. It should however be noted that Krippendorff's Alpha can also be used to establish inter-rater reliability of nominal items, and agreement between values on Fleiss Kappa and Krippendorff's Alpha is considered to give more weight to the result.

Fleiss Kappa Results for each participant, taking into account 22 nominal items, are reported in the following table.

Table 32 Fleiss Kappa Results. Nominal items

Raters	Participant 1	Participant 2	Participant 3	Participant 4
6 raters	0.722	0.743	0.751	0.751
7 raters	0.739	0.75	0.764	0.745

Note: 22 Nominal items

While there is no consensus on standards for interpretation of Fleiss kappa, Landis and Koch (1977) suggested a commonly used interpretation for Kappa values as follows: $\kappa < 0$ No agreement; 0.0 — 0.19 Poor agreement; 0.20 — 0.39 Fair agreement; 0.40 — 0.59 Moderate agreement; 0.60 — 0.79 Substantial agreement; 0.80 — 1.00 Almost perfect agreement. However, it should be noted that such interpretation has been controversial, especially considering that 0.60 (the lower score for the substantial agreement criteria), may be too low for research on the healthcare field. In the above results, it can be seen that Fleiss kappa values for all participants, were above 0.70.

When calculating Krippendorff's alpha for the nominal items, results are almost identical to the Fleiss kappa.

Table 33 Krippendorff's alpha. Nominal items

Raters	Participant 1	Participant 2	Participant 3	Participant 4
6 raters	0.723	0.743	0.752	0.752
7 raters	0.739	0.75	0.764	0.745

Note: 22 items

For interpretation of the Krippendorff's alpha coefficient in the document, the standards of Landis and Koch (1977) are used.: $\alpha<0$ ``poor" agreement, 0 to 0,20 ``slight" 0,21 to 0,40 ``fair" ; 0,41 to 0,60 ``moderate"; 0,61 – 0,80 ``substantial", and

0,81 to 1 ``near perfect''. In this case the agreement for the nominal variables for all the evaluated participants is considered substantial. The concordance on both calculations (Fleiss kappa and Krippendorff's alpha) gives more weight to the agreement for the nominal items.

As mentioned earlier, Krippendorff's Alpha was chosen to calculate inter-rater reliability of the ordinal items. Krippendorff's alpha applies to this data set, meeting assumptions including: multiple raters, multiple scale values and categories, multiple level of measurements. Results are presented in Table 34.

Table 34 Krippendorff's alpha ordinal items

Raters	Participant 1	Participant 2	Participant 3	Participant 4
6 raters	0.904	0.948	0.97	0.957
7 raters	0.916	0.946	0.97	0.96

Note: 88 ordinal items

According to the standards presented on the previous paragraphs, results for the ordinal variables on Krippendorff's Alpha are interpreted as "near perfect agreement" for all participants.

Both Krippendorff's Alpha and Fleiss Kappa provided group level statistics, calculating a general result of agreement. However, to examine further the relation between the scores of the APMT administrator and each rater, statistical methods for calculation of inter-rater agreement for two raters were used. Unweighted kappa and weighted kappa coefficient were used for the nominal variables, and Cohen kappa for the ordinal variables. It is relevant to include such analysis, as the administrator has a different condition to that of the raters. Raters provide their scores interpreting the session administration, while the administrator is in the moment of the session, rating it.

Table 35 presents the results for unweighted and weighted kappa for four participants, calculating the coefficient for two raters at a time. The two raters are: the administrator of the assessment and each one of the raters. Twenty two nominal variables were included for the analysis. Even though both coefficients are reported, the weighted kappa is considered to be more suitable for the analysis of variables on the data set, as it takes into account not only absolute agreements, but also relative concordances.

Scores have been highlighted according to the criteria for interpretation of Landis and Koch (1977). Yellow for scores between 0,41 and 0,60 interpreted as moderate agreement. Orange for scores between 0,61 and 0,80 interpreted as substantial agreement. Green for scores above 0,80 interpreted as almost perfect agreement.

Table 35 Unweighted and weighted kappa results

Participant 1	Admin and Rater 1	Admin and Rater 2	Admin and Rater 3	Admin and Rater 4	Admin and Rater 5	Admin and Rater 6
unweighted kappa	0,76	0,65	0,82	0,77	0,94	0,76
weighted kappa	0,95	0,88	0,96	0,88	0,99	0,74
Participant 2	Admin and Rater 1	Admin and Rater 2	Admin and Rater 3	Admin and Rater 4	Admin and Rater 5	Admin and Rater 6
unweighted kappa	0,81	0,88	0,87	0,81	0,68	0,54
weighted kappa	0,93	0,94	0,93	0,97	0,94	0,83
Participant 3	Admin and Rater 1	Admin and Rater 2	Admin and Rater 3	Admin and Rater 4	Admin and Rater 5	Admin and Rater 6
unweighted kappa	0,93	0,93	0,8	0,69	0,69	0,74
weighted kappa	0,89	0,81	0,84	0,86	0,86	0,82
Participant 4	Admin and Rater 1	Admin and Rater 2	Admin and Rater 3	Admin and Rater 4	Admin and Rater 5	Admin and Rater 6
unweighted kappa	0,81	0,88	0,81	0,5	0,55	0,82
weighted kappa	0,89	0,9	0,86	0,6	0,65	0,89

Note: 22 Nominal items

Results of the unweighted kappa are lower than those for the weighted kappa. However, as mentioned previously, the weighted kappa incorporates the magnitude of the disagreements distinguishing degrees of disagreement. As such it should be regarded as a more adequate measure of the agreement in this case.

The inter-rater agreement using weighted kappa, shows mostly scores above 0,81. Using the standards presented before, those results would be interpreted as “almost perfect agreement”. Only results for participant 4, rater 4 (0.6 moderate agreement) and 5 (0.65 substantial agreement) were different.

For the ordinal items Cohen’s kappa was used to calculate agreement between the administrator and each rater. Results are presented on table 36.

Table 36 Cohen's kappa. Ordinal items

Participant	Admin and Rater 1	Admin and Rater 2	Admin and Rater 3	Admin and Rater 4	Admin and Rater 5	Admin and Rater 6
Participant 1	0,91	0,93	0,93	0,92	0,97	0,89
Participant 2	0,89	0,92	0,89	0,90	0,90	0,90
Participant 3	0,94	0,95	0,95	0,95	0,95	0,93
Participant 4	0,98	0,98	0,97	0,94	0,96	0,97

Note: 88 items

As can be seen all Cohen kappa values can be interpreted using Landis and Koch (1977) criteria as “almost perfect”.

Calculating Fleiss kappa and Krippendorff’s alpha, provided the general agreement for both types of items. In turn, weighted kappa for nominal variables and Cohen’s kappa for ordinal variables calculated the agreement between the administrator and each one of the raters. If interpreted using Landis and Koch results for nominal items are interpreted as “substantial agreement”, and for the ordinal items as “almost perfect agreement”.

However, none of these methods allow for identification of items with disagreements nor for possible sources of the disagreements. Such level of analysis is important on studies of reliability, as it will highlight difficulties with instructions, scoring criteria, or suggest training improvements for specific items. Final inclusion or exclusion of these items is decided based upon several considerations arising from the item level analysis, and Factor Analysis. Considering that items on APMT are considered categorical data, Intra Class Correlation is not an adequate method of analysis for the data of the APMT. Therefore an analysis based on the observation of the raters data, is used to decide which items should receive a more in depth analysis, regarding the instructions provided in the manual, the scoring criteria, and the level of instruction required for raters and administrators. When looking into the inter-rater agreement database, it is evident that there were several items with concordant scores across raters for all participants (55 items). In other items, scores for three participants were in perfect agreement, and for the remaining participant there were discordant ratings with close values (28 items). Considering its consistency and agreement, those items were not further analyzed.

The rest of the items (27 items) were examined further, finding that 15 items (5 nominal and 10 ordinal) had discordant ratings for two or three participants, while 12 items (5 nominal and 7 ordinal), had discordant ratings for all participants. As can be seen, 10 out of 22 nominal items, and 17 out of 88 ordinal items, for a total of 27 items, had discordant ratings for two or more participants.

Closer examination of the 27 items with discordant ratings for two or more participants, reveals that 19 of them correspond with the motivation scales (9 items, ordinal variable), the overall performance scales (4 items. ordinal variable), the type of support (4 items, nominal variable), and the relationship scores (2 items, ordinal variable). Description of the scales and rating criteria is provided below.

For the motivation scales, the ratings criteria were organized on a scale from 1 to 4. *Not motivated*=1, *Slightly Motivated*=2, *Adequately motivated*= 3, *Highly Motivated*=4. There was one motivation scale per task for a total of 9 motivation items.

On the overall performance scales, the scoring scale was numeric from 1 to 6: *Not able to perform*=1, *Performed requiring support from therapist*=2, *Performed independently with mistakes*=3, *Performed independently with self verification but without correction*=4, *Performed independently with self verification and correction*=5, *Performed correctly and independently*=6. The overall performance scale is presented at the end of each *Moment of the session*. A total of four overall performance items are presented throughout the APMT. Right next to the overall performance scale, a type of support description is presented to explain the most frequently support provided by the therapist during the corresponding Moment of the session (verbal, gestural, prompt). It was possible to mark more than one choice. The choices were assigned a numerical code on the database.

As for the relationship scores, a general estimation of how easy it was for the therapist and for the child to establish the relationship, is provided in the ratings using a scale 1-4: *Very difficult*=1, *difficult*= 2, *easy*=3, *very easy*= 4.

Aside from those items, a majority of the items showing greater discordance among raters (6 items), correspond to items describing musical aspects. Those items are presented in the table below. It should be mentioned that on the response sheet, the administrator and the raters, found the rating criteria presented on Table 37, not the numerical code assigned for each choice on the database.

Table 37. Musical data items with discordant ratings

Musical aspect observed	**Rating criteria**
Melodic contour on prelude singing to task 3	*Same, Similar, Different*
Sustained beat on prelude singing to task 3	*Yes, Sometimes, No*
Type of accompaniment when playing on task 3	*Pulse, Melodic rhythm, None*
Synchrony of voice and instrument playing on task 3	*Always, Sometimes, Never*
Time of instrument exploration on preparation for task 8	*1 minute or less, 2-4 minutes, more than 4 minutes*
Musical materials of child were similar to the therapist on task 9	*Always, Sometimes, Never*

Up to this point, the items with discordances were part of the complementary categories (motivation, overall performance, description of musical data). The items provided other type of information for clinicians regarding some characteristics of the child's music making, level of independence and support; and the motivation and relationship building (important as they might interfere with the child´s performance on APMT).

The last item not included on the attention categories, was an item from task 5. The item was designed to describe a certain type of child's response to a mistake introduced by the therapist without previous instruction provided. The rater marks one choice: *gestural, verbal, both*. The item showed discordant ratings for two participants.

However, some items with discordances were in fact part of the attention categories. This was the case for one item on task 3, classified on the alert category. On this task, the child must follow a direction to stop playing or singing according to a verbal instruction. The item requires the rater to respond if the response of the child was immediate. The choices were: *always, sometimes, never*. Disagreement in ratings, were found for all four participants.

In summary, the inter-rater reliability results showed substantial agreement for nominal scores, and almost or near perfect agreement for the ordinal scores. Analysis on inter-rater agreement between administrator and each of the raters, improved results for nominal items for most of the participants and pair of raters from substantial to almost perfect agreement. There was no indication of level of education or years of practice of the raters, having an effect on inter-rater agreement with the administrator. A total of 27 items (10 nominal and 17 ordinal), had discordant ratings for two or more participants. The majority of these items, are classified on the complementary categories. However, one item does belong to the alert category, and accounts for 25% of the score on this category, given that there are only four items in the category. Some of the possible causes of discordance found, could be addressed by including additional training for specific items, more detailed instructions for rating of the musical data items, or even exclusion of some musical data items.

A discussion of the inter-rater agreement results will be presented on Chapter 6.

5.2. VALIDITY RESULTS

There are several procedures to establish validity of the APMT. The main focus for this section are the second and third sub-questions of the research study

Sub-question 2: Will there be correlations between results from standardized neuropsychological assessment of attention and the proposed music therapy assessment supporting criterion/concurrent validity of the music therapy assessment?

Sub-question 3: Can factor analysis be used to support construct and content validity of the music therapy assessment?

5.2.1. **CONCURRENT VALIDITY RESULTS**

The second sub-question of the research study, highlight the need to establish correlations between results on standardized assessments of attention in neuropsychology, and APMT results, to establish concurrent validity. According to Maroof (2012), concurrent validity is established using two tests of similar methodologies, and preferably different sources. Measures should be measured concurrently.

The standardized neuropsychological tool chosen for establishing correlations was the Evaluación Neuropsicológica Infantil-ENI (Roselli et al, 2004). The tool has been used in other research studies, and there have been validation studies establishing norms for Colombia, Mexico and USA.

The ENI is a neuropsychological assessment battery containing tests for assessing different areas. Attention is one of the areas. As was presented on section 2.1.4 there

are 4 tasks in the assessment dedicated to attention. The tasks are divided according to the type of modality of the stimuli presented: visual or auditory.

For the visual attention assessment, two tasks are part of the battery. A drawing cancellation task, and a letter cancellation task. In the drawing cancellation task, a stimuli sheet with several drawings of a bunny in two different sizes (big and small) is presented to the child. The child must mark ("cancel") the big bunnies. The score is calculated according to the number of bunnies correctly cancelled, minus the number of mistakes. The maximum natural score, is 44. The task of letter cancellation, presents a stimuli sheet with 14 lines of letter series. All but one letter are vowels. The child must cancel that letter, but only when it appears before a specific vowel. Scores are calculated according to the number of correct responses, minus the number of mistakes. The maximum natural score is 82.

There are also two tasks for assessment of auditory attention. Forward digit span and backwards digit span. The administrator orally presents to the child series of numbers of increasing length. For the forward digit span, the first series has 3 digits, and the last one 8 digits. For the backwards digit span, the first series has 2 digits, and the last one 7 digits. Scores are calculated according to the maximum number of digits the child is able to repeat in the correct order. The maximum natural score for the forward digit span is 8 and for the backwards digit span is 7.

In the normative study for Colombia, and Mexico (n=788), the test-retest stability coefficient for the attention tasks was established as follows: Drawing cancellation (r=0.773), letter cancellation (r=0.881), forward digit span: (r=0.424), backwards digit span (r=0.572).

As was described on the methodology chapter (chapter 4), the criteria for choosing the ENI as the standardized attention assessment to look for correlations included: the results of a survey sent to clinical institutions asking for the tools used in neuropsychological assessment, and the fact that there are norms of the tool for Colombia were the majority of the study's participants were enrolled.

From the total sample of the APMT study, the results on every ENI tasks were reported for 12 participants. Results on some ENI attention tasks were reported for 3 additional participants. This was a methodological difficulty and a limitation of the research study. Referral to neuropsychological assessment was an inclusion criteria. However, the neuropsychological assessment was a clinical procedure independent from the study. Meaning that, even though referral to neuropsychological assessment was part of the inclusion criteria, the neuropsychological assessment itself was not a condition of the study.

Neuropsychologists were informed on the tools to be used for correlation. However, sometimes the assessment protocols did not include the chosen assessments.

Neuropsychologists in clinical practice, are required to provide a reasoning for applying a particular set of assessments according to needs of the child, and in accordance to institutional and health system guidelines. On occasions, the application of the specifically chosen neuropsychological assessments was not part of the established procedure and given that the application of the neuropsychological battery was not part of the research procedures, it was not ethical to force the application of extra tests.

The ENI scores are expressed in natural and scalar scores, and there are also percentiles of age related performance. Scalar scores and percentiles are calculated according to the normative study of the tool (Roselli et al, 2004) which takes level of difficulty and age as variables for performance. Since the APMT does not have scalar scores nor percentiles, a decision was made to use the natural scores for establishing correlations.

Even though the included ENI tasks and the APMT all were designed to assess attention, there are some differences between both tools, the first one of which is the fact that the ENI categorizes the tasks as visual or auditory attention modalities. The APMT does not use such classification. In Music Therapy it is difficult to separate both modalities, as they are in constant interaction. Even though interactions in music therapy clearly rely on auditory cues, the visual cues are also constantly adding information. Furthermore, as Joyce and Hrin (2015) pointed out the classification of attention tasks into visual or auditory attention, is not congruent with evidence arising from large brain systems research, demonstrating that both sensory modalities work together instead of separated.

Taking into account the previously presented consideration, the classification of the type of tasks used in ENI into the categories of attention was evaluated. Cancellation tasks (used in ENI for visual attention) are considered to be tasks for assessing selective and sustained attention (Soprano, 2009; Mitrushina, Boone, Razzani & D'Elia, 2005). According to Soprano (2009) if the child must control and handle two sets of information (which is the case for the ENI letter cancellation task), the tasks should also be considered to be divided attention tasks. The digit span tests in turn, are categorized as tests for selective attention (Soprano, 2009).

Correlations were run between results on each ENI tasks, and results on the APMT categories of attention. It is important to keep in mind that tasks on APMT were structured under a cross-modal attention paradigm, and it is not possible to determine the weight of each modality into the performance of the task.

For the establishment of correlations, Spearman rank correlation was used, with two tailed test of significance. Results are presented in the following table. Results in bold are significant at the 0,05* or 0,005* * level

Table 38 Spearman correlation results ENI/APMT

		ENI DRAWINGS	ENI LETTERS	ENI DIGITS FORWARD	ENI DIGITS BACKWARDS	APMT ALERT	APMT DIVIDED	APMT SELECTIVE	APMT SUSTAINED
ENI DRAWINGS	Rho Correlation coefficient	1,000	,689*	0,330	**,735****	0,548	**,592***	**,836****	**,664***
	Significance (bilateral)		0,013	0,295	0,006	0,065	0,043	0,001	0,019
	N	12	12	12	12	12	12	12	12
ENI LETTERS	Rho Correlation coefficient	**,689***	1,000	**,606***	**,775****	**,585***	**,773****	**,803****	**,688****
	Significance (bilateral)	0,013		0,028	0,002	0,036	0,002	0,001	0,009
	N	12	13	13	13	13	13	13	13
ENI DIGITS FORWARD	Rho Correlation coefficient	0,330	**,606***	1,000	**,687****	0,173	**,843****	0,422	0,315
	Significance (bilateral)	0,295	0,028		0,005	0,536	0,000	0,117	0,253
	N	12	13	15	15	15	15	15	15
ENI DIGITS BACKWARDS	Rho Correlation coefficient	**,735****	**,775****	**,687****	1,000	0,481	**,771****	**,578***	0,497
	Significance (bilateral)	0,006	0,002	0,005		0,070	0,001	0,024	0,060
	N	12	13	15	15	15	15	15	15
APMT ALERT	Rho Correlation coefficient	0,548	**,585***	0,173	0,481	1,000	**,580***	**,705****	**,696****
	Significance (bilateral)	0,065	0,036	0,536	0,070		0,024	0,003	0,004
	N	12	13	15	15	15	15	15	15
APMT DIVIDED	Rho Correlation coefficient	**,592***	**,773****	**,843****	**,771****	**,580***	1,000	**,607***	**,544***
	Significance (bilateral)	0,043	0,002	0,000	0,001	0,024		0,016	0,036
	N	12	13	15	15	15	15	15	15
APMT SELECTIVE	Rho Correlation coefficient	**,836****	**,803****	0,422	**,578***	**,705****	**,607***	1,000	**,680****
	Significance (bilateral)	0,001	0,001	0,117	0,024	0,003	0,016		0,005
	N	12	13	15	15	15	15	15	15
APMT SUSTAINED	Rho Correlation coefficient	**,664***	**,688****	0,315	0,497	**,696****	**,544***	**,680****	1,000
	Significance (bilateral)	0,019	0,009	0,253	0,060	0,004	0,036	0,005	
	N	12	13	15	15	15	15	15	15

Note: *Significant correlation in the 0,05 level (two tailed). **Significant correlation in the 0,005 level (two tailed)

The drawings cancellation task (considered to be a selective and sustained attention task), has a very strong significant correlation with the selective attention category (r=0.836**). A strong significant correlation was found with the sustained category (r=0,664*), and a moderate correlation (r=0.592*) with the divided attention category. No significant correlation was found with the alert category. According to the classification of the drawings cancellation task, the findings point to the establishment of construct validity of the selective and sustained attention category.

Correlations results between the letter cancellation task and the selective attention (r=0,803**), divided (r=0,773**) and sustained attention (r=0,688**), also point in the same direction. A moderate correlation was found between the letter cancellation task and the alert category (r=0,585*).

A significant correlation (of lower magnitude) was also found between the digits forward task and the selective attention (r=0,578*). However, a stronger correlation was found between the digits forward and the divided attention category. Given that the digits forward is not considered a divided attention task, the finding is contradictory.

Similarly, the strongest correlation for the digits forward task was with the divided attention category (r=0,788**). In fact, no significant correlation was found between the digits forward and the selective attention category.

As can be seen, results from the ENI visual attention tests and the ENI auditory attention to establish concurrent validity, are not consistent. While correlations between the ENI visual attention tasks and the APMT tasks, point towards a preliminary establishment of concurrent validity for the APMT categories, the correlations with the auditory attention tasks do not.

5.2.2. **CONSTRUCT VALIDITY RESULTS. FACTOR ANALYSIS AND POLYCHORIC CORRELATIONS**

In section 5.1.1., while speaking of internal consistency results of the APMT, it was mentioned that Cronbach's alpha was not necessarily the most adequate indicator of internal consistency for the APMT. Since there was possible multi-dimensionality of the data, and multiple scoring systems, the use of factor analysis (to determine dimensions of the data) and polychoric correlations (to determine inter-item correlations) were necessary to complete the reliability analysis (Tavakol & Dennick, 2011). Factor Analysis is also considered a method for establishing construct validity of assessment tools.

As Yong and Pierce (2013) explain, factor analysis is a statistical method used to "summarize data so that relationship and patterns can be easily interpreted and understood" (pp. 79). The organization of the items into factors with a common theme,

uncovers underlying constructs, concepts or a dimension of the construct. The same authors state that Exploratory Factor Analysis (EFA) is usually the factor analysis method to be use when developing new scales, being suitable for use with both ordinal/continuous and dichotomous/categorical data.

Even though Confirmatory Factor Analysis (CFA) could be used to test the stability of the factor structure, conducting EFA and CFA on the same sample is not consider adequate in statistics, given that the chance of agreement increases, making it difficult to identify inconsistencies (Izquierdo, Olea, Abad, 2014). The authors suggest use of CFA on the same sample, only with large samples, which may allow for splitting data, testing half data using EFA and half using CFA. The sample from pilot B, is consider a small sample for that procedure.

As Costello and Osborne state, there are few absolute guidelines on Exploratory Factor Analysis (2005). Common use in statistics and theory driven decision making are part of the researcher's rationale for making decisions. But there are no absolute answers for the decision making.

Some of the guidelines to be taken into account when conducting Exploratory Factor Analysis, are summarized below. The sources for this information are Costello and Osborne (2005), and Yong and Pearce (2013).

The item loads on factor analysis range between -1 and 1. Items with scores closer to 0, are interpreted as less correlated with the factor, while scores closer to 1, demonstrate high correlation with the factor. Scores closer to -1 show high degree of correlation but of inverse proportion. Although the adequate item load for inclusion varies in function of the sample size, a load of 0.50 or higher is consider a strong loader, and a bottom cut off point of 0.32 is recommended (Costello and Osborne, 2005). However, there are considerations regarding sample size, encouraging researchers with small samples to use higher cut-off points.

In addition to the identification of items composing a factor, the factor analysis also suggests the number of factors to retain from the analysis. Even though it has been common use in statistics to retain factors with eigenvalues larger than 1, this criteria has been re-evaluated including other rationale such as the breaking point of the scree-plot (inclusion of factors before the breaking point) and the cumulative proportion of included factors. For the cumulative proportion criteria, even though the common use of cumulative proportion indicates a cumulative proportion of 0.95 for including factors, in the social sciences and humanities, the cumulative proportion is around 60% (Hair, Black, Babin, & Anderson, 2014).

The other issue to be examined in this section are the polychoric correlations, looking at the reliability and construct validity of the tool. The polychoric correlations deal with correlations between items under the same factor. This method of analysis of

correlations is used when there are multiple scoring systems, which is the case for the APMT data. While low correlations between items may indicate that the items may not be suitable for measuring one same construct, high correlations (≥0.70) could indicate redundance and therefore, exclusion of one of the items could be recommended (Kline, 1979; Boyle, 1991).

Given that the APMT already has a categorization of the items into categories, the EFA is performed using the attention categories (alert, divided, selective and sustained attention) as subsets of data. By conducting the analysis on each category, the correlations and latent factors from each category can be establish, and used for determining construct validity of the categories. Classification of the items was attached to Soprano's (2009) description of types of tasks for each category.

Additionally, in the APMT there are scales for motivation, overall performance, and impulsivity. However, these scales are meant to be more descriptive in nature, and to aid in the interpretation of the attention category results. Items on these scales were not included for Factor Analysis, as they do not belong to the attention categories.

The psych package from the R software was used to conduct Exploratory factor analysis using the Principal Axis Factor Analysis (function pa, Psych package in R software). Considering that all factors should be a dimension of a unique construct (attention), a certain degree of correlation between the factors was expected. For this reason, the Oblimin rotation was chosen. The Factor analysis method and rotation used, conducts the analysis allowing common variance, and possible cross-loadings of items (items with loadings in more than one factor). However, whenever cross-loadings occur, it is important to examine discriminant validity of the item examining both - how strong the load on each item is, and the difference between the loadings (Costello & Osborne, 2005).

Labeling of the factors is a crucial part of factor analysis as a method. When EFA results were examined at first, the salient common issues for the items appeared to be the response modality and the length of the stimuli or task. Factors got labeled using that criteria. However, such labels were too specific, and theoretically difficult to interpret in light of attention theory. As mentioned previously, the labeling of the factors, require the researcher to take into account theoretical considerations regarding the construct being assessed. While reviewing attention models again, the construct of functions of attention appeared to be a good labeling criteria. Several models of attention such as the Luria Model, Pribram and McGuinness, the Posner-Petersen Model and the Mirsky model (Luria, 1979; Mirsky, Anthony, Duncan, Ahearn, Kellam 1991) . describe attention functions. The Mirsky model was chosen for the analysis, considering that the functions of attention were a result of a factor analysis on data from both adults and children's neuropsychological assesssments, and the fact that there is an updated description of brain systems related to each function (Mirsky et al., 1991, Mirsky et al. 1994, Koziol et al., 2014). As Koziol (2014) explains there

is not enough evidence of the brain systems theory in children yet. However, the information already available on adults, is an important first step towards understanding brain systems as related to the factors found on the present research study. Most definitively, from the point of view of brain systems and processing, the functions of attention, should be considered to be of higher hierarchy, than considerations for response modality and length of stimuli.

In attention theory, there is a common use of organization of attention into the categories included in the APMT, reflecting a level of thinking in terms of processes within a cognitive approach. In turn, the concept of attention functions relates with neurofunctional approaches. The Mirsky model while identifying distinct elements supported by distinct brain regions, emphasizes that the brain regions are organized into a system.

A brief summary of the functions from the Mirsky Model as described by Mirsky et al. (1991), Koziol et al. (2014) and Fernandez (2014) is presented on table 39.

Table 39 Attention functions-Brain Systems Mirsky Model.

FUNCTION	**DEFINITION**	**BRAIN SYSTEM**
Focus/execute	Ability to allocate attentional resources on specific task while screening out distracting stimuli and execute rapidly manual or verbal responses required in the task.	Corpus striatum, inferior parietal lobe. Focus: Superior temporal cortex Koziol et al.: Bilateral medial occipital, occipitoparietal, occipitotemporal, and parietal cortices and the Dorsolateral prefrontal cortex (DLPFC).
Sustain	Capacity to maintain attention on some aspect of the environment for a considerable long period of time for task completion	Tectum Mesopontine reticular formation. Midline and reticular thalamic nuclei Koziol et al. : DLPFC, ventral medial frontal cortex, subcortical regions of the basal ganglia, (striatum, globus pallidus, and thalamus) which project back to the cortex.

Encode	Ability to register information initially. Hold in memory briefly and allow mental operations with the information. Immediate recall, and hold f information while performing action or cognitive operation	Hippocampus and corpus striatum Koziol et al.: Functional system consistent with FrontoParietal Network (FPN) associated with working memory. Network includes: Dorsolateral prefrontral cortex, bilateral inferior parietal lobule, anterior cingulate gyrus, ACC. In children the same network has been identified, but there is less consistent activation of the full FPN.
Shift	Capacity to move from one salient aspect of the environment (stimuli) to another	Prefrontal cortex. Anterior cingulate gyrus. Koziol et al: ventral prefrontal cortex, caudate nucleus, dorsomedial thalamus. Anterior cingulate gyrus and putanen activation for negative feedback
Stability	Reliability of attentional effort. Coherence between response and stimuli. Presumably reflected on variability of response reaction time and commission errors.	Errors of commission: ventral, inferior fronto-cortico-striatalpallidal-thalamo-cortical Loop.

5.2.2.1 Alert category. Exploratory Factor Analysis and Polychoric correlations

The Alert category had four items. The items were presented in different moments of the session (task 1, 3, 5 and 9). Alert is defined by Soprano (2009) as the minimum energy mobilized allowing the nervous system to be receptive to information.

Items measuring "Alert" in Neuropsychology usually measure the reaction time (Soprano, 2009). In Music Therapy, to measure the reaction time of the child, would implicate using apparatus external to the session, and might take away the focus of the therapist from the interaction with the child. Therefore, the items designed to include on this category, were related with the observation of presence of the reaction, and immediateness.

Table 40 Items Alert Category

CODE	**QUESTION**	**SCORING SYSTEM**
1A1	Child gave a response on the space left in the song?	Always (2), Sometimes (1), Never (0)
3A2	Response was immediate	Always (2), Sometimes (1), Never (0)
5A1	Child notices the mistake? (Involuntary attention task)	Yes (1)/No (0)
9A1	Child participated in the music making	Always (2), Sometimes (1), Never (0)

Exploratory Factor Analysis results of the category are presented below.

Table 41 Exploratory Factor Analysis Alert Category

ITEM	FACTOR 1	FACTOR 2
1A1. Child gave response?	0.04	**0.62**
Item 3A2. Response was immediate	0.28	-0.11
Item 5A1. Child notices mistake?	**0.88**	-0.02
Item 9A1. Child participated in music making	0.36	-0.29
	FACTOR 1	FACTOR 2
Cumulative proportion	*0.67*	*1.0*

Note: Standard Loadings above 0.5 appear in bold.

It can be seen that composition of Factor 1, included one item (5A1) with loads above 0.5. As a factor with only one item would not be acceptable, item 9A1 with a standard load of 0.36 is included. The load is consider acceptable according to the theoretically

suggested cut off of above 0.32, but could be questionable in the context of this study's sample. Item 3A2 could be further examined as a third item, with a standard loading of 0.28. However, the factor might not be considered stable according to Costello and Osborne (2005) criteria mentioning that factors should at least have three items with high loadings.

Using the cumulative proportion criteria for deciding on inclusion or exclusion of factor 2, the decision would be to exclude factor two, since the cumulative proportion of factor 1 is 0.67. As mentioned earlier, the cumulative proportion describes the percentage of variance attributed to the factors. For the social sciences and humanities, the common use in statistics is to include items responsible for 60-70% of the variance (Pett, Lacki & Sullivan, 2003). In this case, factor 1 alone already accounts for almost 70% of the variance. Exclusion of factor 2 implied exclusion of item 1A1. Since a combination of results from the remaining items on task 1, provides the same information as item 1A1, the structure of the task is not affected.

When labeling the factor it was difficult to find a cohesive definite label from the functions of attention to use. Items 5A1 and 9A1 (the highest loads), both refer to stability. Since item 5A1 does not include instructions for the child, and the involuntary reaction is the focus, it is assumed that the child must have stability of the attentional focus to be able to identify a mistake in the song without previous instructions. Item 9A1, also require stability for continuous participation in the music making. However item 3A2, could be more related to the focus/execute function, as it focus on the speed of the response. Further examination of the stability of the factor could be necessary.

Examination of the polychoric correlations of factor 1 items (including item 3A2) is presented on table 42.

Table 42 Polychoric correlations Alert

	Item 3A2	**Item 5A1**	**Item 9A1**
Item 3A2	1		
Item 5A1	0.24	1	
Item 9A1	0.12	0.31	1

Results indicate all items could be suitable to assess the same construct. The strongest correlation is found between items 5A1 and 9A1. Polychoric correlations for item 3A2, indicate correlations with item 5A1, and 9A1. However, the correlation with

item 9A1 is low. On the one hand, there are two previous issues suggesting exclusion of item 3A2. The item loading on the factor is much lower than the loadings of the other two items. The second issue is that the item, was problematic in the analysis of inter-rater agreement. In the other hand, this item is the one actually referring to the reaction time, going beyond just the reaction. In terms of parallels with tasks in neuropsychological assessments of attention (as explained by Soprano, 2009), is the most similar item. Therefore, there is theoretical rationale to include it for further analysis. Additionally it is recommended to have factors with three or more items (Yong et al, 2013). If a decision is made to include it after CFA, the item should be re-structured in order to improve inter-rater agreement.

Conclusions EFA for Alert: Two factors were identified on the EFA. Based upon low number of items with high loadings on the factor (1 item), and high cumulative proportion of factor 1, a decision was made to keep only factor 1. Three items were included on the factor (5A1, 9A1 and 3A2). The factor was labeled alert/stability-focus. The factor is considered unstable due to low number of items with high loadings. Even though item 3A2 has lower standard loadings on the factor, it is included for further analysis based upon methodological and theoretical considerations.

5.2.2.2 Divided attention category. Exploratory Factor Analysis and Polychoric correlations.

Divided attention is defined as the ability to attend a stimulus with the interference of a competing stimulus (Cohen, 2014). In the APMT, the divided attention category has two items, found in tasks 3 and 4. In task 3, the child and the therapists are singing and accompanying with instruments a familiar song (therapist uses guitar, child chooses an instrument). While singing the song, the therapist verbally indicates to the child to stop singing or playing (while continuing with the other). In task 4, the child and the therapists are singing and accompanying the same song, doing the pulse using hand drums. As they sing the song, the therapist introduces tempo changes, and the child synchronizes with the new tempo, keeping the pulse.

Table 43 Items Divided attention category

CODE	QUESTION	SCORING SYSTEM
3A1	Child stop singing or playing?	Always (2), Sometimes (1), Never (0)
4A1	Attempt to synchronize with the tempo change	Always (2), Sometimes (1), Never (0)

Exploratory Factor Analysis results of the category is presented below.

Table 44 Exploratory Factor Analysis Divided attention

CODE	FACTOR 1
3A1. Child stop singing or playing?	**0.66**
4A1. Attempt to synchronize with the tempo change	**0.66**

EFA results extract one factor, with both items having identical loadings of 0.66. Having only one factor, is not possible to calculate cumulative proportion.

Considering that the extracted factor only has two items, the factor is considered unstable. As mentioned on the reliability results (section 5.1.1), the low number of items on the category presents a difficulty for analysis. Given that exclusion of the factor, would imply exclusion of the items affecting the assessment structure, and the fact that there could be correlations with items from other categories, the factor is included for further analysis.

When relating to the attention functions, the factor is labeled as sustained, given that both items on the factor are required to maintain attention on a specific aspect of the task for a considerable period of time, for completion of the task.

The polychoric correlations matrix for the category of divided attention shows a correlation between the two items of the category of 0.44, consistent with good inter-item correlation, indicating both items suitable for measuring the same construct.

Conclusion for EFA and polychoric correlations for divided attention: One factor was identified and labeled as divided/sustained. Both items on the category have high standard loadings for the factor, indicating inclusion. Polychoric correlations support inclusion of both items and suggest reliability of the factor.

5.2.2.3 Selective attention category. Exploratory Factor Analysis and Polychoric correlations

The selective attention category on the APMT has a larger number of items than the previously presented categories. The items belong to tasks 1, 2 and 7. Additionally, two other items (8A11, and 9A2) were included for the Exploratory Factor Analysis (EFA). These items belong to the category of musical data, and are part of tasks 8 and 9. The items refer to describing if the child's musical materials are related to the

therapists' materials in at least one aspect. There is not enough evidence in the literature to be able to state that these items are related to selective attention. However, if the child is to incorporate musical materials from the therapist's music making, it is required to: attend to the therapist's music making, focus on a specific element or combination of elements, store that information and immediately use it on his own music production. The variables are then included in the EFA, to test the possibility of incorporating these musical data into the category.

Table 45 Selective attention items

TASK	**CODE**	**QUESTION**	**SCORING SYSTEM**
In the hello song, the child is asked to respond on the space left in the song by saying or singing hello, his name, or the therapist name.	1A2, 1A3, 1A4, 1B1, 1B2, 1B3	Child sing or said: child's name (1A2), therapist's name (1A3), hello (1A4) according to the lyrics. It is categorized on selective attention, as three choices are given a priori for the child to choose from, at the appropriate time. The child must be attentive to the song, identify the moment to sing/speak, and choose the correct answer. Codes with letter B, represent the repetition of the activity if child was unable the first time. This is included in the selective attention category as omissions and errors are also included when scoring selective attention tasks.	Yes (1)/No (0)

Therapist accompanies the hello song with a movement for each verse, instructions are given to the child to imitate the movement	2A1, 2A2, 2A3,	Child imitated the movement presented by the therapist while singing. Child observes the movements first. Getting familiar with the three choices of movement. Then, while in the song, the child focuses on the movements, the moment of the change, and the correct movement.	Yes (1)/No (0)
Child is asked to recall the movements from the previous activity.	TOTAL2B	Child recall movements used in task 2 A. Categorized as selective attention, as recall tasks are usually categorized as such.	1 point per movement recalled in the right order
Beat span. Therapist presents an increasing number of clap beats (from 1 to 7 beats). Child listen to the model, and then reproduces the model	7A1, 7A2, 7A3, 7A4, 7A5, 7A6, 7A7	Child recall and execute the beat series correctly. Is a recall task, and as such is categorized on the selective attention category	Yes (1)/No (0)
Task 8. Turn taking with instruments. Task 9. Good bye improvisation	8A11, 9A2	Child's musical materials were similar to the therapists in at least one aspect?	Always (2), sometimes (1), never (0)

Items 7A1, 7A2 and 7A3 were excluded of the EFA, because their standard deviation was 0, which is a problem for inclusion in factor analysis. Exclusion of span tests items for factor analysis, due to 0 standard deviations has been described before (Bowden, Petrauskas, Bardenhagen, Meade & Simpson, 2012; Luo, Chen, Zen, & Murray, 2010).

There is a possible explanation for the lack of variance for these items. Task 7 is the beat span. The first three models include up to 3 beats. When assessing attention using number span, the usual series of numbers begin at three numbers for the forward digit span, and two numbers for the backwards digit span. This procedure, and the scores obtained by the children on these items, indicate that they are easy for children, and perhaps should not be taken into account in scores. The Exploratory Factor Analysis for selective attention results are presented in table 46.

Table 46 Selective attention Exploratory Factor Analysis

	FACTOR 2	FACTOR 1	FACTOR 4	FACTOR 3	FACTOR 5
1A2. Hello song. Child's name	**-0.76**	-0.10	-0.13	-0-04	0.06
1A3. Hello song. Therapist's name	**-0.74**	0.04	0.13	0.08	-0.04
1A4. Hello song. Hello	0.02	-0.04	0.05	**-0.98**	-0.03
1B1. Item repetition. Child's name	**0.76**	0.10	0.13	0.04	-0.06
1B2. Item repetition. Therapist's name	**0.93**	-0.08	-0.11	-0.05	0.08
1B3. Item repetition. Hello	-0.02	0.04	-0.05	**0.98**	0.03
2A1. Movement. Tapping one hand.	0.00	0.31	-0.37	-0.36	0.28
2A2. Movement. Clapping	0.07	0.08	0.05	0.10	0.33
2A3. Movement. Tapping two hands	-0.01	0.03	-0.07	0.10	**0.85**
TOTAL2B. Recall of movements	0.08	0.25	**0.50**	-0.24	0.27
7A4. Beat span. Series of 4 beats	-0.11	0.14	**0.81**	-0.06	0.09
7A5. Beat span. Series of 5 beats	-0.04	**0.65**	0.30	0.10	0.25
7A6. Beat span. Series of 6 beats.	-0.03	**0.98**	0.11	-0.08	0.07

7A7. Beat span. Series of 7 beats.	0.25	**0.60**	0.18	0.11	-0.05
7A1B. Second attempt series of 1 beat	0.10	-0.01	**-0.49**	0.22	-0.17
7A2B. Second attempt series of 2 beats.	-0.08	-0.15	-0.34	-0.01	**-0.58**
7A3B Second attempt series of 3 beats	-0.10	-0.13	**-0.60**	0.12	0.02
7A4B. Second attempt series of 4 beats	-0.04	0.12	0.03	-0.01	**-0.71**
7A5B. Second attempt series of 5 beats	-0.04	**-0.76**	0.41	-0.16	0.09
7A6B. Second attempt series of 6 beats	0.01	-0.19	0.26	**0.58**	0.05
7A7B. Second attempt series of 7 beats	-0.24	0.24	-0.06	-0.17	0.20
9A2. Musical materials were similar to therapist's. Improvisation task.	0.23	0.03	0.32	-0.01	0.21
8A11. Musical material were similar to therapist's. Turn taking task.	0.05	0.11	0.29	-0.06	0.01
	FACTOR 2	FACTOR 1	FACTOR 4	FACTOR 3	FACTOR 5
Cumulative proportion	*0.22*	*0.44*	*0.64*	*0.82*	*1.0*

Note: standard loadings above 0.5 (direct and inverse proportion) appear in bold.

Taking into account the previously mentioned recommendations for number of factors to be retained, the first three factors would be kept, as they account for over 60% of the variance (Factors 2, 1, and 4).

It can be seen that the two items referring to musical data obtained standard loadings in all factors below 0.30. The highest correlation was found on Factor 1. Implications are presented below.

If only items with loadings above 0.50 are included, the factors composition would be as follows.

Table 47 Selective attention. Factor Composition

	FACTOR 2
1A2. Hello song. Child's name	**-0.76**
1A3. Hello song. Therapist's name	**-0.74**
1B1. Repetition of item 1A2	**0.76**
1B2. Repetition of item 1A3	**0.93**

	FACTOR 1
7A5. Beat span. Series of 5 beats	**0.65**
7A6. Beat span. Series of 6 beats	**0.98**
7A7. Beat span. Series of 7 beats	**0.60**
7A5B. 2nd attempt. Series of 5 beats	**-0.76**

	FACTOR 4
TOTAL2B. Movement recall	**0.50**
7A4. Beat span. 4 beats	**0.81**
7A3B. Repetition of series of 3 beats	**-0.60**

The composition of the factors evidenced that items from task 7 and 1 were clearly separated, while items from task 2 were clustered with some items from task 7. Task 7 items were divided in two factors. Items corresponding to beat series from 3 to 4 beats (until the fourth series), have high loads on factor 4, and items corresponding to 5-7th beat series, on factor 2.

Factor 2. Items on factor belong to task 1. All items have high loads on the factor. Items 1B1 and 1B2, with the highest loadings on the factor, refer to parts of task 1 when the therapist has to repeat a part of the hello song for the child to be able to provide the correct response. These items are only administered, when the child is not able to respond correctly in the first opportunity. Items 1A2 and 1A3, with negative loads are the first opportunity to perform the task. Given that task 1 requires focus and selection of the appropriate response and timely execution, the label for the factor would be related with the function of focus/execute. However, given the proportion of the loadings with positive loadings for the repetition, and negative loadings for the correct execution, factor was labeled: Selective/focus-not execute.

Factor 1 selective attention: Items on factor belong to the 7th task and correspond to the longest beat series (5-7 beats). Item 7A5B, referring to the need for a second attempt on the 5th beat series, has a high but negative load into the factor. Given the nature of the items, factor was labeled: Selective/encode

Factor 4 selective attention: Items included on factor 4, come from tasks 2 and 7. Item 7A4 (beat span, series of 4 beats), has the highest loads on the factor. Since the previous beat series were not included in the EFA due to standard deviation=0, this item is the breaking point for the beat span task, which is considered an encoding task. However, it is relevant that items 7A1B (-0.49), 7A2B (-0.34) and 7A3B (-0.60) have high negative loads into the factor. These items refer to the child's need to repeat the model of the first three beat series on the beat span. Item 7A1B, did not reached the 0.5 mark, but was close and it is decided to include it on the factor. Item 7A2B did not reached the 0.5 mark either, but has a load above the cut off point (0.32) proposed by Costello and Osborne (2005). The fact that these three items (which could be considered indication of error commission) got clustered together with item 7A4, indicate that while encoding is an important function for 7A4, stability of attention could be a more relevant theme for this factor. Item TOTAL2B is a recall task. The structure of task 2, implicates that in order to recall the movements, the child must first perform the movements in the song. Therefore there is also a relation with the stability functions. Given the previous considerations, the factor was labeled: selective/stability.

In table 46, it can be seen that the items belonging to musical data included in the category (8A11 and 9A2), have low standard loads in all factors. However, the loads for factor 4, are higher than for other factors. These items look at the use of musical materials from the therapist into the child's music making using instruments, which requires both encoding to recall what he heard, and stability of the attentional focus. The inclusion of these items could be considered, giving congruence with the label for factor 4. Inclusion is decided as it might be important as a starting point to look at musical data as indicative of attention.

According to the analysis, the three factors on the selective attention category are labeled: selective/focus-not execute, selective-encode, selective-stability.

Polychoric correlation results for selective attention factors are presented below.

Table 48 Polyhoric Correlations Factor 2 Selective attention

ITEMS	1A2	1A3	1B1	1B2
1A2	1.0			
1A3	0.444	1.0		
1B1	-1.0	-0.444		

1B2	-0.99	-1.0	0.998	1.0

The high polychoric correlations for most factor 2 items, indicate possible redundancy. In this case common use in statistics indicate exclusion of some of the items. But exclusion of any of the items, would implicate to leave outside of the task, one of the response choices, altering the structure of the task, which could cause an alteration of the results as well. When presented with less choices, it could be more difficult to distinguish a guess from a choice.

Table 49 Polychoric correlations Factor 1 Selective attention

ITEMS	7A5	7A6	7A7	7A5B
7A5	1.00			
7A6	0.957	1.00		
7A7	0.809	0.888	1.00	
7A5B	-0.63	-0.865	-0.678	1.00

Items 7A5, 7A6 and 7A7 refer to the imitation of the beat span (5, 6 and 7 beats). Considering high correlations, items appear to be redundant, and exclusion of one or two items could be recommended. However, the span beat is a series. Changes in the presentation, excluding one or more items, would affect performance on the task (the direction of the effect is not possible to determine). 7A5B refers to the need of a second attempt on the fifth series, explaining the negative correlation.

Table 50 Polychoric Correlations Factor 4 Selective attention

ITEMS	TOTAL 2B	7A4	7A1B	7A3B
TOTAL2B	1.00			
7A4	0.475	1.00		
7A1B	-0.249	-0.741	1.00	
7A3B	-0.335	-0.841	0.623	1.00

The high polychoric correlations for task 7 items, indicate possible redundancy. However, there is rationale for inclusion of all items, as the repetition items (7A1B and 7A3B) refer to the need of repetition of the beat series previous to the 4th series.

The composition of the selective attention factors suggests the exclusion of several items. The items, reasons and implications for the exclusion, and decisions are presented in the table below.

Table 51 Items suggested for exclusion Selective attention

ITEM	Reason for exclusion	Additional issues	Decision
1A4. Hello song. Hello response	low loads in included factors	low variance	Keep on the APMT. Exclude the scoring from the category. Exclude for further analysis
1B3. Hello song. Need for repetition of hello response item	low loads in included factors	low variance	Keep on the APMT. Exclude the scoring from the category. Exclude for further analysis
2A1. Hello song. Taping one hand	low loads in included factors		Keep on the APMT. Exclude the scoring from the category. Exclude for further analysis
2A2. Hello song. Clapping	low loads in included factors		Keep on the APMT. Exclude the scoring from the category. Exclude for further analysis
2A3. Hello song. Tapping	low loads in included factors		Keep on the APMT. Exclude

with two hands			the scoring from the category. Exclude for further analysis
7A1, 7A2, 7A3. Beat span. 1-3 beats	Standard deviation=0	Digit span tests begin with 3 digits for forward span. Might be too easy.	Keep on the APMT. Exclude the scoring from the category. Exclude for further analysis
7A2B	Load below 0.5. Above the 0.32 cut-off point	The items corresponding to the repetition of the first and the third beat series had high loads into the factor. Is an indication of stability	Inclusion
7A4B, 7A6B	low loads in included factors		Keep on the APMT. Exclude for further analysis
8A11, 9A2. Musical materials were similar to therapists	Low loads in included factors	There is no previous evidence of similarities of musical materials being described as selective attention. Inclusion of the items in CFA, could reveal other correlations for further analysis.	Inclusion

Summary of EFA and polychoric correlations Selective attention.

Five factors were extracted. Based upon the cumulative proportion, a decision is made to include three factors (with a total cumulative proportion of 0.64). Factor 2: focus-non-execute, Factor 1: encode, Factor 4: stability. Within the category of selective attention, three dimensions related to three functions of attention were found. Based upon the EFA, some items were excluded due to low loads into the factors.

5.2.2.4 Sustained attention. Exploratory Factor Analysis and Polychoric correlations.

Sustained attention was the category with the larger number of items (33).

The items included in the Sustained attention category are presented in table 52.

Table 52 Sustained attention items

TASK	CODE	QUESTION	SCORING SYSTEM
Task 2. Therapist accompanies the hello song with a movement for each verse, instructions are given to the child to imitate the movement	2A4, 2A5, 2A6	Child sustained the movement?	Yes (1)/No (0)

Task 6. Using a familiar song, therapist sings the song, and make intentional mistakes. Instructions are given to child, to raise his hand when he identifies a mistake. The first three mistakes are lyric mistakes, mistakes 4, 5 and 6 are rhythmic, and mistakes 7, 8, and 9 are melodic	6A1, 6A2, 6A3, 6A4, 6A5, 6A7, 6A8, 6A9 CONTROL6RHYTHM, CONTROL6MELODY 6A1OR, 6A2OR, 6A3OR, 6A4OR, 6A5OR, 6A6OR, 6A7OR, 6A8OR, 6A9OR	Child identifies the mistake and raises hand. There are lyric mistakes (6A1, 6A2, 6A3), rhythmic mistakes (6A4, 6A5, 6A6), and melodic mistakes (6A7, 6A8, 6A9) When child could not identify any of the rhythmic or melodic mistakes, a lyric mistake is introduced to control for difficulties in perception of melodic o rhythmic mistakes. When child does not raise hand, but a reaction is observed by the therapist (gestures, change in posture etc), the OR choice is marked	Yes (1)/No (0)
Task 8. Turn taking with instruments.	8A1, 8A3, 8A5, 8A7, 8A9 8A2, 8A4, 8A6, 8A8, 8A10	Child waited for turn? Child played during the turn?	Yes (1)/No (0)

Given the large amount of items in the category, and considering that the *Moments of the session*, have already been used as subsets of data, a decision was made to conduct Exploratory Factor Analysis, using *Moments of the session* as testlets. A possible limitation of conducting EFA using these subsets of data is that important latent factors get overlooked. However, since further factor analysis is to be conducted because of multi-dimensionality of some categories, the stability of the extracted factors can be tested. Given that each task belongs to a different Moment of the session, each task was analyzed separately.

Exploratory Factor Analysis Sustained Attention Moment 1.

The task for sustained attention included in Moment 1, is task 2. The EFA for the included items is presented on table 53.

Table 53 Exploratory Factor Analysis. Sustained attention: Moment 1

ITEM	FACTOR 1
2A4. Hello song. Child sustained movement. Tapping one hand.	**0.72**
2A5. Hello song. Child sustained movement. Clapping	**0.52**
2A6. Hello song. Child sustained movement. Tapping two hands	**0.66**

Note: standard loadings above 0.5 appear in bold

All items included in the analysis have standard loads higher than 0.5, indicating inclusion on the factor.

The polychoric correlations between the items are presented in the following table.

Table 54 Polychoric correlations. Sustained attention: Moment 1

ITEM	2A4	2A5	2A6
2A4	1.00		
2A5	0.64	1.00	
2A6	0.72	0.59	1.00

Correlations between the items suggest good inter-item correlation. Given that performance on the three items, require identification of the movements, immediate identification of the changes in movement, while performing the movement, there is a strong component of working memory. Given the closeness and even overlap describe between the encode function and the working memory, the factor was named: sustained/encode

Exploratory Factor Analysis. Sustained attention: Moment 3

Moment 3, in sustained attention, includes task 6. In task 6, the therapist introduces a series of mistakes while singing a familiar song multiple times. The child raises his hand when identifying a mistake. The possible mistakes were lyrics, rhythmic or melodic mistakes. Items with "OR" on the code , refer to the child displaying a reaction to the mistake, but not the reaction expected according to the instruction. Table 55 presents the Exploratory Factor Analysis for the corresponding items.

Table 55 Exploratory Factor Analysis. Sustained attention: Moment 3

ITEM	FACTOR 1	FACTOR 2
6A1	0.36	-0.23
6A1OR	0.38	0.29
6A2	0.21	-0.04
6A2OR	-0.37	0.25
6A3	0.33	0.04
6A3OR	-0.24	-0.07
6A4	0.27	-0.12
6A4OR	0.23	-0.03
6A5	0.41	0.22
6A5OR	-0.17	0.20
6A6	0.47	0.02
6A6OR	0.13	**0.53**
6A7	**0.75**	0.01
6A7OR	-0.07	**0.80**
6A8	**0.76**	-0.04
6A8OR	0.03	**0.95**
6A9	**0.77**	-0.08
6A9OR	-0.01	**0.84**
CONTROL6RHYTHM	**0.54**	0.14

CONTROL6MELODY	**0.80**	0.09
	FACTOR 1	FACTOR 2
Cumulative proportion	*0.57*	*1.00*

Note: standard loadings above 0.5 (direct and inverse proportion) appear in bold

Item loads indicate that each factor corresponds to one type of observation: on factor 1 the items referring to respond according to the instruction, and on factor 2 the items referring to having a different response (gesture, posture) to the mistake.

Items 6A1 through 6A4 don't have high loads on the factor. From item 6A5 a progression of loads is evident until reaching the highest load on the last item of the task (CONTROL6MELODY).

The cumulative proportion of the factors indicate that even though it would be recommended to keep both factors, factor 1 still explains almost 60% of the variance.

Composition of the factors, including only items with loads above 0.50 is presented below.

Table 56 Sustained attention: Moment 3. Factor 1

	FACTOR 1
6A6	0.47
6A7	**0.75**
6A8	**0.76**
6A9	**0.77**
CONTROL6RHYTHM	**0.54**
CONTROL6MELODY	**0.80**

Note: standard loadings above 0.5 appear in bold

It can be seen that the last mistakes, are the ones with highest loads in the factor. Item 6A6 is also included on the factor, as the load is almost 0.5. These mistakes include lyric (CONTROL6RHYTHM, CONTROL6MELODY), rhythmic (6A6), and melodic (6A7-6A9) mistakes.

The tasks require the ability to shift attention, to adjust perceptual skills to identify a new type of mistake. The response is linked to an identification. The factor was labeled: sustained/shift.

Table 57 Polychoric correlations Sustained-Moment 3. Factor 1

ITEMS	6A6	6A7	6A8	6A9	CONT6RHY	CONT6MEL
6A6	1.0					
6A7	0.67	1.0				
6A8	0.69	0.98	1.0			
6A9	0.71	0.93	0.96	1.0		
CONT6 RHY	0.59	0.38	0.36	0.47	1.0	
CONT6 MELO	0.64	0.86	0.87	0.94	0.59	1.0

Eventhough some correlations are high indicating redundancy, it should be noted that given that this task is a long task presenting 11 different mistakes, excluding items from the CFA, could influence the results, and therefore exclusion will not be recommended.

Composition of Factor 2 is as follows.

Table 58 Sustained attention: Moment 3. Factor 2

	FACTOR 2
6A6OR	**0.56**
6A7OR	**0.80**
6A8OR	**0.95**
6A9OR	**0.84**

Note: standard loadings above 0.5 (direct and inverse proportion) appear in bold

Factor 2 included items corresponding to the observation of a reaction different from the one provided in the instructions. Only items corresponding to the reactions on the last four mistakes on the item had high loads. The items corresponding to the previous mistakes, did not obtained high loads. Given that the items with high loads correspond to reactions different to the instructions, the label for the factor was: sustained/lacks stability.

Correlations of Factor 2 are presented in the following table.

Table 59 Polychoric correlations. Sustained-Moment 3. Factor2

	6A6OR	6A7OR	6A8OR	6A9OR
6A6OR	1.0			
6A7OR	0.65	1.0		
6A8OR	0.70	0.92	1.0	
6A9OR	0.69	0.88	0.99	1.0

Even though correlations between items are high, items will be included as changing the structure of the task, could affect the responses.

Exploratory Factor Analysis. Sustained attention: Moment 4

The sustained attention category for Moment 4 of the session, included task 8 which was turn taking playing instruments task. There were 5 turns. Items 8A2, 8A4,8A6, 8A8, 8A10, refer to playing during turn (as mentioned before, items 8A2 and 8A4 were excluded from the EFA, because their standard deviation was 0). Items 8A1, 8A3, 8A5, 8A7, and 8A9 refer to waiting for the turn. EFA for the task is presented in table 60.

Table 60 Exploratory Factor Analysis. Sustained/Moment 4.

ITEM	FACTOR 2	FACTOR 3	FACTOR 1
8A6	0.01	**0.50**	-0.33
8A8	**0.96**	-0.01	0.07
8A10	**0.69**	-0.01	0.04
8A1	-0.16	0.03	0.20
8A3	-0.26	-0.06	**0.60**
8A5	-0.27	**0.84**	0.16
8A7	0.10	0.06	**1**
8A9	0.33	**0.79**	0.02
	FACTOR 2	FACTOR 3	FACTOR 1
Cumulative proportion	0.35	0.68	1.00

Note: standard loadings above 0.5 (direct and inverse proportion) appear in bold.

The cumulative proportion suggested the inclusion of Factors 1 and 2, as they account for over 60% of the variance.

Items corresponding to playing in the last two turns had high loads on Factor 1. Items corresponding to the middle turn (waiting and playing on the third turn), and to waiting on the last turn loaded on factor 2.

Items in factor 1 required sustainment of attention paired with execution of the playing action. Items in factor 2 were in the middle of the task, or the last control of impulsivity, suggesting a correlation with the stability function of attention. According to these characteristics, Factor 1 was labeled: Sustained/sustain. The stability of the factor needs to be examined further, given that the factor has only two items. Label of Factor 2 is: Sustained/stability.

After EFA was performed for sustained attention in all Moments of the session, items with low loads in factors or other difficulties, were examined to define exclusion. The reasons, and the decision are presented in table 61.

Table 61 Items suggested for exclusion Sustained attention

ITEM	**Reason for exclusion**	**Additional issues**	**Decision**
6A1,6A2, 6A3, 6A4, 6A5 Mistake identification. Mistakes 2-5.	low loads in included factors	To exclude the items, could change the task structure to a point were the sustained attention is not further assessed	Keep the items on the APMT. Exclude scores from the total score of the category. Exclusion for further analysis
6A1OR, 6A2OR, 6A3OR, 6A4OR, 6A5OR, 6A6OR, 6A6OR, 6A7OR,	Belong to a factor excluded for theoretical consideration	The OR items, corresponded to items were the child did not responded according to the instruction. Might be clinically relevant. But in terms of sustained attention, don't correspond to the expected response.	Keep the items on the APMT. Exclude scores from the total score of the category. Exclusion for further analysis

6A8OR, 6A9OR		Impact of exclusion is reduced by cumulative proportion of factor 1, which accounts for over half of the variance.	
8A1, 8A2, 8A3 8A4	8A2, 8A4: Standard deviation=0. 8A1, 8A3: Low loads in factors included	First two turns in the music making. To exclude turns could change the composition of the factor to a point were the remaining items would change in nature	Keep items on the APMT. Exclude scores from the total score of the category. Exclude for further analysis

Summary of EFA and polychoric correlations Sustained attention: The analysis was made for each moment of the session. EFA extracted a total of five factors:: Task 2 (1 factor): sustained/encode; Task 6 (2 factors): sustained/shift, sustained/lacks stability; Task 8 (2 factors): Sustained/sustain, sustained/stability.

Taking into account theoretical considerations, factor sustained/lacks stability is excluded given that it does not necessarily refer to sustained attention, but to a description of a child's response in the absence of the expected response.

5.2.2.5 Exploratory Factor Analysis. Model 34 items

Considering that EFA using attention categories as sets of data resulted in multi-dimensionality of two of the attention categories (selective and sustained attention), exploratory factor analysis using the complete data set of 34 items with high loads on the category factors was conducted. The second analysis, allows for identification of associations between items from the different categories, testing the applicability of attention functions as labels for the factors.

A compilation of EFA extracted factors is presented in table 62 to serve as a basis for the analysis. The items appear in the order they belong to the factors.

Table 62 Extracted factors compilation. Exploratory Factor Analysis

	ALERT	DIVIDED	SELECTIVE			SUSTAINED			
Label according to Mirsky's attention functions	**stability-focus**	**sustain**	**focus-nonexecute**	**encode**	**stability**	**encode**	**shift**	**sustain**	**stability**
3A2	0.28*								
5A1	0.88								
9A1	0.36*								
3A1		0.66							
4A1		0.66							
1A2			-0.76						
1A3			-0.74						
1B1			0.76						
1B2			0.93						
7A5				0.65					
7A6				0.98					
7A7				0.60					
7A5B				-0.76					
TOTAL2B					0.50				
7A4					0.81				
7A1B					-0.49				
7A2B					-0.34*				
7A3B					-0.60				
8A11					0.29*				
9A2					0.32*				
2A4						0.72			
2A5						0.52			
2A6						0.66			
6A6							0.47		
6A7							0.75		
6A8							0.76		
6A9							0.77		
CONTROL6RHYT							0.54		
CONTROL6MELO							0.80		
8A8								0.96	
8A10								0.69	
8A6									0.50
8A5									0.84
8A9									0.79

Note: *Items with loads ≤0.5. Rationale for including these items is provided on the EFA section for each category.

The factor model emerging from the Exploratory Factor analysis using the 34 items from all extracted factors on the categories is presented in the table below.

Table 63 Final Factor Composition. Model 34 items

	PA1	PA5	PA2	PA6	PA4	PA3
3A2	0.26	0.24	0.33	0.16	0.11	0.26
5A1	**0.52**	**0.01**	**-0.09**	**0.12**	**-0.13**	**0.12**
9A1	**0.72**	**-0.07**	**0.05**	**-0.19**	**-0.03**	**0.02**
3A1	0.42	-0.07	0.31	0.31	0.11	-0.12
4A1	0.30	0.27	0.32	0.17	0.11	0.29
1A2	**-0.09**	**0.03**	**0.90**	**-0.04**	**0.02**	**-0.10**
1A3	**0.12**	**0.00**	**0.60**	**0.07**	**-0.14**	**0.49**
1B1	**0.09**	**-0.03**	**-0.90**	**0.04**	**-0.02**	**0.10**
1B2	**-0.05**	**-0.03**	**-0.75**	**-0.16**	**0.15**	**-0.38**
7A5	**0.42**	**0.04**	**-0.07**	**0.37**	**0.45**	**0.13**
7A6	**0.30**	**0.15**	**-0.13**	**0.30**	**0.62**	**0.04**
7A7	**0.22**	**0.10**	**-0.23**	**0.16**	**0.45**	**0.01**
7A5B	**0.24**	**0.05**	**0.02**	**0.10**	**-0.93**	**-0.17**
TOTAL2B	0.23	0.04	-0.11	0.36	0.25	-0.31
7A4	**0.76**	**0.08**	**0.01**	**0.20**	**-0.15**	**-0.04**
7A1B	**-0.61**	**-0.07**	**-0.04**	**0.21**	**-0.04**	**0.09**
7A2B	-0.44	-0.03	0.10	-0.35	-0.18	0.30
7A3B	-0.38	-0.23	0.16	-0.22	0.09	0.17
8A11	0.38	-0.07	-0.05	0.02	-0.04	0.15
9A2	**0.70**	**-0.09**	**-0.23**	**-0.18**	**-0.05**	**0.08**
2A4	**0.22**	**-0.12**	**0.39**	**-0.01**	**0.46**	**-0.35**
2A5	**0.08**	**-0.01**	**-0.04**	**0.26**	**0.43**	**-0.24**
2A6	0.40	0.23	0.34	-0.09	0.32	-0.31
6A6	**0.17**	**0.52**	**-0.05**	**-0.28**	**-0.09**	**0.00**
6A7	**-0.08**	**0.87**	**0.00**	**0.01**	**-0.03**	**0.04**
6A8	**-0.12**	**0.93**	**-0.03**	**-0.01**	**-0.07**	**0.01**
6A9	**0.00**	**0.91**	**0.02**	**0.01**	**-0.08**	**-0.10**
CONT6RHYT	0.40	0.20	-0.18	0.15	-0.18	0.35
CONT6MEL	**0.15**	**0.61**	**0.09**	**0.02**	**0.11**	**0.11**
8A8	**-0.11**	**0.12**	**-0.04**	**0.06**	**0.34**	**0.67**
8A10	**0.05**	**0.01**	**0.03**	**-0.03**	**0.20**	**0.75**
8A6	**-0.20**	**-0.32**	**0.01**	**0.45**	**0.26**	**-0.20**
8A5	**-0.03**	**0.09**	**0.25**	**0.84**	**-0.20**	**-0.17**
8A9	**-0.02**	**0.00**	**-0.14**	**0.86**	**0.12**	**0.25**

Note: standard loadings above 0.45 (direct and inverse proportion) appear in bold. Items highlighted in blue, obtained loads below 0.45 in the factors.

It can be seen that several items with loads above 0.45 appear in a consecutive order in the item column (i.e. 6A6, 6A7, 6A8, 6A9). Given that the item order from the categories extracted factors was maintained on this table, the clustered organization of some items reflect that items belonging to one factor on a category, also loaded together when the model included items from all the categories.

However, items from extracted factors on the alert and divided categories, and factor selective/stability, got separated loading into different factors. It should be remembered that factors from the alert and divided categories had less than 3 items with loads above 0.50, and therefore were considered to be less stable according to Costello and Osborne, (2005).

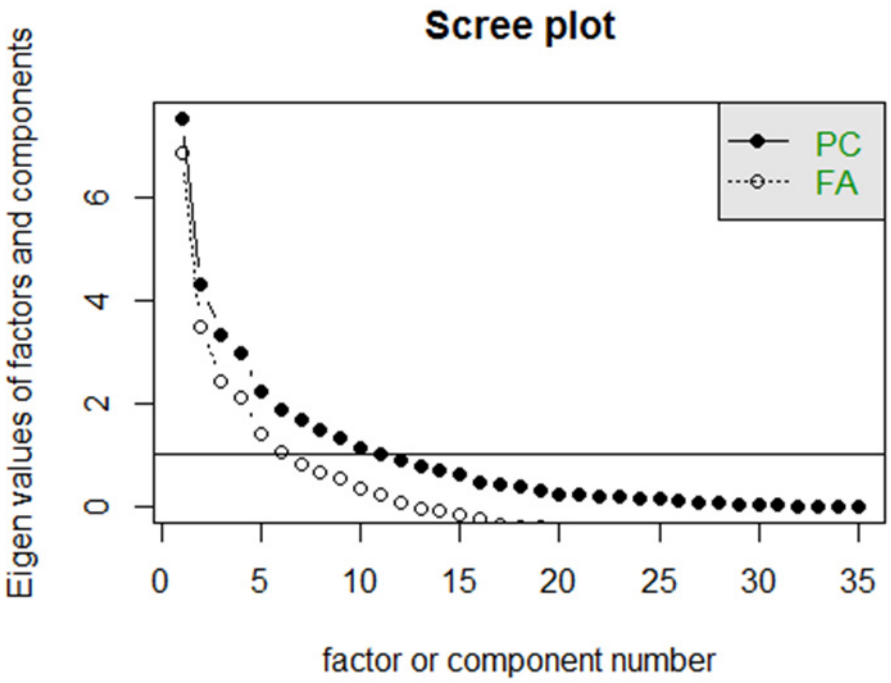
The cumulative proportion of the factors was:

Table 64 Cumulative proportion Factors

	PA2	**PA3**	**PA1**	**PA5**	**PA4**	**PA6**
Cumulative proportion	0.22	0.41	0.58	0.73	0.88	1.00

Even though the cumulative proportion suggest inclusion of 5 factors, the pattern on the scree plot using both Principal components (PC) and Factor Analysis (FA) (Figure 6), suggests the inclusion of the 6 factors, as the break point is identified after the 6th factor.

Figure 6 Scree Plot Second Factor Analysis



Note: PC: Principal Component; FA: Factor Analysis.

The composition of the factors is presented below, as well as an explanation to the label assigned to each factor. Only items with a standard load of ≥0.45 were included in the analysis.

Factor 1. Stability

This factor, clustered together items belonging to factors from different categories. Items 9A1 and 5A1 belong to the alert category, and the one factor extracted from the category was named stability. Item 7A4, 7A1B and 9A2 were part of the stability factor from the selective attention category.

Table 65 Composition Factor 1: Stability

ITEM	LOADING	DESCRIPTION
9A1	**0.72**	Task 9. Improvisation. Child participates in the music making. Rating criteria: yes, sometimes, no.
7A4	**0.76**	Task 7. Beat span. Is the 4 beats series. Rating criteria: yes/no
7A1B	**-0.61**	Task 7. Beat span. Child required repetition of the first best series (1 beat) to correctly perform
9A2	**0.70**	Task 9. Improvisation. Child's musical materials were similar to the therapist's? Rating criteria: always, sometimes, never.
5A1	**0.52**	Task 5. Identification of a mistake introduce by therapist without instructions. It's an involuntary attention task

All of the items belong to stability factors on their original categories (alert and selective attention). Since items 9A1 and 9A2 got clustered together in the same factor, it appears to point to a relationship between stable participation in the music making, and similarity of the child's musical materials to the therapist's musical materials.

Items included from task 7, refer to stability as it was seen on the analysis per categories, that the breaking point for the beat span is the 4th series. The previous series had a standard deviation of 0. Item 7A1B refers to a repetition of the first beat series. The item for the execution had a standard deviation of 0, but the need for a repetition of the model, did not and had a high load on the factor. Items 7A2B (-0.44) and 7A3B (-0.38) were not included on the factor as they did not reached the cut-off point (0.45). However it can be seen that their loads were close to the cut-off point. The negative correlation of these three items (7A1B, 7A2B, 7A3B), support the idea of stability being the central theme for the factor.

Factor 5. Shift

All items from the shift factor from the sustained attention category obtained high loads on factor 5. There was not a shift factor on the other categories.

Table 66 Composition Factor 5. Shift

ITEM	**LOADING**	DESCRIPTION
6A6	**0.52**	Task 6. Mistake identification. Child raises hand when identifies an intentional mistake made by the therapist. Mistake 6. Rhythmic mistake
6A7	**0.87**	Same as 6A6. Mistake 7. Melodic mistake
6A8	**0.93**	Same as 6A6. Mistake 8. Melodic mistake
6A9	**0.91**	Same as 6A9. Mistake 9. Melodic mistake
CONTROL6MELODY	**0.61**	Task 6. A control item introduced after the melodic mistakes going back to the lyrics mistake. Child must adjust to the new demand

All items on the factor, require shifting attention from one element to the other (rhythm, melody, lyrics), to be able to identify different mistakes presented by the therapist.

Factor 2. Focus/execute

Composition of Factor 2, include items from the selective attention category: factor focus/ non-execute

Table 67 Composition Factor 2: Focus Execute

ITEM	**LOADING**	**DESCRIPTION**
1A2	**0.90**	Task 1. Hello song. Therapist sings the song, and according to the lyrics the child must say or sing his name
1A3	**0.60**	Task 1. Hello song. Therapist sings the song, and according to the lyrics the child must say or sing the therapist's name
1B1	**-0.90**	Task 1. Hello song. If child was unable to say or sing his name in the correct space, therapist repeats the part of the song to give him a second opportunity
1B2	**-0.75**	Task 1. Hello song. If child was unable to say or sing the therapist's name in the correct space, therapist repeats the part of the song to give him a second opportunity

As can be seen, items on Factor 2, required both selection and execution of an action in a timely manner.

It is interesting to see that the direction of the correlations changed between the analysis per categories and the analysis mixing all categories. On the EFA analysis for the selective category, items 1B1 and 1B2 obtained positive loads, and items 1A2 and 1A3 negative loads. Given that items with the letter B refer to the need of repetition to perform on the task, the factor had been labeled focus-non execute. But since the positive loads on this factor are for the items corresponding to the correct performance on the first attempt, the label is changed to focus-execute.

Factor 6. Stability-control

Composition of factor 6 includes items from the stability factor on the sustained category.

Table 68 Composition Factor 6: Stability-control

ITEM	LOADING	DESCRIPTION
8A5	**0.84**	Task 8. Taking turns in music making. Third turn. Child waited for turn
8A6	**0.45**	Task 8. Same as 8A6. Child play during turn
8A9	**0.86**	Task 8. Same as 8A6, but on last turn.

Items on Factor 6, refer to stability and sustainment. The item with the highest loads correspond to impulsive responses (control) on the third and the fifth turn. The item corresponding to impulsive response on the fourth turn was not included due to low loads on the extracted factors from the category. The lowest load is for the item corresponding to the participation in the third turn (execution).

Given that factor 1 was already labeled using the stability function, there is a need to examine the correlations between the factors. The correlation between factors 1 and 5 is 0.29, and is the highest correlation between factors. Even though it is not high enough to infer the need to test both factors in a single factor, the fact that it is the highest, may support both factors referring to dimensions of stability.

Factor 4. Encode

Items from the selective and sustained attention encode factors, obtained high loads on factor 4.

Table 69 Composition Factor 4: Encode

ITEM	LOADING	DESCRIPTION
7A5	**0.45**	Beat span task. Series of 5 beats.
7A6	**0.62**	Beat span task. Series of 6 beats
7A7	**0.45**	Beat span task. Series of 6 beats
7A5B	**-0.93**	Beat span task. Child required a second attempt on series of 5 beats
2A4	**0.46**	Imitation and sustainment of a movement presented by the therapist. First movement within the song
2A5	**0.45**	Imitation and sustainment of a movement presented by the therapist. Second movement within the song

Given the nature of the items, the factor is labeled encode. The encode function refers to hold of information allowing mental operations while performing actions. It has been described by Koziol et al. (2014) and Fernández (2014), as a function close or even overlapping with working memory.

Factor 4. Sustain

Factor 4 included all items from the sustain factor of the sustained attention category

Table 70 Composition Factor 4: Sustain

ITEM	LOADING	DESCRIPTION
8A8	**0.67**	Task 8. Turn taking. Turn number 4. Child played during turn
8A10	**0.75**	Task 8. Turn taking. Turn number 5. Child played during turn

Items on factor 4 require the child to sustain attention to achieve task 8 completion. Both items belong to task 8, and represent turns 4 and 5 of the turn taking. The items correspond to the question of whether the child played during turn. Playing in the last two turns also requires maintenance of the attentional focus.

The factor composition only includes 2 items which implies a violation to criteria for factor retention, which should be at least three items with high loading (Costello & Osborne, 2005).

Summary Factor Analysis 34 items model: The factor analysis extracted 6 factors which were labeled according to Mirky's functions of attention: stability, shift, focus-execute, stability-control, encode and sustain. The last factor is considered unstable due to low number of items.

Cronbach's alpha was calculated again to test the reliability of the final item pool (25 items). A Cronbach alpha of 0.739 is found for the final item pool data indicating acceptable internal consistency.

Cronbach's alpha for each factor was also calculated. Given that several items in the factor have opposite scoring systems (highest= better/negative=better), scores on such items were converted to match the scoring system of the majority of the items on each factor.

Table 71 Cronbach's alpha for Final Factors

FACTOR 1	FACTOR 5	FACTOR 2	FACTOR 6	FACTOR 4	FACTOR 3
0,757	0.843	0.800	0.672	0.806	0.796

Alpha for factors 1 and 3 are considered acceptable. For factors 5, 2 and 4, are considered good, and for factor 6 is considered questionable.

5.2.3. **SUMMARY VALIDITY RESULTS**

Chapter 5.2. presented the concurrent and construct validity results of the APMT pilot study.

Results from correlations with standardized tests were mixed, indicated preliminary concurrent validity for the APMT categories of selective, sustained and divided attention, according to correlations with the visual attention tasks on the ENI. No correlations were found between the digits forward and the selective, sustained and alert categories. Correlations were found between the selective and divided attention categories and the digits backwards task. The mix results between the auditory attention ENI tasks and APMT, could indicate either lack of concurrent validity, substantial differences in the auditory stimuli on both assessments, or differences related with the assessments goals. Either way, the concurrent validity should be examined further due to inconsistent findings, and because only results for part of the sample were collected.

Given that multi-dimensionality was found on the Factor Analysis for the attention categories, a second Factor Analysis was performed using only items with high loads on the extracted attention category factors. Results from the Factor Analysis reduced the items to a 25 final item pool.

An unexpected finding deriving from the Factor Analysis, was that the functions of attention from the Mirsky Model (Mirsky et al., 1991) appear to be the construct internally organizing the APMT, instead of the attention categories. Factors from the attention category analysis, and the 34 item model analysis were labeled according to the construct. The factor composition of both the factors from the attention categories and the 34 item model analysis, were labeled according to the attention categories, providing preliminary indication of construct validity.

Following criteria from common use in statistics to perform Confirmatory Factor Analysis on the same data set as Exploratory Factor Analysis, which indicate the need for large sample sizes, it is suggested to conduct Confirmatory Factor Analysis using data from a different sample.

There was an aspect of reliability included on the factor analysis results. Cronbach's alpha for the final item pool continue to indicate acceptable internal consistency. Cronbach's alpha for factor 6 was considered questionable. For factors 1 and 3 acceptable. For factors 5,2 and 4, good.

CHAPTER 6. DISCUSSION

This chapter will mirror the order of the results chapter. First, the discussion of reliability results is presented. Afterwards, the results regarding validity (including correlations with standardized neuropsychological tools, and factor analysis) are discussed. At the end of the discussion chapter, the discussion of the main research question is presented.

6.1. DISCUSSION OF RELIABILITY

The main focus of this section is research sub-question 1: Is it possible to establish inter-rater reliability of the proposed assessment?

As mentioned on the results chapter, whenever reliability is evaluated, internal consistency should be examined. Therefore the results for internal consistency and inter-rater reliability will be discussed on this section.

6.1.1. **DISCUSSING THE INTERNAL CONSISTENCY RESULTS**

Internal consistency on this research study was established in two ways: examining Cronbach's alpha (on the complete data set, subsets of data, and the final item pool), and polychoric correlations on the factor analysis.

The results on internal consistency on the complete data set were interpreted as good. However, given that factor analysis concluded that there were multiple dimensions (factors) on the data, Cronbach's alpha results on the complete data set, was not necessarily an appropriate indication of internal consistency. A most reliable measure, would be the Cronbach's alpha on the reduced final item pool (α=0.739) considered acceptable. While there is a decrease on the alpha between the complete data set and the final item pool, it is relevant that even with a considerable item reduction (and given that Cronbach's alpha is highly dependent on number of items), the coefficient is still considered acceptable, and demonstrate internal consistency.

The Cronbach's alpha calculations before data reduction uncovered difficulties related with balance on item numbers per category and composition and types of tasks on the alert category.

When referring to the number of items on the subsets of data, it was evident that the subsets of data with poorer results were those with less number of items. While this is understandable, as Cronbach's alpha relies on number of items in the data set, it uncovers an unbalance on the internal structure of the subsets of data. While the categories of selective and sustained attention had larger number of items, the alert

and divided attention categories had very few items (4 and 2 respectively). A difficulty embedded within this structure was that across the categories, the weight of a single item varied considerably. While on the divided attention category scores on a single item accounted for 50% of the category's performance, the sustained attention category accounted for 5% of the performance.

Furthermore, for the attention category of alert, which had the poorest results on the internal consistency calculations, a discussion on the composition and types of tasks on the category is in place. In traditional neuropsychological assessment tests, alert tasks measure the reaction time and usually involve accurate measures of it using external apparatus. This is appropriate within the context of these tests, given that the administrator's role is somehow restricted to the provision of the tasks. When designing the APMT, a choice was made not to include apparatus to measure the alert items to avoid distraction, considering the role of the administrator in terms of the relationship and confidence building, and that the therapist was already involved in quite a lot of actions for the implementation of the tasks. The approach on the APMT design to the alert category, was then more general considering the presence or absence of the expected response (3 items), and how immediate was the reaction (1 item). It could be said that the item observing immediateness of the response was more related to actual alert tasks. However, as it will be discussed in the corresponding sections, reliability and validity problems were identified with this specific item. Considering both the theoretical inconsistency between APMT items and neuropsychological items for assessing alert, and the poor internal consistency results, the complete structure of the category requires revisions.

6.1.2. **DISCUSSING THE INTER-RATER RELIABILITY RESULTS**

To begin discussing the inter-rater reliability results, a brief summary will be presented first.

Pilot study results established inter-rater reliability for the APMT. Several statistical methods were used according to the level of analysis (group level statistics, or individual level statistics) and the type of variables. The results for the group statistics were interpreted as substantial agreement for the nominal variables and near perfect agreement for the ordinal variables. No major differences were identified when excluding the ratings of the music therapist administering the assessment. Results were similar when looking at the individual level statistic (results between administrator and each raters).Coefficients for the nominal variables were consistently substantial or almost perfect. For the ordinal variables, coefficients were considered almost perfect across participants and pairs of raters. No major patterns or differences were identified according to level of education or years of clinical experience of the raters.

The inter-rater reliability results are encouraging, and an indication of clarity of rating, and appropriateness of materials (manual and video) for training raters. However, considering the inclusion criteria for the raters, there are certain aspects of inter-rater reliability which cannot be responded through the current research study.

Raters for the study had to be music therapists with at least two years of clinical experience and with experience working with children. Therefore, it is still unknown if music therapists with less experience, or experience in other clinical areas, would have similar results. The variables of experience with structured assessment methods or academic research were not examined on the current research study and should be explored in more depth, as such type of experience could influence the way the administrator approaches the assessment procedure and its interpretation.

Additionally, and as a characteristic of the sample not mentioned on the inclusion criteria, all raters were master's level and even PhD level music therapists, so it could be argued that undergraduate music therapists could have different results. An important note regarding education level, is that music therapy is not an undergraduate program in Colombia. Therefore, the master level raters' from Colombia do not have an undergraduate diploma on music therapy or clinical experience in the field previous to the Master's course.

Another characteristic of the sample of raters was that the majority of them were Colombian music therapists. Considering the multi-cultural nature of the Latin American region, it is still unknown if the inclusion of therapists from other countries would provide similar inter-rating reliability results.

Regarding training required for administering and rating the assessment, APMT included written material (APMT manual), video material (administration sessions), and the researcher being available for questions. Additionally, the APMT music therapist administrators performed a mock session before administering the assessment. From the inter-rater agreement results and the consistency of the data, it may be inferred that such training was enough for administering the assessment, at least for music therapists with similar characteristics to those in the sample. Some exceptions will be presented in the following sub-sections regarding training for specific items, were discordant ratings were found.

It is necessary to point out, that the conclusions regarding training are only applicable for the administration of the APMT assessment. It is possible that more detailed training, may be required for a proper interpretation of the assessment results. This issue was not part of the scope of this study, given that it was not appropriate to interpret results prior to the establishment of validity for the APMT. Some theoretical framework is presented on the Manual, so that the music therapist can understand the rationale behind the APMT design. However, music therapists using the APMT in their clinical practice, will require a solid understanding of attention, music and

attention, attention development in childhood, and interactions of attention with cognitive functioning, in order to interpret the APMT results. A following step into the development of the APMT, would be to design a comprehensive training, and further develop and study the interpretation of the APMT results.

6.1.2.1 Discussing the concordance of the nominal variables

The results discussed in the previous section established the inter-rater reliability of the APMT. However, the statistical methods used do not provide details on individual items. To be able to identify relevant issues for specific items, observations of the data regarding concordances and discordances in ratings are required. Observations do not take into account agreement by chance, weight of the disagreement, nor relative agreements (which are part of the kappa statistics analysis). The analysis is solely based in the observations of the ratings from all raters.

Several nominal items in the APMT had rating discordances for two or more participants. The problems suggested by the discordances (especially for items with discordant ratings for all participants) should again call the attention upon design considerations and the training required to provide consistent ratings. A description of the items is provided on Table 72, and further analysis is presented below.

Table 72 Nominal Variables with discordances

Item Description	Rating critera	Number of participants with discordant ratings
Type of accompaniment. On task 3, the child is singing and playing an instrument of his choice. Administrator instructs the child to stop singing or playing according to an instruction. Rater describes musical characteristics of the singing.	Pulse, Melodic Rhythm, None	2
Voice and playing synchronized. On task 3, described on the previous item.	Always, Sometimes, Never	2

How did he reacted to the mistake? On task 5, without giving instructions, the administrator sings a familiar song and makes a very obvious mistake changing a fundamental component of the song. Rater is describing the response of the child (if child in fact, reacted)	Gesture, Verbal, Both	2
Time of exploration On task 8, the administrator arrange certain instruments prior to beginning the turn taking task. The child is asked to explore the instruments. Rater measures the duration of the exploration	1 minute or less, 2-4 minutes, more than 4 minutes.	3
Musical materials were similar to the tx On task 9, children and administrator are making an improvised Good Bye song. Rater describes the similarity between the children's musical materials with those of the administrator.	Always, Sometimes, Never	2
Type of support (4 items). Complements information for the Overall Performance scale for each moment of the session. Describes the type of support provided by the administrator.	Verbal, Gestural, Prompting, More than one, No Support	4

Melodic contour of the child's singing. On task 3, the child is singing a song he is familiar with. Administrator describes the singing taking as a reference the original song.	Same, Similar, Different	4

There are four type of support items with discordances for all participants. Discordances point to a design problem. The type of support item was presented at the end of each *Moment of the session* (right next to the overall performance scale). But the child may have required different types of support on each of the two or three items on the *Moment of the session*. The rater could have focus on the performance on the first, or the last item, or could have try to find a balance between both of them. The raters (including the administrator), probably approached rating the type of support from different perspectives generating discordant ratings for all participants. Exclusion of the type of support items would not be recommended, as information regarding the child's need for an external source of regulation is recorded. For future versions of the tool, further training on the topic of support in assessment would be recommended, as well as the inclusion of the type of support items for every task in a way that would not affect the pace of the session.

Musical data items in turn, were descriptive in nature registering characteristics of the child's music making. These materials were included in the APMT for two reasons. First, to be able to assess possible correlations between some of these music characteristics with attention related tasks, and second to register information clinically relevant for music therapists. Not to include this type of information could limit the usefulness of the APMT in the clinical setting. Since it is common practice in music therapy to analyze music, it was not expected to find discordant ratings on the musical data items. But since there were discordances, it was highly important to identify sources of difficulty. The first one was related with non-specific rating criteria or incomplete instructions provided (i.e. duration of the exploration, without instructing when to begin counting the time). The second difficulty arose in task 3, were the therapist had to handle several things at the same time. During the task, the therapist had to be involved in singing and playing, providing a verbal instruction to the child to stop playing or singing. When the task was over, the therapist had to record the child's response, and if the response was immediate. Additionally the musical data required the therapist to record synchrony between singing and playing, and type of accompaniment. The difficulties with task 3, highlighted the need to always consider how much simultaneous information can be collected, so that better judgement is used into the design of complex tasks.

As it can be seen, all sources of discordances of the nominal variables (most of them from the musical data category), can be traced back to design problems and lack of anticipation of certain situations that occur in the clinical practice. Any future revision of the APMT must take into account the sources of difficulty, the inner structure of the APMT (suggested by the factor analysis results), and the experience from Pilot B. Including new items, will always encompass the risk of adding sources of confusion into the tool.

6.1.2.2 Discussing concordance of ordinal items

In this section, the observations of the data regarding concordance/discordance in ratings of the ordinal items is presented.

Most APMT ordinal items had near perfect inter-rater agreement and ratings concordance. However, discordances for two or more participants were found for the complementary scales: motivation scales, the overall performance scales, and the relationship scores.

The complementary scales were included on the APMT considering issues such as motivation and relationship building with the therapist which may affect attention and the music therapy process, and the importance of accounting for autonomy and self-correction in attention performance.

Motivation plays a major role on the display of attentional skills, as low levels of motivation could lead to lower scores on performance on attention tasks. To gather information regarding the child's motivation complement the results enhancing interpretation. The relationship scores reveal relevant information, as difficulties in this area could impact the child's performance on the assessment, the administrator's ratings, and subsequently the music therapy process. The discordances for the motivation and the relationship scales were always between the 3 and 4 criteria (adequately motivated/highly motivated, easy to establish relationship/very easy to establish relationship). Again, the difficulty pointed to a design difficulty, as the difference between both choices (3-4) is too subjective, hence causing different interpretations. Interestingly enough, the criteria for the motivation scale had been changed during the transition from Pilot A to Pilot B, taking into account feedback regarding how different degrees of motivation should be taken into account. While the researcher still finds it appropriate to differentiate between a highly motivated child, and a motivated child, it must be said that the differentiation will be always subjective according to the therapist, and therefore to use a numeric score to record the differences, will encounter reliability difficulties. But to use a differential score (3-4 on the motivated side) allows identification of type of tasks preferences. Given the purpose of the APMT, such identification is considered important, and therefore the scale should be kept on its current form, understanding that there always be a subjective component of the scoring of the administrator.

Looking into the motivation scale, it is relevant to notice that most ratings on the scale were on the "motivated" side (ratings 3 or 4). The result is relevant, as performance of the child in the APMT tasks, would be less impacted by low motivation. The motivation levels in other assessments of attention are not known, as there are not recorded (at least in the literature explored by the researcher). Neuropsychologists often report the child's motivation throughout the assessment, but there are no items on the assessment referring to the topic. This could be considered a strength of the APMT assessment in line with Thaut's statement when referring to the therapeutic mechanisms associated with the development of the Music attention control training protocol: "music provides the additional dimensions of emotion and motivation to help facilitate concentration and keep the person on task" (Thaut, 2014 p. 260).

A different design difficulty was identified for the Overall Performance scale. It is the same difficulty identified for the type of support item (nominal item). The scale was only presented at the end of each *Moment of the session*. Since there were between 2 and 3 tasks on each *Moment of the session*, the child's performance was sometimes different across the tasks. As a consequence, rating the item was confusing. The scale also provides relevant information (regarding autonomy, self-correction, and self-verification), but there is a need for adjusting the presentation of the scale and provide better training to appropriately use the criteria. Since the overall performance will be an important element of the APMT interpretation, it would be important for the administrator to have a clear understanding of the different terms and the implications in terms of cognitive development of autonomy, self-correction and self-verification.

The remaining item with discordances on the ordinal variables was part of task 3. As it was already discussed on section 6.1.2.1 regarding musical data items from task 3, there were multiple operations occurring at the same time during the task affecting concordance in ratings for task 3 items. The therapists and the child sing and accompany a familiar song. The child must stop playing or singing (while continuing the other action), according to an instruction from the therapist. The ordinal item with discordant ratings refers to how immediate was the child's response. It is highly relevant that this was the only ordinal item with discordant ratings, as it was the only item on the assessment, making reference to the reaction time. When discussing the internal consistency results, it was mentioned that the difficulty to report reaction time on APMT tasks made it difficult to establish reliability and validity of the Alert category. Later, in the discussion of Factor Analysis results, new elements will be added regarding the reliability, validity and relevance of this particular item.

6.1.2.3 Conclusion remarks inter-rater reliability

As it can be seen from the content of this discussion, the inter-rater reliability analysis departed from the group level statistics, moved into the individual level statistics (pairs of raters), and finished with item observations. The first analysis (group and individual level statistics) resulted on coefficients interpreted as Substantial or Almost

perfect agreement. Identification of problems causing discordance on specific items resulted on valuable information for future adjustments of the APMT. Such identification does not necessarily mean that the possible adjustments will increase reliability of the APMT. Whenever changes are introduced to the assessment, new reliability and validity studies must be conducted. However, there is an increase of awareness of the researcher towards specific issues affecting the APMT design.

It is a fact that the presence of multiple scoring systems and both nominal and ordinal variables, made the analysis of the data complex. But, in such complexity there was also an interesting puzzle in the making. As the statistical results were analyzed, some pieces found a place in the puzzle, while others appeared to belong to a different puzzle. The connections that can be made with the variety of data of the APMT begin to provide foundation for the APMT (or at least parts of it) as a reliable assessment.

6.2. DISCUSSION OF VALIDITY

As part of the APMT pilot study, several aspects of validity were examined. Results from correlations between ENI and APMT, and Exploratory Factor analysis, were taken into account. Separate sections for each statistical procedure will be presented in the chapter.

6.2.1. **DISCUSSION OF CORRELATIONS ENI-APMT**

A common approach to determine validity of a new assessment is to correlate results of the proposed assessment with results from other tools measuring the same construct and administered concurrently. This type of validity, is called concurrent validity.

Even though there are a number of assessments specific for attention, it is uncommon for neuropsychologists to administer tests for an isolated function, such as attention. It is more frequent to use complete neuropsychological assessments batteries (several tests organized to assess diverse functions), so that information regarding several functions can be connected into a final report. Neuropsychological assessments with tasks for assessing attention, validated for the population, and previously used in research were searched to decide on a tool to be used for establishing concurrent validity of the APMT. The chosen assessment was the ENI. The characteristics of the tool and the validation information was presented already on chapter 5.2.1.

A methodological difficulty was found in the course of the study, as it was not possible to collect ENI data from all participants. Scores from the ENI attention tasks were only reported for a small sample of 15 participants (3 of them only reported results on the auditory attention tasks). Such difficulty was not predicted in advance. The fact that the ENI was chosen as the tool for correlations taking into consideration consultation with institutions providing neuropsychological services; and the fact that the ENI was the only assessment with validation studies for Colombian population

(Rosselli et al., 2013), led the researcher to assume that the tool would be commonly used. The internal validity of the study was affected by this methodological difficulty, and the results regarding concurrent construct validity will need further confirmation in future studies. Both the sample and the partial sample of this study are smaller. Some conclusions will be discussed from the correlation results with ENI, but it is important to recall that the data does not reflect the complete sample, and therefore information is limited, requiring further testing to confirm concurrent validity of the APMT.

ENI and APMT present different inner structures. The ENI assessment tasks are divided into visual and auditory attention tasks. The APMT tasks are divided into four attention categories (alert, divided, selective and sustained attention). There could be then a theoretical difficulty to compare results from both assessments. The APMT does not use the separation between visual and auditory attention tasks because there is evidence in research that both modalities influenced each other (Joyce and Hrin, 2015), also because in music therapy clinical practice it would be difficult to create experiences were the auditory part of the experience is clearly separated from the visual part.

To perform and interpret the correlations, the categorization of the type of tasks on the ENI according to attention categories was taken into account.

An interesting finding from the results is the fact that significant correlations were found between the visual attention tasks and the APMT categories corresponding to the categorization of cancellation tasks (selective, sustained and divided attention). However, the correlations of the auditory attention tasks with the APMT, were not as clear. For the digits forward task, correlations were only found with the divided attention category. For the digits backwards task, with the selective and divided attention categories. Given that digit span tasks are considered to be selective attention tasks, the lack of correlations with the digits forward task, and the stronger correlations with the divided attention category on the digits backwards task, do not support construct validity of the APMT categories.

Since the APMT is a music therapy assessment, the fact that the correlations with the auditory attention tasks from the ENI assessment (digits forward span and digits backwards span) do not point towards the establishment of construct validity, could be problematic. However, considering the characteristics of music processing, and specific stimuli on the digit span tasks, correlations were not necessarily expected.

Even though, there are no specialized modules of attention for music processing (Janata et al., 2002), there are differences in the responses to the different stimuli. In the literature review (section 2.2.4.), a series of research studies on music and attention were presented. Among other themes, evidence arising from the studies indicate automatic capturing of attention networks when using music stimuli (Koelsch, 2009);

larger neural responses when cue to attend to a music stimuli consistent of familiar music (Meltzer et al. 2015); and children better performance on sustained attention tasks when presented in music (Wolfe and Noguchi, 2009).

Additionally, the auditory attention tasks on the ENI are limited to the digit span, leaving out several aspects of non-musical auditory stimuli. Auditory attention related to words, texts and sounds are not part of the ENI attention tasks. Given the characteristics and overlap of language and music processing, it is possible that other tests of auditory attention would better correlate with tasks using music stimuli. For example, the validation study of the MASA-R (Waldon et al. 2016), found correlations with the auditory attention tasks of the NEPSY assessment. In the NEPSY auditory attention tasks the child is given a target word and he must touch a circle whenever he listens to the target word (from a list of words). For future studies, the use of other neuropsychological assessments could be recommended for establishing concurrent validity.

Additionally, it should be reminded that the Exploratory Factor Analysis results suggested a different inner structure for the APMT. Therefore the difficulties to establish concurrent validity of the APMT could also be related to the fact that the relevance of the attention categories in the APMT structure got re-evaluated. The presence of irrelevant items, or inadequately categorized items could have influenced the concurrent validity results.

It is not possible to determine the weight of each of the potential reasons for the correlations results between ENI and APMT. However, given the emerging structure of the APMT according to factor analysis, correlations should be further explored with the attention battery suggested by Mirsky et al. (1994) in order to establish concurrent validity of the APMT considering the final item pool, and the factor structure.

According to the previously presented elements it can be concluded that given the available data is not possible to establish concurrent construct validity of the APMT tool considering the structure of the attention categories. Further studies using other neuropsychological assessments are recommended, taking into account the factor structure of the APMT.

6.2.2. **DISCUSSION OF FACTOR ANALYSIS AND POLYCHORIC CORRELATIONS**

In the previous section, the concurrent validity of the APMT was discussed. Construct validity on the research study was established using Exploratory Factor Analysis and polychoric correlations dealing with item level analysis.

Exploratory Factor Analysis (EFA) and Polychoric correlations were used in the study to examine factors from the data set, and further examine correlations between items.

Given that APMT tasks were designed taking into account available literature on assessment of attention and tasks from attention assessments, there was a preconceived notion of the classification of task items into categories of attention (alert, divided, selective and sustained attention).

The Exploratory Factor Analysis was conducted using such a preconceived structure, as the primary organization construct. Exploratory analysis was chosen instead of moving straight to Confirmatory analysis for two reasons. First, because the design and classification of the items were research based but still exploratory, as the literature on children assessment of attention in music therapy is limited. Therefore there was a need to examine the correlations between items in the same category, and how they were organized. Second, because the number of dimensions of the data on each category, and corresponding themes were unknown.

After performing Exploratory Factor Analysis, Confirmatory Analysis was not conducted taking into account considerations such as the sample size, and possible change agreement on the models from EFA and CFA, when using the same sample.

Regarding the correlations between items on the same category, polychoric correlations preliminarily indicated that the selective, divided, and sustained categories were structured correctly.

One factor was extracted on the categories of Alert and Divided attention. As such, only one dimension of the category was represented on the items. However, the factors were considered unstable according to the parameter of number of items with high loads on each factor.

For the selective attention three factors were extracted, while four factors were extracted for the sustained category, . The implication of such finding was that there was more than one dimension being examined on each category. In other words, the scores obtained were not responding to a unique aspect. As such, it could not be expected that the factor structure for the pilot study, would respond to the categories of attention.

When looking into the reasons for such a result, and possible ways to approach a solution, it was necessary to go back to attention theory. The chosen structure for the APMT was congruent with a classification dealing with processes, meaning that the attention categories reflected processes of attention. However, there was a need to find elements that could be common to all or most processes.

As mentioned on the literature review (chapter 2.1.1), there are several models of attention. Taking into account literature on the Posner and Petersen model (1990), the Mirsky et al. model (1991), and the Luria model (1979), a decision was made to use the Mirsky Model as a central point for the analysis . The decision was made based

upon the fact that the Mirsky's model used a factor analysis approach to define attention processes, based upon results on neuropsychological assessments, evaluating not only adult population but also children population. It was also taken into account the fact that the model has been revised and updated (Koziol et al. 2014), and that there is a body of literature regarding the description of the attentional functions in terms of brain systems (Joyce and Hrin, 2015).

The construct of attentional functions from the Mirsky model was found as a possible common element organizing the emerging factors. While the attention categories appeared to be more related with isolated mechanisms, the functions were related to large brain systems.

The basic considerations for deciding on the attention categories as the concept guiding the structure of the assessment, were based upon the classification of attention tests into such categories. As Spikman and Van Zomeren (2010) identified, the approach was useful while designing and organizing the items, but turned out to be problematic for factor analysis.

At first, the finding was disruptive according to what had been a process of years into the design and pilot study of an assessment of attention. However, in the process of understanding the construct, advantages to the new perspective were found.

The first advantage is to be able to approach the APMT from a more comprehensive and connected way. A second advantage is the possibility to better understand the underlying brain systems involved in the different tasks proposed in the assessment.

The shift of focus guided the labeling of the factors. In the beginning the factors were thought to be more related with length of task (according to the factors on the Music Based assessment of attention, Jeung, 2013) or modality of response. Such labels were quite clear for some factors, but the combination of several characteristics made it difficult to interpret the factor structure as a whole. In the new perspective, it was easier to understand the underlying structure. However, the factors on the divided and the alert category, were difficult to label under this perspective, as the items appeared to respond to different functions. Such difficulty was associated with the instability of the factors.

Using the items from the extracted factors on the categories, a new Exploratory Factor analysis was conducted using all the items (34 in total). The emerging structure had 6 factors. One of the factors contained only two items indicating instability of the factor.

Most of the items from the categories were clustered together again on the final factors indicating stability of most category factors. However, and as it was expected given the instability of the alert and divided attention factors, their items got separated in the final analysis.

For the alert category, the item separation in the factor analysis, was the last of a series of results indicating problems of reliability and validity. For the divided attention category, the separation indicated that while it was possible that both items were related (which can be implied from the polychoric correlations between the two items), the fact that the categories of attention were no longer the organizing structure for the assessment invalidated the correlation in light of a different structure.

The reduction of the item pool, implicated the exclusion of tasks 3 and 4, as the items corresponding to such tasks did not obtained high loads on any of the factors. Task 3 was a complex task involving the child in playing and singing, while at the same time attending to a verbal instruction to stop one of the actions while continuing with the other. Results of reliability had indicated discordances in ratings for one of the items on the task, suggesting exclusion. Task 4, was a synchronization task were the child had to attempt to synchronize with tempo changes introduced by the therapists. The tasks were first included as part of the alert and the divided category. With the changing overall structure and the separation of the items from those categories, the relevance of the items in light of the new factors is questioned. Given the type of information factor analysis provides, it could be said that there is no need to include the tasks in order to obtain sufficient information regarding the current six factors. However, synchrony is one function that music therapists should be able to observe for clinical reasons. Perhaps, it could be possible in new versions of the APMT to include synchrony as an aspect to observe in improvisation or in the first two tasks while singing the hello song.

The rest of the tasks will be kept. While not all items from the tasks were included in the final item pool, they will remain being part of the APMT, as exclusion in most of the cases could change the nature of the tasks. For example, the beat span included 7 beat series. However, the first three series items had standard deviation=0. But if excluding the items, the performance of the child could change, as the duration in time and material to process and respond will be less.

Two of the three musical data items included in the analysis had high loads on factor stability. The items refer to participation in improvisation and similarities of musical materials of the child with musical materials of the therapist. The preliminary finding relating these items with attention functions is relevant and should encourage the inclusion of more musical data deriving from improvisation tasks in future studies.

It is necessary to recall that the structure should only be considered preliminary and should be tested further with different samples, and using Confirmatory Factor Analysis according to common use in statistics.

6.2.3. **DISCUSSION OF THE MAIN RESEARCH QUESTION**

This section's guide is the main research question. Can a music therapy assessment designed to provide a profile of the attention of a child, do so in a valid and reliable manner?

The process towards establishing validity and reliability of a new assessment tool, begins long before the data collection process and the statistical procedures. The design of the tool, takes careful consideration, and literature revision. However, the researcher can never predict the validity and reliability results.

The pilot study of the APMT, revealed its reliability. There is also preliminary evidence of construct validity of the tool, even though a reconsideration of the organizing structure of the APMT was suggested.

Even though the polychoric correlations indeed indicated correlations between items from the categories supporting the APMT design, the multi-dimensionality of data on some of the categories revealed that there was an underlying, higher in hierarchy, structure related to attentional functions. Even though the current factor structure should be considered preliminary (pending Confirmatory Factor Analysis with other samples), the identification of this element structuring the APMT is perhaps the most relevant result of the APMT pilot study. If the attention categories refer to processes (more isolated in nature), the attention functions open perspectives towards a broader understanding of attention in connection with large brain systems. The discussion on the previuos section highlighted the new perspectives opening as a result of such finding.

Concurrent validity of the APMT could not be established. Methodological difficulties to collect data from the complete sample, as well as difficulties related to the characteristics of the ENI attention tasks and the change of the organizing structure might have impacted the results.

A question regarding what would be an appropriate instrument to use for establishing concurrent validity of the APMT arises from the results. I had been advised that the attention assessment battery associated with the Mirsky model could be considered in the future. From the quantitative point of view, considering theoretical congruence, the use of such battery would probably be more appropriate than the use of the attention tasks of the ENI. The fact that the assessments were not designed for Spanish speaking populations, and have not been validated in some Latin American countries, would pose other methodological challenges for future studies within the Latin American context.

However, the use of such battery would only constitute a partial response to the question. Other considerations, not included in the analysis of the correlations

between the ENI and the APMT, provide other perspectives to be considered when thinking about the establishment of validity for the APMT.

The APMT has been designed to be a baseline for music therapy treatment, an assessment of the display of attentional skills within a music therapy session so that the clinician can begin to build the therapeutic relationship, and establish a baseline to construct directions for the treatment process. The Evaluación Neuropsicológica Infantil (ENI), has different purposes. The ENI manual, establishes six purposes for neuropsychological assessment (Translation to English by the researcher): "(1) to determine the usual cognitive activity of the patient, not necessarily following a pathological condition. (2) to analyze symptoms, signs, and fundamental syndromes. (3) to provide additional information to make a differential diagnosis between two apparently similar conditions. (4). To propose underlying pathologies to the cognitive condition. (5) To suggest therapeutic and rehabilitative procedures. (6) To determine efficacy of a particular treatment" (Matute, Roselli & Ardila, 2014. p. 17). In summary, the neuropsychological assessment as conceived by the ENI authors, has a diagnostic goal. The APMT, on the other hand, is not intended to be a diagnostic assessment, but a process-oriented assessment.

The differences in goals, also implicate differences regarding the roles of the clinician and the child, the relevance of relationship and motivation in the assessment process, and the use of the assessment results.

The ENI manual states that establishing a positive relationship with the child is important. In the assessment procedures, it is stated that a positive relationship must be established prior to the administration of the tasks to ensure reliability of the results (Matute et al., 2014). The issue of relationship establishment in the APMT is also considered crucial, but approached in a different manner. It is not considered as a procedure previous to the APMT administration but an integral part of it, being observed and assessed, as it affects both the child and the music therapist. Additionally, the relationship is conceived as framed within the music therapy process, not only as a pre-condition for the assessment.

Something similar occurs with the role of motivation on the assessment. While this aspect is not included explicitly on the ENI, the neuropsychological assessment report usually includes observations regarding the child's motivation. However, the observations are often limited to the impact of motivation on the test performance. On the APMT, motivation aspects are explicitly included on each task. In this way, the impact of motivation can be evaluated in detail, but it is also possible to identify the type of tasks which were more or less motivating for the child, information relevant for the music therapy process. The high motivation scores on the pilot study (generally between 3 and 4) could be an indication of an overall positive experience for the child, which again is relevant for the music therapy process but, more importantly, could mean that the child obtained a positive experience as a result of it's participation in

the assessment. This should be a condition of assessment processes. Assessment should not only be a source of information for the professional, but also a source of meaningful experiences for the child participating in the assessment.

Regarding the roles of the clinician and the child, using Kossman's classification of assessment practices it could be stated, that in the ENI the role of the neuropsychologist is more in line with classical assessment practices. In such practices, the relational aspect is limited given the need for detachment to provide valid results. In this sense, to be able to comply with the tests standards, it is necessary for the administrator to restrict dialogue, and not provide support during the performance of the assessment (Kossman, 2015). In contrast, the roles on the APMT are closer to contemporary approaches such as collaborative assessment. During the APMT, the administrator can provide support when the child requires it, the child participates in choices regarding musical materials and instruments, and on the last part of the assessment, the turn taking and the good bye improvisation, provide only a general structure where the child and the therapist can create. Finally, there is an acknowledgement of the mutual influence of the relational aspects on the assessment results.

Kossman (2015) refers to the classical assessment practices as the information-gathering model, a three-part process involving: the administration of standardized tests, the interpretation of results with priorities based on nomothetic principles, and the statement of recommendations according to the results. In such model, the clinician administers the standardized battery, while the patient has a passive role. Finally, the internal validity considerations of norms referenced results are given priority over the external validity considerations of applicability of the results to the patient's treatment and life. The author highlights the fact that tests results on the information gathering model are regarded as end product.

The collaborative assessment, instead, has different principles including: collaboration between the patient and the clinician in the assessment process, interpretation of test results contextualized in the patients' life events, respect for the individual complexity and ambiguity (Gorske & Smith, 2009). Kossman (2015) states that tests results in the collaborative assessment approach, are considered supplemental sources of information. While the APMT does not completely follow every aspect of the collaborative assessment models, the nature of the relationship, the non-passive role of the child, the detachment from assessment as a diagnostic procedure, and the explicit relevance given to motivation, support and relationship building as assessment aspects, is fully congruent with the model. The issues of providing feedback and collaborating in the establishment of treatment goals have not been addressed on the APMT design. However, they have not been addressed either in collaborative psychological and neuropsychological assessment of children, since most of the literature is based upon adult assessment, with no indication of the operationalization when assessing children.

Considering the above presented elements, it is necessary to complement the concurrent validity analysis of the APMT with ways of establishing construct validity framed on contemporary assessment methods. While it will require the use of other research methods for establishing validity, the inclusion of such methods would be responsive to APMT guiding principles. Being able to establish validity through both quantitative and qualitative approaches, would be in line with the ideas of contemporary assessment as a blend between scientific and humanistic approaches.

According to Finn and Tonsager (1997), and Aschieri (2012), there is a need in the assessment field to recognize the importance of valid, reliable assessments without disregarding the relational process. In music therapy, to be able to design valid and reliable assessment procedures, without compromising the relationship building is a difficult task. There is a risk to give priority to the replication conditions, overlooking the relational aspects. The possibility to blend objective observation, relationship building, and music interactions in music therapy assessment, observed throughout the research process is promising in terms of building the bridge between traditional and contemporary assessment approaches. Results on APMT preliminarily establishing reliability and construct validty, while maintining the relational aspects and a certain degree of flexibility, indicate the assessment could be on the right track towards accomplishing the blend between the approaches.

As is the case when new assessments are designed, pilot study results are only to be considered a first step into the process of completely establishing validity and reliability. The pilot study of the APMT had a small sample, with restricted inclusion criteria and took place in institutions conveniently selected. Therefore, studies with larger samples and including other populations such as regular school students on the same age range as the pilot study, and taking place in more institutions, would be required to further establish reliability and validity of the APMT. The control of variables affecting internal validity, as was the case of the ENI data collection, will be fundamental for future research.

In light of the pilot study results, APMT requires adjustments. Such conclusion was expected as the design of assessments, should never be considered a perfectly definitive endeavour. The original structure of the assessment regarding the *Moments of the session*, and the design of the majority of the tasks, do not appear to need changes. But results do indicate the need for adjustments in items such as exclusion of some tasks and items, adjustments to the tasks instructions so that administrators are able to record results from this type of items in a more reliable way, and adjustments to training required for administering the assessment. Furthermore, given that adjustments to the APMT have been proposed according to the results, a revised version of the APMT should be validated.

To sum up the discussion of the research questions of the APMT, it is necessary to call attention to an element - highly important for the researcher - in the design process

of the APMT: the usefulness and applicability of the assessment in regular clinical settings related to ecological validity. While reviewing the literature for this study, it became evident that some assessments were not necessarily easy to use in clinical settings. APMT was designed in Spanish language and for the Latin American context. Its usefulness and applicability were dependent on contextualization. Given the clinical settings and working conditions for music therapists in the region, video analysis is not necessarily a clinically applicable assessment method. Access to technology can also be a constraint. APMT had to be responsive to these needs. That is why the administration of the APMT does not require video analysis or computer based tools. A simple instrument setting, a manual and a paper response sheet, along with appropriate training, are the only elements necessary for the use of APMT. The length of the administration session is also appropriate, being consistent with a 45-60 minutes session.

Considering cultural issues, it is necessary to briefly discuss the fact that the design process of the APMT was performed in parallel in two languages: Spanish and English. The researcher's first language is Spanish, and she performed the translations. The first version of the tasks were always designed in Spanish. But since feedback was provided both in English and Spanish, there was a constant translation of the items between both languages. Being the researcher a clinician who has been working for over 12 years in Colombia, but educated as a Music Therapist in the United States and Denmark, special care was taken to use terms that convey faithfully the meaning and depth of every adjustment in both languages. However, proof reading of the APMT in Spanish and English by native speakers music therapists might be necessary to ensure fidelity of the translations on the reviewed version of the APMT.

The origin of this research study was the idea of being able to assess children's general development in music therapy in a valid and reliable way. In the process, the original idea had to be adjusted to the assessment of only one function: attention. Promising results on the research study should serve as encouragement to proceed with the original idea of assessment of general development or at least other functions, to complement APMT.

APMT is not considered completely finished at the end of this research study. However, it was established as a tool for assessment of attention in music therapy providing reliable and valid results. The search for improving the tool, and perform further and larger pilot studies will continue.

CHAPTER 7. FUTURE RESEARCH DIRECTIONS

The limitations of the research study have been delineated along the results and discussion sections, and will dictate the course for future research directions regarding the APMT as an assessment of attention.

Providing the suggested adjustments for the APMT arising from the reliability and validity results, the pilot study of the revised version is an identified need. Since the training will also be adjusted to include theoretical and practical elements it will be necessary to establish reliability of the revised training protocol. Subsequent studies with larger samples and conducting Confirmatory Factor Analysis, could provide a better understanding of the stability of the factor model and the possibility of assessing attention functions in music therapy.

Once the revised version of the APMT is validated, and with the purpose of exploring generalizability of the results in terms of music therapist qualifications, future studies should include less experienced music therapists as administrators and raters. To explore generalizability to other populations, participants such as regular students should be included.

Given that the concept of attentional functions is being used as the organizing structure for assessing attention on the APMT according to the emergent Factor structure, concurrent validity of the tool could be further explored using neuropsychological assessments from the attention assessment battery proposed by Mirsky and Duncan (2004), or the parts of the battery validated for Latinamerican population. If in fact each factor correlates with the assessments on the battery assigned for each attention function, it could be established that attention functions are being assessed in the APMT.

Also related with the establishment of validity, it would be important to conduct studies considering neuropsychological assessments framed under qualitative approaches. The identified potential of the APMT to highlight features beyond scores, include the relational aspects as part of the assessment, thus attempting to bridge the scientific and the humanistic approaches, indicate that other ways of looking at its validity might be appropriate.

Since the focus of this research study was the design process and pilot study of the APMT, the issue of interpretation and use of the results in the music therapy process, has not been explored. The topic was not part of the study, as the reliability and validity of the tool were unknown. However, in light of the promising evidence found in the Pilot study, this is an important future direction.

There is also a need for testing the validity and reliability of the APMT in other cultural contexts and languages. Providing the sample design, it is necessary to further study populations with different characteristics. It is also clear that the APMT design is guided by a cultural bias of the researcher, and therefore might not necessarily lend similar results when used in other cultures.

In a more general way, given that in fact it was possible to design an assessment of attention in music therapy, future research should be implemented into the design of assessments for other functions. It has been clear throughout the research process, that music therapy assessment is becoming a more relevant and frequent research topic. As more music therapy assessments are designed and test for validity and reliability, clinicians have more available tools. The use of valid tools in the field contribute to positioning music therapy in the health field, and open new communication possibilities with other professionals in interdisciplinary team work.

REFERENCES

Aschieri, F. (2012). Epistemological and ethical challenges in standardized testing and collaborative assessment. *Journal of Humanistic Psychology*, 52 (3), 350- 368. DOI: 10.1177/0022167811422946

Altenmüller, E., Schlaug, G. (2012) Music, Brain and Health: Exploring Biological Foundations of Music's Health Effect. In. R. MacDonald, G. Kreutz, & L. Mitchell (Eds.) *Music, Health, & Wellbeing*. Oxford: Oxford University Press.

Altenmüller, E., Schlaug, G. (2013). Neurologic music therapy: The beneficial effects of music making on neurorehabilitation. Acoustical Science and Technology, 34 (1), 5-12. doi: 101250/as.34.5

American Psychological Association (2017). Clinical Neuropsychology. Retrieved from http://www.apa.org/ed/graduate/specialize/neuro.aspx

Anvari, S.H., Trainor, L.J., Woodside, J, Levy, B.A. (2002). Relations among musical skills, phonological processing and early reading ability in preschool children. *Journal of Experimental Psychology*, 83(2), 111-130.

Ardila A, Rosselli M. Development of language, memory and visuospatial abilities in 5 to 12-year-old children using a neuropsychological battery. *Developmental Neuropsychology* 1994; 10: 97-120.

Azcoaga, J. (1997). Las funciones cerebrales superiores y sus alteraciones en el adulto y el niño. Buenos Aires, Argentina. Paidós.

Azcoaga, J., Peña, E., Eslava-Cobos, J., Mejía, L. (2008). Enfoque Neurofisiológico: fundamentos teóricos y metodológicos. In J. Eslava-Cobos, L. Mejía, L. Quintanar and Y. Solovieva (Eds.) *Los trastornos del aprendizaje: Perspectivas neuropsicológicas* (pp. 23-52). Bogota: Editorial Magisterio.

Bamberger, J. (2003). The development of intuitive musical understanding. *Psychology of Music*. 31 (1), 7-36.

Bamberger, J. (2006) What develops in musical development? In G. McPherson (Ed), *The child as musician: Musical development from conception to adolescence.* Oxford, U.K. Oxford University Press

Baxter, H. T., Berghofer, J. A., MacEwan, L., Nelson, J., Peters K., and Roberts, P (2007*). The Individualized Music Therapy Assessment Profile IMTAP*. London: Jessica Kingsley Publishers.

Bigand, E., Poulin-Charronnat, B. (2006). Are we experienced listeners? A review of the musical capacities that do not depend on formal music training. *Cognition*, 100, 100-130

Bittencourt-Chastinet, J., Morais, C., Solovieva, Y., Quintanar, L. (2012). Propuesta de adaptación de la prueba de abordaje Luriano "evaluación neuropsicológica infantil Puebla-Sevilla" para el idioma portugués. *Magis, Revista Internacional de Investigación en Educación*, 4 (9), 669-683.

Black, L.M., Stefanatos, G. (2000). Neuropsychological assessment of developmental and learning disorders. In ICDL Clinical practice guidelines (pp. 425-474). Retrieved from: http://www.icdl.com/bookstore/icdl-clinical-practice-guidelines.

Bolduc, J. & Montésinos-Gelet, I. (2005). Pitch awareness and phonological awareness. *Psychomusicology*, 19(1), 3-14.

Bowden, S.C., Petrauskas, V.M., Bardenhagen, F.J., Meade, C,E., Simpson, L.C. (2012). Exploring the Dimensionality of Digit Span. Assessment, 20(2), 188–198. DOI: 10.1177/1073191112457016

Boyle, G. J. (1991). Does item homogeneity indicate internal consistency or item redundancy in psychometric scales? *Personality and Individual Differences*, 12(3), 3291-294. doi:10.1016/0191-8869(91)90115-R

Brotons, M., Koger, S. (2000). The impact of Music Therapy on language functioning in dementia. *Journal of Music Therapy*, 37 (3).

Bruscia, K. (1991) Musical origins, Developmental foundations for music therapy. Proceedings of the annual conference of the Canadian Association of Music Therapy.

Bruscia, K. (1998). *Defining Music Therapy*. Gilsum, NH: Barcelona Publishers.

Caramazza, A., Coltheart, M. (2006). Cognitive Neuropsychology twenty years in. *Cognitive Neuropsychology*, 2006, 23 (1): 3-12.

Carpente, J.A. (2014). Individual Music-Centered Assessment Profile for Neurodevelopmental Disorders (IMCAP-ND): New Developments in Music-Centered Evaluation. *Music Therapy Perspectives*, 32(1): 56–60. https://doi.org/10.1093/mtp/miu005

Carpente, J.A. (2016). *Inter-rater Reliability on the Individual Music-Centered Assessment Profile for Neurodevelopmental Disorders (IMCAP-ND) for*

Autism Spectrum Disorder. Manuscript submitted for Publication. Molloy College.

Castles, A., Kohnen, S., Nickels, L., Brock, J. (2014). Developmental disorders: what can be learned from cognitive neuropsychology? *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 369: 20130407. http://dx.doi.org/10.1098/rstb.2013.0407

Chase, K. (2004) Music Therapy assessment for children with developmental disabilities: a survey study. *Journal of music therapy*, 24, 1, 28-54

Christensen, E. (2012). *Music Listening, Music Therapy, Phenomenology and Neuroscience*. Unpublished Doctoral Dissertation. Aalborg University, Denmark

Cohen, R. (2014). *The neuropsychology of attention.* New York: Springer Science+business media.

Costello, A., Osborne, J.W. (2005). Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most From Your Analysis. *Practical Assessment Research and Evaluation*, 10 (7). Retrieved from: http://pareonline.net/getvn.asp?v=10&n=7

Cross, I. (2005). Music and meaning, ambiguity and evolution. In Miell, D., MacDonald, R. and Hargreaves, D.J. (Eds.) *Musical Communication*. Oxford: Oxford University Press, 27-43.

Cubelli, R. (2007). The history of neuropsychology according to Norman Geschwind: continuity and discontinuity in the development of science. *Cortex,* 41 (2), 271-274.

Cubelli, R., De Bastiani, P. (2011). 150 years after Leborgne. Why is Paul Broca so important in the history of neuropsychology?. *Cortex*, 47, 146-147.

Dalla Bella, S., Peretz, I., Rousseau, L., & Gosselin, N. (2001). A developmental study of the affective value of tempo and mode in music. *Cognition*, 80(3), B1–B10.

Daveson, B. A., Magee, W. L., Crewe, L., Beaumont, G., Kenealy, P. (2007). The music therapy assessment tool for low awareness states. *International Journal of Therapy and Rehabilitation, 14* , 545-549.

Decuir, A. (2005). Statistical methods of analysis. In B. Wheeler (Ed.), *Music therapy research* (pp. 138-167). Gilsum, NH: Barcelona Publishers.

De Jong, R., Toffanin, P., Harbers, M. (2010). Dynamic crossmodal links revealed by steady-state responses in auditory–visual divided attention. *International Journal of Psychophysiology*. 75 (1), 3–15. doi:10.1016/j.ijpsycho.2009.09.01

DNP. (2010) Sistema Nacional de Evaluaciones.Evaluación de impacto programa Batuta. Informe Final. Unpublished final report. https://sinergia.dnp.gov.co/Sinergia/Archivos/27725fe5-a3ad-4008-ba27-711fa95864bc/Batuta_impactos.pdf

Fernandez, A.L. (2014). Neuropsicología de la atención. Conceptos, alteraciones y evaluación. Revista Argentina de Neuropsicología. 25, 1-28.

Finn, S. E., Tonsager, M. E. (1997). Information gathering and therapeutic models of assessment: complementary paradigms. *Psychological Assessment*, 9(4), 374–385.

Forgeard, M., Schlaug, G., Norton, A. (2008). The relation between music and phonological processing in normal reading children and children with dyslexia. *Music Perception*, 25, 383-390

Gattino, G.S. (2012). Musicoterapia aplicada a avaliacao da comunicacao nao verbal de criancas com transtornos do espectro autista: revisao sistematica e estudo de validacao. Published doctoral thesis. Universidade Federal do Rio Grande do Sul. Retrieved from http://hdl.handle.net/10183/56681

Gilbertson, S. (2005). Music therapy with people who have experienced traumatic brain injury: A literature review. In D. Aldridge: *Music therapy in neurological rehabilitation* (pp.83-138). London: Jessica Kingsley, Publishers

Glozman, J. (2002). La valoración cuantitativa de los datos de la Evaluación Neuropsicológica de Luria. *Revista Española de Neuropsicología*. 4 (2-3), 179-196

Glozman, J. (2007). A.R. Luria and the history of Russian Neuropsychology. *Journal of the History of the Neurosciences*, 16: 1-2, 168-180, DOI: 10.1080/09647040600550368

Gold, C., Rolvsjord, R.,Mössler, K., Stige, B. (2012). Reliability and validity of a scale to measure interest in music among clients in mental health care. *Psychology of Music*. 41(5) 665 –682. doi: 10.1177/0305735612441739

Gordon, E (1986). A factor analysis of the Musical Aptitude Profile, the primary measures of music audiation and the intermediate measures of music audiation. *Bulletin of the Council for Research in Music Education,* No. 87, 17-25.

Grahn, J., Brett, M. (2007). Rhythm and beat perception in motor areas of the brain. Journal of Cognitive Neurosciences, 19, 893–906.

Green, C., Chen, C.E., Helms, J.E., Henze, K.T. (2011). Recent reliability reporting practices in Psychological Assessment: Recognizing the people behind data. *Psychological Assessment*, 23 (3) pp. 656-669

Hail, Hopner, Fiorello (2002). Analizing digit span components for assessment of attention processes. Journal of psychoeducational assessment, 20, 128-143.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R. (2014). *Multivariate Data Analysis*. Essex: Pearson Education Limited

Hald, S. (2012). Music Therapy, Acquired Brain Injury and Interpersonal Communication Competencies: Randomized cross-over study on music therapy in neurological rehabilitation. Published Thesis Aalborg University. Retrieved from: http://vbn.aau.dk/en/publications/music-therapy-acquired-brain-injury-and-interpersonal-communication-competencies(e14888a8-706e-4942-8f21-f92638583185).html

Hallam, S. (2010). 21st century conceptions of musical ability. *Psychology of music*. 308-330

Hannon, E., Trainor, L. (2007). Music acquisition. Effects of enculturation and formal training on development. *Trends in cognitive science*, 11 (11), 466-472.

Hegde, S. (2014). Music-based cognitive remediation therapyfor patients with Traumatic Brain Injury [Review]. *Frontiers in Neurology,* 5, 34. doi: 103389/fneur.2014.00034

Heilman, K. M., Schwartz, H. D., & Watson, R. T. (1978). Hypoarousal in patients with the neglect syndrome and emotional indifference. *Neurology,* 28 (3), 229–232

Hopfinger, J., Parks, E (2012). Involuntary attention. In G. Mangun (Ed), *The neuroscience of attention: Attentional control and selection* (pp.30-53). doi: 10.1093/acprof:oso/9780195334364.001.0001

Humphreys, L. G. (1970). A skeptical look at the factor pure test. In C. E. Lunneborg (Ed.), Current problems and techniques in multivariate psychology:

Proceedings of a conference honoring Professor Paul Horst (pp. 23-32). Seattle: University of Washington.

Humphreys, L. G. (1981). The primary mental ability. In M. P. Friedman, J. P. Das

Humphreys, L. G. (1986). An analysis and evaluation of test and item bias in the prediction context. *Journal of Applied Psychology*, 71, 327-333

Izquierdo, I., Olea, J., Abad, F.J. (2014). Exploratory factor analysis in validation studies: Uses and recommendations. Psicothema, 26 (3), 395-400. doi: 10.7334/psicothema2013.349

Jacobsen, S.L, Wigram, T. (2007) Music therapy for the assessment of parental competencies for children in need of care. *Nordic Journal of Music Therapy*, 16 (2), 129-143

Jacobsen, S.L (2012). *Music Therapy Assessment and Development of Parental Competences in Families Where Children Have Experienced Emotional Neglect. An Investigation of the Reliability and Validity of the Tool Assessment of Parenting Competencies (APC*). Unpublished Doctoral Dissertation. Aalborg University, Denmark.

Jacobsen, S., Magee, W., Storm, S., Thomas, D., O'Kelly, J., Wosch, T., Waldon, E., Ala-Ruona, E. (2016). Music therapy assessment: Bridging gaps. *Nordic Journal of Music Therapy*, 25, 92.

Jackson, N.A. (2003) A survey of music therapy methods and their role in the treatment of early elementary school children with ADHD" *Journal of Music Therapy*, 40 (4), 302-323.

Janata, P., Tillmann, B., & Bharucha, J.J. (2002). Listening to polyphonic music recruits domain-general attention and working memory circuits. *Cognitive, Affective and Behavioral Neuroscience.* 2(2), 121-140.

Janata, P. (2009). Music and the self. In R. Haas and Brandes, V(Ed), *Music that works: Contributions of biology, neurobiology, psychology, sociology, medicine and musicology*. New York: Springer Science+business media.

Jeung, E. (2013). Psychometric Validation of a Music-Based Attention Assessment: Revised for Patients with Traumatic Brain Injury. *Journal of Music Therapy*, 50(2), 66–92.

Joyce, A., Hrin, S. (2015) Attention: An Evolving Construct, Applied Neuropsychology: Child, 4:2, 80-88, DOI: 10.1080/21622965.2015.1005476

Juslin, P.N., Sloboda, J.A. (Eds. 2010). *Handbook of Music and Emotion. Theory, Research, Applications*. Oxford: Oxford University Press.

Juslin, P.N., Sloboda, J.A. (2013). Music and Emotion. In D. Deutsch (Ed), *Psychology of Music*. London: Academic Press.

Kline, P. (1979) *Psychometrics and psychology*. London, UK: Academic Press

Koelsch, S., Fritz, T., Schulze, K., Alsop, D., Schlaug, G. (2005). Adults and children processing music: An fMRi study. *Neuroimage*, 25 pp. 1068-1076.

Koelsch, S. (2009). A neuroscientific perspective in Music Therapy. [Review]. Annals of the New York Academy of Sciences. 1179, 374-384. doi: 10.1111/j.1749-6632.2009.04592.x

Koelsch, S. (2011). Toward a neural basis of music perception: a review and updated model. *Frontiers in Psychology,* 2, 110. Doi: 10.3389/fpsyg.2011.00110

Koelsch, S. (2015). Music evoked emotions: principles, brain correlates and implications for therapy. Annals of the New York Academy of Sciences, 1337, 193-201. doi: 10.1111/nyas.12684

Kolb, B., Muhammad, A., Gibb, R. (2010) Searching for factors underlying cerebral plasticity in the normal and injured brain*, Journal of Communication Disorders*, 44 (5), 503-514.

Kossman, A. (2015). *An argument for collaborative therapeutic neuropsychological assessment: efficacy, research and patient-centeredness* (Doctoral Dissertation). Retrieved from Proquest Dissertations and Theses database (Proquest No. 3737805)

Knox, R., Yokota-Adachi, H., Kershner, J., Jutai, J (2003). Music Attention training program and alternating attention in brain injury: An initial report. *Music Therapy perspectives*, 21 (2), 99-104

Koziol, L.F., Joyce, A.W., Wurglitz, G. (2014) The Neuropsychology of Attention: Revisiting the "Mirsky Model", *Applied Neuropsychology: Child*, 3:4, 297-307, DOI: 10.1080/21622965.2013.870016

Kwak, E.E. (2007). Effect of rhythmic auditory stimulation on gait performance in children with spastic cerebral palsy. *Journal of Music Therapy,* 44 (3), 198-216

Landis JR, Koch GG. (1977) The measurement of observer agreement for categorical data. *Biometrics*, 33, pp.159-174

Leany, B., Benuto, L., Thaler, N. (2013),Neuropsychological Assessment with Hispanic clients. In L. Benuto (Ed), *Guide to psychological assessment with Hispanics*. New York: Springer Science+Busines Media

Levitin DJ, Menon V. (2003). Musical structure is processed in "language" areas of the brain: a possible role for Brodmann area 47 in temporal coherence. *Neuroimage*, 20:2142–52. DOI: 10.1016/j.neuroimage.2003.08.016

Levitin, D.J., Tirovolas, A.K. (2009). Current Advances in the cognitive neurosciences of music. [Review]. Annals of the New York Academy of Sciences. 1156, 211-231. doi: 10.1111/j.1749-6632.2009.04417.x

Levitin, D. (2012). What does it mean to be musical?. *Neuron,* 73, 633-637. doi: 10.1016/j.neuron.2012.01.017

Lichtensztejn, M., Machi, P., Lischinsky, A. (2014). Music Therapy and disorders of consciousness: Providing clinical data for differential diagnosis between vegetative state and minimally conscious state from music-centered Music Therapy and Neuroscience perspective. Music Therapy Perspectives, 32 (1), 47-55. Doi: https://doi.org/10.1093/mtp/miu001

Limb, CJ., Braun, AR. (2008) Neural Substrates of Spontaneous Musical Performance: An fMRI Study of Jazz Improvisation. *PLoS ONE* 3(2): e1679. doi:10.1371/journal.pone.0001679

Loewy, J. (2000). Music psychotherapy assessment. *Music Therapy Perspectives, 18,* 47–58.

Luo, D., Chen, G., Zen, F., & Murray, B. (2010). Modelling working memory tasks on the item level. *Intelligence, 38*,66-82.doi:10.1016/j.intell.2009.07.003

Luria, A. (1974). *The working brain*. New York: Basic Books.

Luria, A.R. (1979). *Atención y Memoria*. Moscú: Ediciones Universidad de Moscú

Lütz, J. (2012). The relationship between Music and Language. Frontiers in Psychology, 3:123. D09:103389/fpsyg.2012.00123

Magee, W. (2007). Development of a music therapy assessment tool for patients in low awareness states. *Neurorehabilitation 22*, 319-324

Magee, W.L., Lenton-Smith, G; Siegert, R.J., Daveson, BW; & O'Kelly, J. (2012) Music Therapy Assessment Tool For Low Awareness States (MATLAS): Establishing Reliability and Validity (Poster presentation). *Ninth World Congress in Brain Injury*, Edinburgh, March 21-25.

Magee, W. L., Siegert, R. J., Daveson, B. A., Lenton-Smith, G., Taylor, S. M. (2014). Music therapy assessment tool for awareness in disorders of consciousness (MATADOC): Standardisation of the principal subscale to assess awareness in patients with disorders of consciousness. *Neuropsychological Rehabilitation*, 24(1), 101–124. doi: 10.1080/09602011.2013.844174

Magee, W., Siegert, R., Taylor, S., Daveson, B., Lenton-Smith, G. (2016). Music Therapy Assessment Tool for Awareness in Disorders of Consciousness (MATADOC): Reliability and Validity of a Measure to Assess Awareness in Patients with Disorders of Consciousness. *Journal of Music Therapy,* 53 (1), 1-26. doi:10.1093/jmt/thv017

Magee, W., O'Kelly, J. (2015). Music Therapy with disorders of consciousness: current evidence and emergent evidence-based practice. *Annals of the New York Academy of Sciences*. 1337, 256-262. doi: 10.1111/nyas.12633

Mahone, E.M., Schneider, H.E. (2012). Assessment of attention in preschoolers. *Neuropsychology review,* 22 (4), 361-383. doi: 10.1007/s11065-012-9217-y

Mahoney, J. (2009). Interrater agreement on the Nordoff-Robbins evaluation scale I: Client therapist relationship in musical activities. *Music and Medicine*, 2 (1), 23-28. Retrieved from http://mmd.sagepub.com/cgi/doi/10.117/19438621093486167

Malegiannaki, A.C, Metallidou, P. (2017). Development of Attentional Functions in School-Age: Evidence from both Traditional and Computerized Tasks. *Journal of educational and developmental psychology*, 7 (1), pp. 42-51. Retrieved from http://dx.doi.org/10.5539/jedp.v7n1p42

Malloch, S., & Trevarthen, C. (2009). *Communicative musicality : exploring the basis of human companionship.* Oxford ; New York: Oxford University Press.

Maroof, D.A. (2012) *Statistical Methods in Neuropsychology: Common Procedures Made Comprehensible*. USA: Springer. DOI 10.1007/978-1-4614-3417-7_2

Matute, E., Rosselli, M., Ardila, A., Ostrosky-Solis, F. (2007) *Evaluación neuropsicológica Infantil*. México: Manual Moderno

Matute, E., Rosselli, M., Ardila, A. (2014). *Manual Evaluación Neuropsicológica Infantil (ENI)*. México: Manual Moderno.

Matute, E., Rosselli, M., Ardila, A. (2010). Evaluación Neuropsicológica Infantil. In M. Rosselli, E. Matute and A. Ardila (Eds.) *Neuropsicología del Desarrollo Infantil* (pp. 71-119). México: Manual Moderno

McDermott, O., Orgetta, V., Ridder, H.M., Orell, M. (2014). A preliminary evaluation of the psychometric properties of Music in Dementia Assessment Scales (MiDAS). *International Psychogeriatrics*, 26 (6), 1011-1019. doi:10.1017/S1041610214000180

McDermott, O., Orell, M., Ridder, H.M. (2014). The development of Music in Dementia Assessment Scales (MiDAS). *Nordic Journal of Music Therapy*, 24 (3), 232, 251. Doi: 10.1080/08098131.2014.907333

Meadows, T., Wheeler, B., Shultis, C., Polen, D. (2005). Client Assessment. In B. Wheeler, C. Shultis and D. Polen (Eds), *Clinical training guide for the student music therapist (pp. 27-56*). Gilsum, NH: Barcelona Publishers

Meltzer, B., Reichenbach, Ch.S., Braiman, Ch., Schiff, N., Hudspeth, A.J., Reichenbach, T. (2015) The steady-state response of the cerebral cortex to the beat of music reflects both the comprehension of music and attention. *Frontiers in Human Neuroscience*. 9, 1-11. Doi: 10.3389/fnhum.2015.00436.

Meyer, J.P. (2010). *Understanding measurement: Reliability.* Oxford Scholarchip Online. DOI: 10.1093/acprof:oso/9780195380361.001.0001

Mirsky, A. (1989). Neuropsychology of attention: Elements of a complex behavior. In E. Perecman (Ed.), *Integrating theory and practice in clinical neuropsychology* (Vol. xxviii). Hillsdale, NJ: Lawrence Erlbaum.

Mirsky, A. F., Anthony, B. J., Duncan, C. C., Ahearn, M. B., & Kellam, S. G. (1991). Analysis of the elements of attention: a neuropsychological approach. *Neuropsychology Review*, 2 (2), 109–145

Mirsky, A. F., & Duncan, C. C. (2004). The attention battery for children: A systematic approach to assessment. In G. Goldstein, S. R. Beers, & M.

Hersen (Eds.), Comprehensive handbook of psychological assessment (pp. 277–292). Hoboken, N.J.: John Wiley & Sons.

Mirsky, A. F., Fantie, B., & Tatman, J. (1995). Assessment of attention across the lifespan. In R. L. Mapou & J. Spector (Eds.), Neuropsychological assessment: A clinical approach (pp. 17–48). New York, NY: Plenum

Mitrushina, M., Boone, K.B., Razani, J., D'Elia, L.F. (2005). *Handbook of normative data for Neuropsychological assessment.* New York: Oxford University Press

Moreau, D., Ellgring, H., Goth, K., Poustka, F., Aldridge, D. (2009). Psychometric results of the music therapy scale (MAKS) for measuring expression and communication. *Music and Medicine*, 2 (1), 41-47. Retrieved from http://mmd.sagepub.com/cgi/doi/10.1177/1943862109356927

Nan Y., Knösche T.R., Zysset S., Friederici A.D., Friedend A.D. Cross-cultural music phrase processing: an fMRI study. *Human Brain Mapping*. 2008;29:312–328. DOI: 10.1002/hbm.20390

O'Kelly, J., Magee, W. (2013): The complementary role of music therapy in the detection of awareness in disorders of consciousness: An audit of concurrent SMART and MATADOC assessments, *Neuropsychological Rehabilitation: An International Journa*l, DOI:10.1080/09602011.2012.753395

O'Kelly, J., Bodak, R. (2016). Development of the Music Therapy Assessment tool for advanced Huntington's Disease: A Pilot validation study. Journal of Music Therapy, 53 (3), 232-256. doi:10.1093/jmt/thw006

Oldfield, A. (2006). *Interactive music therapy in child and family psychiatry.* London, UK: Jessica Kingsley Publishers.

Ostrosky-Solís F., Ardila, A., Rosselli, M (1999). NEUROPSI: A brief neuropsychological test battery in Spanish with norms by age and educational level. *International Journal of Neuropsychology*, 5, 413-433

Ouimet, T., Foster, N.E.V., Hyde, K.L. (2012). Auditory global-local processing: effects of attention and musical experience. *Journal of the Acoustical Society of America*. 132, 2536-2544. Retrieved from: http://dx.doi.org/10.1121/1.4747009

Pasiali, V., La Gasse, A.B., Penn, S.L. (2014). The Effect of Musical Attention Control Training (MACT) on Attention Skills of Adolescents with

Neurodevelopmental Delays: A Pilot Study. *Journal of Music Therapy*. 51(4), 333-354. doi:10.1093/jmt/thu030

Patel, A. (2003). Language, music, syntax and the brain. *Natural Neurosciences*, 6, 674-681.

Patel, A.D (2008). *Music, Language and the brain*. New York: Oxford University Press

Pavlicevic, M. (2007). The Music Interaction Rating Scale (Schizophrenia;MIR(S)): Microanalysis of co-improvisation in music therapy with adults suffering from chronic schizophrenia. In T. Wosch & T. Wigram (Eds.), *Microanalysis in music therapy: Methods, techniques and applications for clinicians, researchers, educators and students* (pp. 174–185). London, UK: Jessica Kingsley Publishers.

Plahl, C. (2007). Microanalysis of preverbal communication in Music Therapy. In T., Wosch, and T., Wigram, T.: *Microanalysis in Music Therapy: Methods, techniques and applications for clinicians, researchers, educators and students*. London: Jessica Kingsley Publishers.

Peretz, I., Coltheart, M. (2003). Modularity of Music Processing. *Nature Neuroscience*, 6 (7), pp. 688-691

Peretz, I., Radeau, M., Arguin, M. (2004). Two way interactions between music and language: Evidence from priming recognition of tune and lyrics in familiar songs. *Memory and cognition*, 32 (1), pp. 142-152.

Peretz, I., Zatorre, R. (2005). Brain organization for music processing. *Annual review of psychology*, 56, pp.89-114

Peretz, I. (2006). The nature of music from a biological perspective. *Cognition*, 100, pp. 1-32. doi: 10.1016/j.cognition.2005.11.004

Perani, D., Saccuman, M.C., Scifo, P., Spada, D., Andreolli, G., Rovelli, R., Baldoli, C., Koelsch, S. (2010). Functional Specializations for music processing in newborn brain. Proceedings of the National Academy of Sciences of the United States of America, 107 (10), 4758-4763. Retrieved from: http://www.jstor.org/stable/25664871?seq=1#page_scan_tab_contents

Pett, M.A., Lackey, N.R., Sullivan, J.J. (2003). *Making Sense of Factor Analysis: The Use of Factor Analysis for Instrument Development in Health Care Research*. California: Sage Publications

Posner MI, Petersen SE. (1990) The attention system of the human brain. *Annual Review Neurosciences*, 13, 25–42. DOI: 10.1146/annurev.ne.13.030190.000325

Poutanen, M., Berg, S., Kangas, T., Peltomaa, K., Lahti-Nuuttila, P. & Hokkanen, L. (2016). Before and after entering school: The development of attention and executive functions from 6 to 8 years in Finnish children. Scandinavian Journal of Psychology, 57,1–11.

Pozuelos, J.P., Paz-Alonso, P.M., Castillo, A., Fuentes, L.J., Rueda, M.R. (2014) Development of attention networks and their interactions in childhood. *Developmental Psychology,*50 (10), 2405-2415. doi: 10.1037/a0037469.

Pratt, R.B., Abel, H., Skidmore J. (1996). The effects of neurofeedback training with background music on EEG patterns of ADD and ADHD children. *IJAM: International Journal of Arts Medicine*, 4 (1), 24-31.

Pribram, K., McGuinness, D. (1975). Arousal, activation, and effort in the control of attention. *Psychological review*, 82 (2), 116–149.

Prickett, C. (2005). Principles of quantitative research. In B. Wheeler (Ed.), *Music therapy research* (pp. 45–58). Gilsum, NH: Barcelona publishers.

Quintanar, L. Solovieva, Y (2003) *Manual de Evaluación Neuropsicológica infantil*. México: Editorial Benemérita Universidad Autónoma de Puebla.

Quintanar, L., Solovieva, Y., Lázaro, E. (2008) Evaluación neuropsicológica infantil breve para población hispano-parlante. *Acta Neurológica Colombia*; 24, 31-44).

Quintanar, L., Solovieva, Y., Lázaro, E., Bonilla, M. (2008). Los trastornos del aprendizaje: aproximación histórico-cultural: Fundamentos teórico-metodológicos. In J. Eslava-Cobos, L. Mejía, L. Quintanar and Y. Solovieva (Eds.) *Los trastornos del aprendizaje: Perspectivas neuropsicológicas* (pp. 143-172). Bogota: Editorial Magisterio

Rauscher, F.H., Shaw, G.L., Levine, L.J., Wright, E.L., Dennis, W.R., Newcomb, R.L. (1997). Music training causes long-term enhancement of preschool children's reasoning. *Neurological Research*, 19, 2-8.

Reigosa, V., Yañez, G., Uribe, C.M. (2008). Los trastornos del aprendizaje: Aproximación Cognoscitiva: Fundamentos teórico-metodológicos. En In J. Eslava-Cobos, L. Mejía, L. Quintanar and Y. Solovieva (Eds.) *Los trastornos*

del aprendizaje: Perspectivas neuropsicológicas (pp. 267-301). Bogota: Editorial Magisterio

Riccio, C.A., Sullivan, J.R., Cohen, M.J. (2012). Neuropsychological assessment and intervention for childhood and adolescent disorders. Doi: 10.1002/9781118269954

Rickson, D.J. (2006) Instructional and improvisational models of music therapy with adolescents who have attention deficit hyperactivity disorder (ADHD): a comparison of the effects on motor impulsivity". *Journal of Music Therap*y, 43 (1), pp. 39-62.

Robb, S.L. (2003). Music interventions and group participation skills of preschoolers with visual impairments: raising questions about music, arousal and attention. *Journal of Music Therapy,* 40, pp. 266-282.

Robson, C. & McCartan, K, (2016). Real World Research (4th ed.). Chichester: John Wiley.

Rosselli-Cock, M., Matute-Villaseñor, E., Ardila-Ardila, A., Botero-Gómez, V.E., Tangarife-Salazar, E.A., Echeverría- Pulido, S.E., Arbeláez-Giraldo, C., Mejía-Quintero, M., Méndez, L.C., Villa-Hurtado, P.C., Ocampo-Agudelo, P. (2004). Evaluación Neuropsicológica Infantil: Una batería para la evaluación de niños entre los 5 y 16 años de edad. Estudio Normativo Colombiano. Revista de Neurología. 38 (8), 720-731.

Rosselli, M., Matute, E., Ardila, A. (2013). Assessing Developmental Learning and Communication Disorders in Hispanic Children: A Neuropsychological Perspective. In L. Benuto (Ed), *Guide to psychological assessment with Hispanics*. New York: Springer Science+Busines Media

Sabatella, P. E. (2004) Assessment And Clinical Evaluation In Music Therapy: an Overview From Literature And Clinical Practice. *Music Therapy Today* , 5(1), Retrieved from http://www.wfmt.info/Musictherapyworld/modules/mmmagazine/issues/20031217133549/20031217134056/MTT5_1_Sabbatella.pdf.

Saupe, K., Widmann, A., Bendixen, A., Müller, M. M., and Schröger, E. (2009). Effects of intermodal attention on the auditory steady-state response and the event-related potential. *Psychophysiology* 46, 321–327. doi: 10.1111/j.1469-8986.2008.00765.x

Saupe, K., Widmann, A., Trujillo-Barreto, N., Schröger, E. (2013). Sensorial suppression of self-generated sounds and its dependence on attention.

International Journal of Psychophysiology. 90, 300–310. doi:10.1016/j.ijpsycho.2013.09.006

Schnakers, C., Magee, W.L., and Harris, B. (2016) Sensory Stimulation and MusicTherapy Programs for Treating Disorders of Consciousness. Frontiers in Psychology, 7:297. doi: 10.3389/fpsyg.2016.00297

Schön, D., Boyer, M., Moreno, S., Besson, M., Peretz, I., Kolinsky, R. (2008). Songs as an aid for language acquisition. *Cognition*, 106, 975-983.

Schulze, K., Koelsch, S. (2012) Working memory for speech and music. Annals of the New York Academy of Sciences. 1252, 229-236. Doi: 10.1111/j.1749-6632.2012.06447.x

Soprano, A.M. (2009). *Cómo evaluar la atención y las funciones ejecutivas en niños y adolescentes*. Buenos Aires, Argentina: Editorial Paidós

Spielmann, M.I., Schröger, E., Kotz, S., Bendixen, A. (2014). Attention effects on auditory scene analysis: insights from event-related brain potentials. *Psychological Research,* 78: 361-378. doi:10.1007/s00426-014-0547-7

Spikman, J., Van Zomeren, E. (2010). Assessment of attention. In J. Gurd, U., Kischka and J. Marshall (Eds), *The handbook of clinical neuropsychology*. doi: 10.1093/acprof:oso/9780199234110.001.0001

Strait, D. L., Kraus, N., Parbery-Clark, A., Ashley, R. (2010). Musical experience shapes top-down auditory mechanisms: Evidence from masking and auditory attention performance. *Hearing Research*, 261, 22–29. doi: 10.1016/j.heares.2009.12.021

Stuss, D. T., & Levine, B. (2002). Adult Clinical Neuropsychology, Lessons from studies of the Frontal Lobes. Annual Review of Psychology, 53, 401-403.

Tang, W., Cui, Y., Babenko, O. (2014). Internal Consistency: Do We Really Know What It Is and How to Assess It?. *Journal of Psychology and Behavioral Science,* 2 (2), pp. 205-220.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, *2*, 53–55. http://doi.org/10.5116/ijme.4dfb.8dfd

Thaut, M.H. (2005). *Rhythm, Music, and the Brain: scientific foundations and applications*. New York: Routledge.

Thaut, M. H., Gardiner, J. C., Holmberg, D., Horwitz, J., Kent, L., Andrews, G., McIntosh, G. R. (2009). Neurologic music therapy improves executive function and emotional adjustment in traumatic brain injury rehabilitation. *Annals of the New York Academy of Sciences*, 1169, 406–416. doi: 10.1111/j.1749-6632.2009.04585.x

Thaut, M.H., Gardiner, J.C. (2014). Musical attention control training. In M.H Thaut and V. Hoemberg (Eds), *Handbook of Neurologic Music Therapy* (pp. 257-269). Oxford: Oxford University Press

Tillman, B., Janata, P., & Bharucha, J.J. (2003). Activation of the inferior frontal cortex in musical priming. *Cognitive Brain Research*, 16, 143-161.

Tillman, B. (2012). Music and Language Perception: expectations, structural integration, and cognitive sequencing. *Topics in Cognitive Sciences*.4, 568-584. doi: 10.1111/j.1756-8765.2012.01209.x

Tirovolas, A.K., Levitin, D.J. (2011). Music perception and cognition research from 1983 to 2010: a categorical and bibliometrical analysis of empirical articles on *Music perception. Music Perception,* 29 (1), 23-36.doi: 10.1525/m p .2011.29.1.23

Trehub, S. (2003) The developmental origins of musicality. *Nature Neuroscience*, 6 (7), 669-673

Urzúa, A., Ramos, M., Alday, C., Alquinta, A. (2010). Neuropsychological maturity in preschool children: psychometric properties of CUMANIN test. *Terapia Psicológica*. 28, (1), 13-25.

Van Prooijen, J.W., Van der Kloot, W. (2001). Confirmatory analysis of exploratively obtained factor structures. *Educational and Pyschological Measurement*, 61 (5), 777-792. DOI: 10.1177/00131640121971518

Vanderploeg, R (2009). *Clinician's guide to neuropsychological assessment.* USA: LEA

Vigotsky, L.S. (1995). *Obras escogidas, Tomo III*. Madrid: Visor

Vogiatzoglou, A et al. (2011). Sounds of intent: interactive software to assess the musical development of children and young people with complex needs. *Music and Medicine*, 3 (3), 189-195.

Wainer, H., Bradlow, E.T, Wang, X. (2007). *Testlet Response Theory and Its Applications.* Cambridge Unviersity Press.

Wan, C., Schlaug, G. (2010). Music Making as a Tool for Promoting Brain Plasticity across the Life Span. *Neuroscientist*, 16(5), 566–577.

Waldon, E.G., Broadhurst, E.H. (2014). Construct validity and reliability of the music attentiveness Screening Assessment (MASA). Journal of Music Therapy, 51, 154-170. doi: 10.1093/jmt/thu008

Waldon, E., Lesser, A., Weeden, L., Messik, E. (2016). The Music Attentiveness Screening Assessment Revised (MASA-R): A Study of technical adequacy. Journal of Music Therapy, 53 (1), 75-92. doi:10.1093/jmt/thv021

Wassenberg, R., Hendriksen, J.G.M., Hurks, P.P.M., Feron, F.J.M., Keulers, E.H.H., Vles, J. S. H., Jolles, J. (2008). Development of inattention, impulsivity, and processing speed as measured by the d2 test: Results of a large cross-sectional study in children aged 7-13. *Child Neuropsychology*, *14*, 195-210. Retrieved from https://dx.doi.org/10.1080/09297040601187940

Wheeler, B. L. Shultis, C, L., & Polen Donna W. (2005). *Clinical training guide for the student music therapist*. Gilsum, NH: Barcelona Publishers

Wigram, T (1999). Assessment Methods in Music Therapy. A humanistic or Natural Science Framework?. *Nordic Journal of Music Therapy*, 8 (1), 6-24. http://dx.doi.org.zorac.aub.aau.dk/10.1080/08098139909477950

Wigram, T.A (2000). Method of music therapy assessment for the diagnosis of autism and communication disorders in children. *Music Therapy Perspectives*. 18, (1),13–22.

Wigram, T., Pedersen, I. N., & Bonde, L. O (2002). *A comprehensive guide to music therapy*. London, UK: Jessica Kingsley Publishers.

Wigram, T., Wosch, T (2007). Microanalysis in music therapy: A comparison of different models and methods and their application in clinical practice, research and teaching music therapy. In T. Wosch, & T. Wigram (Eds.), *Microanalysis in music therapy* (pp. 298–315). London, UK: Jessica Kingsley Publishers.

Wilmes, K. (2010). The methodological and statistical foundations of neuropsychological assessment. In . In J. Gurd, U., Kischka and J. Marshall (Eds), The handbook of clinical neuropsychology. doi: 10.1093/acprof:oso/9780199234110.001.0001

Wilson, B., & Smith, D. (2000). Music therapy assessment in school settings: A preliminary investigation. *Journal of Music Therapy, 37,* 95–117.

Wolfe, D. E., & Noguchi, L. K. (2009). The use of music with young children to improve sustained attention during a vigilance task in the presence of auditory distractions. Journal of Music Therapy, 46, 69–82. doi:10.1093/jmt/46.1.69

Wolfe, D.E., Waldon, E. G. (2009). *Music Therapy and pediatric medicine: A guide to skill development and clinical intervention*. Silver Spring, MD: American Music Therapy Association

Xomskaya, E. (2002). El problema de los factores en la Neuropsicología. Revista Española de Neuropsicología, 4, 151-167.

Yong, G., Pierce, S. (2013). A beginner's guide to Factor Analysis. Focusing on Exploratory Analysis. *Tutorials in Quantitative Methods for Psychology,* 9(2), p. 79-94. DOI: 10.20982/tqmp.09.2.p079

Zhu, L., Xia, J., Shinn-Cunningham, S. (2011). Relationship between selective auditory attention and brainstem encoding musicians and non-musicians. Journal of the acoustical society of America. 129. Retreived from: http://dx.doi.org.zorac.aub.aau.dk/10.1121/1.3588214

APPENDICES

Appendix A. Approval from ethics committee Aalborg University

AALBORG UNIVERSITET

Faculty of Humanities' Human Research Ethics Board (HREB)

Prof. Hanne Mette Ochsner Ridder (interim chair)
Aalborg University, Kroghstræde 3, 9220 Aalborg, Denmark
http://www.etikudvalg.hum.aau.dk/

The Human Research Ehtics Board (HREB) at the Faculty of Humanities, Aalborg University, was founded January 1, 2009, in response to researchers' wish for advance ethical evaluation of projects that fall below the threshold of the Regional Ethical Committee of North Jutland and thus had no means of obtaining independent ethical review and advice before carring out the research project.

HREB # 201401
Ethical approval

HREB has evaluated the ethics application from Juanita Eslava entitled *Development and pilot study of a Music Therapy Attention Profile of Children at school age*. The project is found to be a low-risk research project with adequate ethical considerations taken into account and has been approved by the Human Research Ethics Board at Aalborg University.

Ethical approval granted

Date: December 12, 2014

Signature: Hanne Mette Ochsner Ridder

Appendix B. Participants consent form

AALBORG UNIVERSITET

DEPARTMENT OF COMMUNICATION AND PSYCHOLOGY

DOCTORAL PROGRAMME IN MUSIC THERAPY
http://www.mt-phd.aau.dk/

TO THE HUMAN RESEARCH ETHICS BOARD,

FACULTY OF HUMANITIES,

AALBORG UNIVERSITY

Overskrift /about: Consent form Research project Juanita Eslava-Mejia

CONSENT FORM

Your child (or the child you are legal guardian to), has been invited to be a participant in the research study "Pilot study of a Music Therapy Attention profile of Children". This study is part of the PhD project of Juanita Eslava-Mejía, a student in the doctoral programme in Music Therapy at Aalborg University.

Purpose of the study

Attention is a very important function in child development. Consequently, different ways of evaluating attention are used by neuropsychologists. Most of them are standardized tests.

The aim of this study, is to establish how valid and useful is the Music Therapy Attention Profile (MTAP). This is a tool designed by the student with the objective of exploring other approaches to assessment of attention from different disciplines, in a way that could provide reliable new information about child's attention.

Your child's participation in the study

As part of the study, the tool would be administered to a total of 60-80 children ages 6 to 9 years old (with no previous diagnosis of any neurological or neuropsychological disorder), that have been referred to Neuropsychological Assessment in Institutions in Colombia, Argentina, and Chile.

Your child's results on the Music Therapy attention Profile, will be compared with the results of the neuropsychological assessment, looking for similarities and differences on the findings of the two tools. This comparison will help us to establish if the tool is valid, and what new information can give us.

As a participant in this study, your child will be asked to attend a session, where the assessment tool Music Therapy Attention Profile will be administered to him/her. During the session, the child will be ask to sing with the therapist some songs that he/she knows, respond to or learn songs he does not know, make movements to the rhythm of music, play musical instruments, and invent songs in the moment. The approximate duration of the session is 1 hour. If the music therapist leading the session, observes that the child is getting too tired during the session, he/she will finish the session, and give you a new appointment for a session to finish the assessment.

A written report of the results of the assessment will be given to you. Please keep in mind, that this tool is in the process of establishing its validity. Therefore results of the assessment only depict the reality of what was observed during the session (s). If you wish, you can have a meeting between you (as a parent or legal guardian of the child), and the music therapist, so that the music therapist can give you an oral report of the results.

Possible benefits of participating in the study include: gain new insight into the child's attention skills as presented in the music therapy session, obtain information regarding the strategies that help the child to complete tasks related with attention, such strategies potentially could be used within the family and academic environment framework. There are no identified potential risks of participating in the study. Child could get tired from participating in the session. When a child is exhibiting signs of tiredness, the music therapist will finish the session and schedule a new session to finish the assessment.

The music therapist carrying out the music therapy assessment, is a trained Music Therapist, recognized by the local Music Therapy Associations and has at least 2 years of professional experience. He/she will also be your contact for the study in your country.

Materials and confidentiality

Your child's identity will be protected using the following procedure: Once a participant enter the study, a code is assigned to all the materials (assessment results)

from the participant. A file is created with the names of the participants and the correspondent code. The file will be kept in a locked cabinet in the researcher's office. Only in this file, the child's name will appear. Access to this file is only for the researcher and the music therapist in the country. In all other files related with the research, the code will be used for identification of participants.

The music therapist administering the assessment, has access to your child's name in order to be able to conduct the session. However, when reporting the results, the music therapists will use the code previously mentioned.

Other expert Music Therapists will be ask to review some of the videos of the assessments, so that they can provide a rating for them. They don't have access to your child's information. Only to the coded video of the assessment administration. The videos will be shared with the experts using private youtube. These means that the videos are only accessible for authorized viewers (the researcher, the music therapists administering the assessments and the external expert Music Therapists).

All materials will be disposed 4 years and 11 months after finishing the study.

All music therapists involved in the research have signed a form commiting to protect your child's materials and maintain confidentiality.

As part of the study, you are being asked to give permission to the Neuropsychologist assessing your child, to share the results of the Neuropsychological assessment with the principal researcher. These results will be used to make comparisons between the results of the Music Therapy Attention Profile and the neuropsychological tool.

Once the results of the Neuropsychological assessment are received by the researcher, your child's identity is replaced by the code that was assigned to him/her once he/she entered the study to ensure confidentiality. The comparisons will help the researcher to: establish if the tool design is good, clarify if it measures what it is intended to measure, understand better how attention mechanisms unfold in music therapy.

Coded results from the Neuropsychological assessment and the Music Therapy assessment will be kept in a locked cabinet in the researcher's office (different from the cabinet containing the codes file).

Results of this research will be presented in academic settings, and could be published in academic journals. In all these scenarios, your child's identity will not be revealed.

Video recording

Sessions will be videotaped, so that the materials can be reviewed by the researcher to ensure the assessments were administered in the same way, with few variations, as

this is very important for the study. As mentioned above some recordings will be sent to a group of expert Music Therapists for them to rate the assessment.

Some selected video fragments of some sessions, could be used for education purposes, including PhD course presentations, conferences and seminars, to exemplify the use of the assessment tool. In such cases, your child's face and name, could be identifiable. You can decide whether you want to grant permission for using the videos for education purposes, by tickling the correspondent box at the end of this form.

Withdrawing from the study

Participation in this study is voluntary, and you may withdraw your child from the study at any time without prejudice. At the time of withdrawal all files of your child's participation in the study will be deleted. Withdrawal from the study will have no consequences on the services from the institution providing the neuropsychological assessment.

Your child will be questioned for his oral assent to participate in the study.

If you have any doubts, or comments, you can communicate with the music therapists in charge in your country:

Argentina: _____

Chile:_____

Colombia: _____

Appendix C. Assessment administrator consent

AALBORG UNIVERSITET

TO THE HUMAN RESEARCH ETHICS BOARD,

FACULTY OF HUMANITIES,

AALBORG UNIVERSITY

DEPARTMENT OF COMMUNICATION AND PSYCHOLOGY

DOCTORAL PROGRAMME IN MUSIC THERAPY
http://www.mt-phd.aau.dk/

Overskrift /about: Therapist's Consent form Research project Juanita Eslava-Mejia

You have been invited to be one of the music therapist, for the research study "Pilot study of a Music Therapy Attention profile of Children". This study is part of the PhD project of Juanita Eslava-Mejía, a student in the PhD Music Therapy program at Aalborg University.

The study

The aim of the study, is to establish the validity and usefulness of the Music Therapy Attention Profile, which is a tool designed by the student. As part of this process, the tool would be administered to a total of 60-80 children ages 6 to 9 years old (with no previous diagnosis of any neurological or neuropsychological disorder), that have been referred to Neuropsychological Assessment in Institutions in Colombia, Argentina, and Chile. Results from the Music Therapy Attention Profile, will be compared with the results from the neuropsychological assessment, to establish whether or not, the tool is valid for characterizing attention of a child in Music Therapy.

Your role

As a music therapist involved in the study, you will be ask to receive and study the assessment materials (manual and videos), and participate in skype meetings with the researcher.

You will keep contact with the institution making referrals for the study in your country, receive referral information, and contact potential participants (if you are the Music Therapist for the Institution. If not, potential participants will contact you). After consent is granted from participant's parents or legal guardians, and assent is granted from the child, you will be administering the Music Therapy attention profile to children participating in the study.

After the assessment is complete, you will give the parent or legal guardian a written report of the results of the assessment. If the parent requests an oral report, you will schedule a meeting with the parents (or legal guardian) of the child, with that purpose.

Confidentiality of materials

You are bound to keep the child's information confidential. Following inclusion in the study, a code will be assigned to the child, and you will use that code when handling all materials. You will only share the materials with the researcher. Results of the assessments will be kept by the researcher in a locked cabinet in her office, and will be kept for 4 years and 11 months after finishing the study.

Video recordings

Assessment sessions will be videotape, so that the researcher can ensure the assessments were administered in the same way, with few variations, as this is very important for the validity of the results.

Some of the videos will be sent to a group of expert Music Therapists for them to provide independent ratings of the assessment, for a procedure call inter-rater reliability. They will only be providing ratings for the child's performance in the assessment.

Videos will be shared using unlisted youtube, meaning that only authorized people have access to the files (researcher, clinicians administering the music therapy assessment and music therapy experts)

Results of this research will be presented in academic settings, and could be published in academic journals. In all these scenarios, your identity will not be revealed.

Some selected video fragments of some sessions, could be used for education purposes, including PhD course presentations, conferences and seminars, to exemplify the use of the assessment tool. In such cases, your face and name, could be identifiable.

Videos will also be disposed after 4 years and 11 months after finishing the study.

Use of your information

Some personal information about yourself such as: years of experience, type of music therapy training, could be included as data for the study. This will be done, so that researcher can assess, whether some of these characteristics have any implications on the assessment administration. From this information, given that Music Therapy is not such a large community in your country, some people could depict your identity.

Retribution

A small fee of 20 USD (this will be expressed in the currency for each country, to comply with country's regulations) per assessment will be paid to you, as a retribution for your time dedication. A varying number from 5 to 20 assessments will be conducted by you, depending on the number of children meeting the inclusion criteria, referred to the institution in your country,

If you have any doubts, or comments, you can communicate with the student researcher (she is the primary contact) directly in the following e-mail address:

Juanita@hum.aau.dk

If you have concerns that you need to communicate to the student's supervisor, you may contact Ulla Holck, e-mail: holck@hum.aau.dk

I _____identified with ID_____ declare that I have read this form thoroughly and my questions regarding the study have been satisfactory responded.

In light of this I:

_____ accept to be a Music Therapist administering the tool for the study

I give permission to the researcher to use the personal information mentioned above as data for the research study. YES____ NO _____

I give permission for video recording the administration of the tool to children in my country for research purposes. YES _____ NO _____

I give permission to the researcher to use video recordings for education purposes, including PhD course presentations, conferences and seminars, to exemplify the use of the assessment tool. YES____ NO_____

Signature:

ID:

Appendix D. Raters Consent form

AALBORG UNIVERSITET

DEPARTMENT OF COMMUNICATION AND PSYCHOLOGY

DOCTORAL PROGRAMME IN MUSIC THERAPY
http://www.mt-phd.aau.dk/

TO THE HUMAN RESEARCH ETHICS BOARD,

FACULTY OF HUMANITIES,

AALBORG UNIVERSITY

Overskrift /about: Expert Consent form Research project Juanita Eslava-Mejia

You have been invited to be one of the expert music therapists, for the research study **"Pilot study of a Music Therapy Attention profile of Children".** This study is part of the PhD project of Juanita Eslava-Mejía, a student in the PhD Music Therapy program at Aalborg University.

The study

The aim of the study, is to establish the validity and usefulness of the Music Therapy Attention Profile, which is a tool designed by the student. As part of this process, the tool would be administered to a total of 60-80 children ages 6 to 9 years old (with no previous diagnosis of any neurological or neuropsychological disorder), that have been referred to Neuropsychological Assessment in Institutions in Colombia, Argentina, and Chile. Results from the Music Therapy Attention Profile, will be compared with the results from the neuropsychological assessment, to establish whether or not, the tool is valid for characterizing attention of a child in Music Therapy.

Your role

As an expert music therapist involved in the study, you will be ask to receive videos of assessments administered to participants of the study, and rate them according to the parameters of the tool. You will receive a copy of the assessment administration instructions along with the videos. The rating of each assessment should take you approximately 2-3 hours. A maximum of 5 assessments will be sent to you.

You will send your ratings (using the formats included in the Assessment, and the code of the video) to the principal researcher to the e-mail provided below.

Confidentiality of materials

You are bound to protect confidentiality of the videos. Materials will be shared with you using private youtube, meaning that only authorized people will have access to it (reseacher, clinicians administering the assessment and expert music therapists such as yourself). We kindly ask you that you review the video materials in a private place.

You must not download the videos for purposes different than the study. You must not distribute them or show them to others.

After sending the results of your rating to the principal researcher you must delete the files from your device.

All videos will be disposed 4 years and 11 months after finishing the study

Use of your material

The ratings you send to the principal researcher, will be include in a database where you will be assigned a code, and your materials will be placed under that code. The list of codes will be kept in a locked cabinet in the researcher's office, and the files with the coded ratings will be kept in a different locked cabinet in the same office.

The ratings will be used to establish inter-rater reliability of the assessment.

If you have any doubts, or comments, you can communicate with the student researcher (she is the primary contact) directly in the following e-mail address:

Juanita@hum.aau.dk

If you have concerns that you need to communicate to the student's supervisor, you may contact Ulla Holck, e-mail: holck@hum.aau.dk

I _____identified with ID_____ declare that I have read this form thoroughly and my questions regarding the study have been satisfactory responded.

In light of this I:

_____ accept to be an Expert Music Therapist rating videos of the administration of the tool

_____ understand that I must protect confidentiality of the materials, and that I can not download the videos for my own personal use.

_____ agree to review the videos in a private space where others will not be able to see the video, and to delete the files once the principal researcher has received my ratings

I give permission to use ratings I send as data material for the research study. YES____ NO_____

Signature:

ID:

Appendix E. Changes from APMT version 1 to APMT version 2

According to Pilot A implementation and feedback from expert music therapists, neuropsychologists, PhD supervisors and Aalborg students and professors, several changes were introduced on version 2 of the APMT.

Some tasks were completely re-designed. Others were excluded and new tasks were also designed and included. Additionally, changes on the scoring system (in the number of choices, and on the frequency of presentation were also part of the transition process.

TASK	DESCRIPTION OF THE ORIGINAL ITEM	CHANGES INTRODUCED	RATIONALE	SOURCE: Consult(1), supervisor (2), Aalbog students and faculty (3)
MOMENT OF THE SESSION 1				
TASK 2 A	Singing the hello song. Administrator makes one movement for each verse. Participant imitates the movement. Administrator withdraws the cue and observe	The administrator continues to make the movements during the entire verses	In order to assess sustained attention using the same task, the administrator should keep the movement and observe if the child continues to imitate the movement, and notices and reacts to the change of the movement.	1, 2

	maintenance from the child			
TASK 3	Singing the hello song, the child proposes a new movement to make with the hello song	Take out the item	The task does not closely relate to attention, as it does to other aspects of executive function. Its usefulness is questioned	2
MOMENT OF THE SESSION 2				
PRELUDE	Participant chooses a song from the list and sings the complete song. It was considered a task	The instructions are the same. But is not considered a task. Becomes a prelude to section 2	To sing a complete song, does not assess attention of any type. To score it as a task, would cause confusion. Relates more to working memory. However, it is important to check that the child really is familiar with the song we are going to use during the section, and that is able to sing. That is why is included but not classified in an attention category	1, 2

TASK 4/ 3	Singing and playing accompaniment during a complete song. Was directed towards sustained attention. It was task 4	Instructions change to stop singing or playing according to a verbal instruction. Is directed towards divided attention. Becomes task 3, due to exclusion of a task	The information gathered through the task, is not considered too valuable as it currently is. At the same time, there were not enough tasks for divided attention. Expert advises to introduce the verbal cuing. It was important to introduce the verbal cuing to evaluate response to that.	1, 2
TASK 4	Administrator sings a song with guitar. Introduces tempo changes every verse. The participant walks to the beat of the music adjusting his walk to the tempo presented by the administrator	Both administrator and participant accompany song playing hand drums. Administrator introduces tempo changes during the song. Child follows the new tempo	To walk, involves gross motor mechanisms that for some of the participants in Pilot A was difficult. To a certain point, to walk could become an interference for grasping the attentional skills, due to a motor skills related difficulty	1, 2, 3
MOMENT OF THE SESSION 3				

TASK 5	Did not exist in the first version	Spontaneously identify a mistake in a song. Administrator asks the child for a song he knows. Without giving any instruction, introduces an obvious mistake. Observe child's response	Neuropsychologists suggest that there is no item on the profile refering to involuntary attention, and introducing this type of task is important from the neuropsychological perspective	1
TASK 6	Description of the item and scoring, were incongruent. Scoring referred to being able to correct the MT	Scoring refers to being able to notice a mistake was made	It is not the same to notice a mistake, than to be able to correct the administrator. Noticing the mistake relates to attention. To be able to correct the therapists involves other processes.	2, 3
TASK 7	Administrator presented rhythmic patterns of increasing beats.	Administrator presents beats. Not patterns. Up to 7 beats	Beat imitation is more consistent with number span in terms of parallel operations.	2
MOMENT OF THE SESSION 4				

PRELUDE	Child explores playing the instruments. Administrator records each time the child plays an instrument. It was considered a task	Instructions are the same, but it becomes a prelude. Administrator only reports on the total duration of exploration, and if there was a favorite instrument	It is important to include a moment of exploration of the instruments so that the child can feel more confident playing in the two tasks of the section. However, the description of the exploration, can not be directly linked to attentional process, therefore can not be included as a score for analysis	2
TASK 8 AND 9	Description of music characteristics on the child's performance.	taken out of the assessment	There is not enough evidence to claim that the parameters can be correlated with attention processes. Therefore its usefulness is questioned.	1, 2, 3
SCORING CHANGES				
CHOICES	Scores were 1/0, always/never in most items	An intermediate response is introduced in some items	For the purpose of scoring is useful to have an intermediate response, as there are some clinical situations were the appropiate response is not always as clear cut as always/never	2
MOTIVATIO	Motivation scale at the end of the moment of the session	Motivation scale after each task	The motivation may vary from one task to the other. It must be presented with each task	2, 3

SUPPORT	there was a scoring for choosing type of support used for every single task	change of support only on the overall performance scale	Clinically is not easy to report on the type of support of each item. It takes the attention of the administrator to this aspect, possibly distracting from others.	2, 3

Appendix F. Manual: Attention Profile in music therapy for children (ages 6-9)

The current assessment has the purpose of providing a profile of attention with strengths, weaknesses, and strategies to support the child, as they display in the Music Therapy session.

There are different purposes for assessments (diagnosis, prescription, evaluation, etc), . This assessment is interpretive, as it gathers data from the music therapy session and interprets it under the light of neuropsychological theory. The tool is designed to give such interpretation, as it organizes the information in attention categories arising from Neuropsychological theory. It is also an evaluative (Bruscia) or long-term assessment (Wigram), as its results will serve as baseline for treatment. It is not a diagnostic assessment, as its goal is not to diagnose a disorder.

Therapists may use the tool as a baseline to propose goals and objectives according to specific needs, and to be able to report to family and other professionals regarding the child's attention skills.

According to the structure of the assessment, music therapist and child will be singing, playing and moving. Re-creation and improvisation methods will be used. Keep in mind that it is crucial that you follow the instructions in the manual and score sheet, in order to obtain accurate information. Also, you must perform at least one mock session before using the tool in a clinical situation, so that you can be familiar with the structure, the instructions, the logistics and the scoring.

The assessment includes 9 TASKS. The TASKS unfold in a 4-part session: hello song, sing and accompany a familiar song, responses to changes, and playing with instruments.

SECTION	NAME OF SECTION	NAME OF TASK
SECTION 1	HELLO SONG	TASK (A,B), 2 (A,B)
SECTION 2	SING AND ACCOMPANY SONGS	TASK 3 , 4
SECTION 3	RESPONSES TO CHANGES	TASK 5, 6, 7
SECTION 4	PLAYING WITH INSTRUMENTS	TASK 8, 9

After every section of the assessment, you will find a motivation rating scale and an overall performance scale for the section.

The current assessment includes a manual, which is the document you are reading, and a score sheet that you must have in hand, to use throughout the actual assessment session to be able to record the information at the moment of the administration.

Make sure you have read the manual several times BEFORE administering the assessment. It contains detailed information that will help you to understand the attention categories, the type of activities included, and the scoring instructions.

After you have read the manual and have a good understanding of the basics of the assessment, you must perform a mock session (ideally more than one), so that you can become familiar with scoring during such practice session. For the administration of the assessment you will print a copy of the score sheet, which you will fill out with pencil. After the administration, you will pass the paper information into the Excel file. Have one Excel file per participant.

Take into account that the current assessment is under a pilot process. For that reason it is highly important that you follow the directions as presented in the manual and record the information in the way proposed in the score sheet. If you find difficulties in the administration, or find inconsistencies while scoring, please keep a record of such observations in the last sheet of the response sheet. Also mention this to the researcher in the different meetings set up for follow-up.

SCORING SYSTEM

There are three types of scoring on the assessment: Item score, motivation score and overall score. The criteria for each score are found written both in the manual and the score sheet. You will find a more detailed explanation on how to score in the manual, as the score sheet is a simplified version with less information, to easily have on hand at the moment of the session.

Item Score

The item score is specific to the performance on a target response and can be numeric, or represented in a word. The numeric score is usually a score of 1 for correct response, and 0 for no response or a different response. The items with the score linked to a word, usually have these criteria: ALWAYS, SOMETIMES, NEVER; or YES/NO.

The scoring system for each item is found right below it. In the score sheet that you will have in hand when administering the assessment, you will find the general scoring instructions, and the rating scale. As mentioned before, in the manual you can find more detailed instructions. Always report the results on the score sheet. **Example**: Below is an excerpt from the score sheet. It corresponds to Item 2A.

ITEM 2A. Imitation of movements		
Score: 1 point for imitating the movement (not 1 point per movement performed. Maximum 1 point per target response). 0 points if there is no response or a different response (describe response under observations). In the last line, add each response's score for a total ITEM score. NOTE: In the first movement (tapping with one hand) if child uses the opposite hand, the score will still be one		
TARGET RESPONSE	SCORE	MOVEMENT WAS SUSTAINED DURING THE ENTIRE VERSE? Yes/no
Tapping with one hand	1	
Clapping	1	
tapping with both hands	1	
TOTAL ITEM SCORE	3	

Let's suppose the child imitates the movements made by the therapist. The scoring instructions state you should rate 1 point on each target response, if child is able to imitate the movements. In the second column and next to each movement (Target response), write the score for that particular movement. In this case 1 point for each, because child correctly imitated every movement. Then on the TOTAL ITEM SCORE, you add the scores for the three movements. Be aware that you are not scoring each correct imitation, i.e.,: if child did 4 claps, the score is 1, not 4. You are scoring that child was able to imitate correctly, not the number of repetitions of the movement. The items, or the different questions on each item, relate to a type of attention that we are observing. In the end, the database adds up the scores from all the questions related to a type of attention, to provide a score for each category.

You find the items color-coded according to the following chart:

color code

alertness	
selective attention	
divided attention	
sustained attention	

Motivation Score

As it is known from research, motivation plays an important role in attention skills. This is why a short scale to rate child's motivation at different moments of the session is also included in the assessment, right before the overall score. You will find it presented as in the chart below on the score sheet, after every item.

MOTIVATION	
On a scale from 1 to 4, rate child's motivation throughout the TASK	
1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

Overall Score

Tasks are organized by moments of the session. Each moment has two or three tasks. In addition to rating each item of the task, at the end of a moment of the session, you find an "OVERALL SCORE" scale. This scale characterizes the performance on a group of tasks that have something in common (music used, type of activity). It includes not only correct performance, but also the level of independence in the performance, and the ability of the child to verify his performance and correct himself when making a mistake. Here, you will also find a place to record the type of support you provided for the child if he was getting anxious or blocked. This is important, as it helps you to report on strategies that might help the child to perform. You will find this scale in the score sheet like this:

Based upon your observation of the child on tasks x, and y, rate child's overall performance, according to the following criteria:

SCORE	**CRITERIA. The child…..**
6	Performed correctly and independently
5	Performed independently with self-verification* and correction**
4	Performed independently with self-verification but without correction
3	Performed independently with mistakes
2	Child performed with support of therapist
1	Could not perform (Even with the support provided)
self verification: when child notices he is making a mistake. It can be a facial expression and/or a verbal expression	
****self correction: when child not only is aware of a mistake, but is able to correct himself.***	

Right next to the criteria 2: CHILD PERFORMED WITH SUPPORT OF THERAPIST, you find some boxes to mark the type of support provided by the therapist. During the administration of the assessment, the child should be able to perform the tasks without support (beyond the regular instruction). The administrator must refrain from offering initial support. HOWEVER IF the child is getting very nervous, frustrated, blocked, or does not understand the instructions, you may provide support in the following ways. (Be aware that in **TASK 1** you **must not** offer any type of support)

TYPE OF SUPPORT PROVIDED (you can mark more than one)	verbal	Gestural
	prompt	

Relationship score

At the end of the assessment, you will find a scale to rate the child's ability to establish a therapeutic relationship with you as the therapist, and your own ability to establish the same with the participant.

On a scale from 1 to 4, rate how easy was it for the child to establish a relationship with the therapist			
1. Very difficult	2. Slightly difficult	3. Easy	4. Very easy
SCORE			

On a scale from 1 to 4, how easy was it for you to establish a relationship with the child?

1. Very difficult	2. Slightly difficult	3. Easy	4. Very easy
SCORE			

ADMINISTRATION PROTOCOL

As you know, assessment is a topic where following instructions is very important. Every action included in the assessment, has been carefully reviewed several times. It is very important that you follow this protocol, so that the results of every participant (regardless of the therapist administering the tool) can be considered reliable.

For the purpose of the pilot study, this is the protocol you must use when administering the assessment. Please keep in mind that possible changes to the tool and the protocol may occur as a result of the study. But NO changes can be implemented at this time, as there is a requirement for homogeneity in the procedure.

1. Read the manual several times. Each person requires a different amount of time to understand and incorporate new information. Make sure that you understand instructions in the manual. If you have any doubts, please send an e-mail with your questions to the researcher, so that she can help you to clarify. Also, so that she can keep a record of your questions. This is very important for the pilot process as it helps to identify unclear instructions and possible adjustments or changes.

2. When you have a good understanding of the structure, instructions, activities and scoring system, review the score sheet. It is an Excel file, which contains the assessment on one sheet. Please remember that you don't find the detailed instructions on the score sheet. Only the scoring criteria, and some key points for each item, so that you can remember the most important features of the item, along with some specific instruction that you should be aware of.

3. Once you feel you are familiar with both the manual and the score sheet, schedule a mock session with a child. (Please keep ethical considerations in mind). If you have any doubts during the mock session, please write them up so you don't forget them, and report them to the researcher. If you identify parts of the assessment where you had trouble remembering the instructions, make a mark, so that you can go back to check that specific part afterwards. If you see the need to do another mock session, don't hesitate. The important thing is that you feel confident that you are administering the assessment according to the parameters.

What do you need for an administration session (mock or real)?

1. Make sure you have read the manual, understand the instructions, know the songs in the appendix and have a clear idea on how to score.

2. Print the score sheet. The file was designed to be printed horizontally. Please set up your printer options accordingly.

3. Organize your setting. Make sure you have the instruments you will need at hand.

4. **Remember to video record the session, so that later on videos can be used for reliability purposes**.

5. Perform the administration session, as established in the manual and score sheet.

6. Record responses DURING the session on the score sheet. Please do so with every item. This way, your scoring does not rely on your memory, but on your "in the moment" observation of the situation. Make sure you perform every task in the assessment, and record every response required. NOTE: Use a pencil. This will allow you to make quick corrections. Also, it allows you to use the same score sheet several times. Whenever the response is a number, you have a box to write the number. When you have to make a choice from words, please put an X right next to the word, in the same box

7. After you are done with the administration session, review the score sheet AND send a picture or scan version of the score sheet file to the researcher. .

8. Keep a log of your difficulties and doubts with questions and comments to send to the researcher. After every session, write the researcher, even if it is a short note like: Everything went well. This will help the researcher to keep track of things that might not have been visible during the design stage.

9. Please keep a back-up of these files.

10. Remember all the confidentiality precautions in order from the consent form. In order to minimize the risks of loosing information, please send the score sheet per participant to the researcher by e-mail once you are done recording the results.

Participant's codes

Each participant has a 4 number code. Please use the code to mark the response sheet.

ATTENTION: DEFINITIONS AND TYPES OF ATTENTION.

For the purpose of the current study, definitions of attention constructed under the paradigm of Neuropsychology are taken into account.

Cohen (2014) states that "attention is the by-product of four related but distinct neurobehavioral sets of processes (elements) that enable (1) sensory selection; (2) executive–attention, response selection, and control; (3) focusing relative to capacity limitations; and (4) sustained attention, vigilance, and response persistence". According to the author, even though these factors share some common mechanisms, each has a distinctive role in different situations and relies on different sets of component processes.

Beyond the cognitive perspective, in the historic-cultural framework, Luria's perspective of attention is presented through the functions of blocks (1973). As

mentioned earlier in the Neuropsychology chapter, there are three blocks, and each one has distinct functions. However, contribution from all blocks is necessary for a complex functional system to work. Summarizing Luria's thoughts on Attention and blocks: Block one, is responsible for arousal. It provides an appropriate level of arousal, so that alert, selective and directed attention can take place. According to Luria, only if there is an appropriate arousal, can more complex processes of attention occur. Block two involves simultaneous and successive processes, while block three is linked to voluntary programming, regulation and verification (Naglieri and Das, 1994).

TYPES OF ATTENTION

For the purpose of this study, the types of attention and their definitions are:

Selective: process by which some informational elements are given priority over others (Cohen, 2014)

Divided: Ability to attend a stimulus with the interference of a competing stimulus (Cohen, 2014)

Sustained: Attentional persistence over a relatively long period of time (Cohen, 2014)

Alert: minimum energy mobilized allowing the nervous system to be receptive to information (Soprano, 2009).

The type of tasks used to assess the different types of attention are described by Soprano (2009) and were taken as the starting point in the design of the tool.

Alert: Tasks measuring the reaction time

Selective-focalized: Tasks requiring filtering capacity between auditory-visual stimuli and distracting stimuli. Includes typically span tests. A growing amount of information is presented to the subject, and he must retain and immediately repeat according to what he heard or saw.

Divided-Simultaneous: Double tasks, where the subject must mentally handle two different sets of information and process it in a simultaneous manner. Tests for assessing divided attention are based upon cancellation tasks

Sustained: Tasks that are generally long and monotonous, where the subject must respond to a certain visual or auditory stimuli differentiated from other, considered distractors. These measure the ability to detect and respond to changes occurring in random intervals during a long period of time. Measure: rate, omissions, commissions, span and decreased vigilance.

THE HELLO SONG. Items 1 and 2

Throughout this moment of the session, you will be singing the Hello song, asking the child to respond in different ways such as saying his name or hello, imitating movements, recalling movements, or proposing movements to the song. In total, you will repeat the complete song 4 or 5 times (Depending on performance on item 1A.)

This task has 2 items: 1 (a,b); 2 (a,b)

ITEM 1.A

Explain to child that you will sing a song that has some parts where he will be ask to respond in certain ways such as: singing or saying hello, his/her name; or the therapist's name (at this point remind him of your name!) Begin the session with the hello song included. Sing it once leaving the space for the target responses: hello, child's name, and the therapist's name. Do not provide any kind of support during the song, beyond the singing. Only let child respond. If child is able to respond to the three targets, proceed to ITEM 2. If not, go to item 1.B when you may introduce support. You want to be aware of two things: if the child gives any type of response in the spaces left for that in the song, and if the response was the correct according to the lyrics of the song.

SCORE

First, score if child gives any response at all in the space left for responses in the song. Then give 1 POINT PER EACH CORRECT TARGET RESPONSE. DO NOT OFFER ANY TYPE OF SUPPORT! 0 POINTS FOR NO RESPONSE OR A DIFFERENT RESPONSE (example: said hello in the space for his name. Describe response under observations). In the last line, add each response's score for a total ITEM score		
Child gave a response on the space left in the song?		
always	sometimes	never
TARGET RESPONSE	SCORE	

Child's name	
Therapist's name	
Hello	
TOTAL ITEM SCORE	
Observations (if any)	

ITEM 1.B (only if child had difficulties with the previous task)

If the child is not able to respond to any or all of the targets, perform the song again. Leave the space for target responses. If child is able to respond, score: 1 repetition (on each target response), and proceed to ITEM 2. If not, repeat ONLY the verse containing the problematic prompting phrase. This item does not have a score, you only record the number of repetitions until the child was able to respond. Repeat a maximum of 3 times.

SCORE

Account number of repetitions until child was able to respond

TARGET RESPONSE	**Number of repetitions**
Child's name	
Therapist's name	
Hello	

OBSERVATIONS (IF ANY)

MOTIVATION	
On a scale from 1 to 4, rate child's motivation throughout the HELLO song	
1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

ITEM 2.A

In this item, the child will imitate movements you make while singing the hello song. To demonstrate, ask the child to observe and sing the hello song ONCE, with you doing the following accompanying movements: Verse 1. Tapping with one hand. Verse 2: clapping. Verse 3: Tapping with both hands. Then, ask child to imitate your movements and sing the song again with the movements together (do not use any harmonic accompaniment so that you can have your hands free for the movements).

SCORE

1 point for imitating the movement (not 1 point per movement performed. Maximum 1 point per target response). 0 points if there is no response or a different response (describe response under observations). In the last line, add each response's score for a total ITEM score. NOTE: In the first movement (tapping with one hand), if child uses the opposite hand, the score will still be 1.		
TARGET RESPONSE	SCORE	MOVEMENT WAS SUSTAINED DURING THE ENTIRE VERSE? Yes/no
Tapping with one hand		
Clapping		
tapping with both hands		
TOTAL ITEM SCORE		

ITEM 2.B

Ask child to show you the movements you just made, in the order you made them (tap one hand, clap, tap with both hands). DO NOT PROVIDE SUPPORT at first, only if child is getting blocked.

SCORE

Score: 1 point per each movement recalled. Max 3	
TARGET RESPONSE	SCORE

Show movements in the order previously performed		
Child showed the movements in a different order?	YES	NO
Child forgot any movement?	YES	NO

MOTIVATION	
On a scale from 1 to 4, rate the child's motivation in the imitation and recall of movements	
1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

OVERALL PERFORMANCE FOR ITEMS 1 AND 2

Based upon your observation of the child during ITEMS 1 and 2, rate the child's overall performance, according to the following criteria:

SCORE	CRITERIA. The child…..
6	Performed correctly and independently
5	Performed independently with self-verification* and correction**

<table>
<tr><td>4</td><td>Performed independently with self-verification but without correction</td><td colspan="3"></td></tr>
<tr><td>3</td><td>Performed independently with mistakes</td><td colspan="3"></td></tr>
<tr><td>2</td><td>Child performed with support of therapist</td><td rowspan="2">TYPE OF SUPPORT PROVIDED (you can mark more than one)</td><td>verbal</td><td>gestural</td></tr>
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</table>

Familiar song. Items 3 and 4.

In this section, the child will be singing a song that is familiar to him. In total, the song will be re-created 4 times. Different conditions will be observed. Child singing alone, and with therapist. Child playing with therapist. Child responding to tempo changes. Before you begin the task, ask the child if he knows the 1st song presented in the appendix for your country. If the child does not know the song, use the next option, and so on. If child does not know any of the songs in the appendix, ask the child for a song he knows and use it throughout the task. If that is the case, you must make sure that the chosen song is short (max. 3 verses of 6 phrases each and chorus between verses). If the song is too long, the nature of what is being measuring in the item could change to sustained attention, as opposed to the types of attention that are targeted when using shorter songs.

Section 2 has two items: 3 and 4

Prelude: Present the song choices from the appendix to the child. If child knows any of the songs, ask the child to sing it once. If child does not know any of the songs, ask him to sing a song he does know. You will use that song for the items. Make sure it is a short song (max. 3 verses of 6 phrases and a chorus in between verses). Respond to the following questions:

What song did you use?	**FROM APPENDIX**	**NUMBER:**	**DIFFERENT:**
Was child able to sing the song?	Complete song	partially and/or making changes	Not able
Describe child's singing in the following aspects			
Melodic contour	SAME	SIMILAR	DIFFERENT
rhythmic patterns	SAME	SIMILAR	DIFFERENT
sustained beat	YES	NO	SOMETIMES
lyrics	SAME	SIMILAR	DIFFERENT

ITEM 3

Ask the child to choose an instrument and explain that you will be playing your guitar again. Explain that in some parts of the song you will ask him to stop playing or singing, and so he should stop until you instruct him to play or sing again. Do this 3 times. Make sure to stop playing 2 times, and stop singing two times. Keep in mind that when you stop either playing or singing you should say the words before. For example: “stop playing”, OR “stop singing”. You must stop for the complete verse. Before resuming you must again say the words: for example: “begin playing”, OR “begin singing”. You want to be aware of the ability to stop when instructed, and to observe if the response was immediate or delayed

SCORE

Mark the correct answer. ALWAYS, if child always stopped singing or playing according to the verbal instruction (does not have to be immediate, but before verse is over and therapist resumes the singing or playing). SOMETIMES, if child was not able to consistently respond to the instruction in the way stated. NEVER, if child never followed the instruction AND/OR required therapist's support.				
TARGET RESPONSE	SCORE			
Stopped singing or playing according to instruction	ALWAYS	SOMETIMES	NEVER	
Response was immediate?	ALWAYS	SOMETIMES	NEVER	
Type of child's accompaniment	PULSE	MELODIC RHYTHM	NEITHER	BOTH
Did the voice and the playing have a synchronized tempo?	ALWAYS	SOMETIMES	NEVER	

MOTIVATION
On a scale from 1 to 4, rate child's motivation in the sing and play accompaniment, ITEM 3

1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

ITEM 4

Take a drum and give the child another drum. Using the same song from the previous item, ask the child to play a pulse on a drum (Using hands, not mallets). First model to the child what it is to play a pulse. Sing the song used on the previous item and play the pulse on the drum for a complete verse. Then ask the child to do the same. Do not score this. It is practice. Explain that now you will be playing the same song, and that you might play faster or slower, and child should always try to follow the new tempo. Then, play the same song twice. Introduce changes of tempo every verse. Observe and score the responses of the child to the tempo changes. In this item, we are not scoring the exact ability to synchronize. We want to know if the child changes his playing when listening to a tempo change, and makes an attempt to synchronize with the new tempo (by playing slower or faster, like the new tempo change). Keep that in mind when scoring

SCORE

Mark the correct answer. ALWAYS, if the child always makes an attempt to synchronize with the tempo changing (does not have to be immediate, but before verse is over). SOMETIMES, if the child was not able to do so consistently. NEVER, if the child never followed the instruction AND/OR for required therapist's support.

TARGET RESPONSE	**SCORE**		
Attempted to synchronize with tempo change	ALWAYS	SOMETIMES	NEVER

MOTIVATION	
On a scale from 1 to 4, rate the child's motivation throughout the follow tempo changes item	
1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

OVERALL PERFORMANCE FOR ITEMS 3 AND 4

Based upon your observation of the child on the SING AND ACCOMPANY A FAMILIAR SONG MOMENT, rate the child's overall performance according to the following criteria.				
SCORE	CRITERIA. The child…..			
6	Performed correctly and independently			
5	Performed independently with self-verification* and correction**			
4	Performed independently with self-verification but without correction			
3	Performed independently with mistakes			
2		TYPE OF	verbal	gestural

	Child performed with support of therapist	SUPPORT PROVIDED (you can mark more than one)	prompt
1	Could not perform (Even with the support provided)		
**self-verification: when child notices he is making a mistake. It can be a facial expression and/or a verbal expression*			
***self-correction: when child not only is aware of a mistake, but is able to correct himself.*			

RESPOND TO CHANGES. ITEMS 5,6 AND 7

In this task, the child will be asked to sing or respond in different ways to changing conditions in familiar songs. Child will also be asked to imitate beats.

It has three items: 5, 6, and 7.

ITEM 5

Item 1. Ask the child for a song he knows. If you know the song, use it for this item. If not, keep asking until the child mentions one you know. Without giving any instructions (almost like an "accident"), begin to sing the song and make an evident mistake (change of music and/or lyrics in an obvious place i.e.,: at the end of a verse, or a keyword that identifies the song).

SCORE

Child noticed the mistake?	**YES**	**NO**	
How did he react to the mistake?	MAKING GESTURE	VERBALLY	BOTH

MOTIVATION RATING SCALE

MOTIVATION	
On a scale from 1 to 4, rate the child's motivation at the moment you were singing the song for this (ITEM 5)	
1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

ITEM 6. Identify specific mistakes and react

Prelude

Choose a song from song choices in the appendix. Make sure it is one for your country. Ask the child if he knows the song. If not, change to another song. Use the same song though out the item. If he does not know any of the song choices, ask him to sing a song he knows (and make sure you know it too), and use that song for the entire task (and report it).

Did you use a song different from the song choices provided?	**YES**	**NO**	**If so, which song?**

Ask the child to listen to you carefully and to raise his hand when he hears a mistake in your singing. For this item it is FUNDAMENTAL that you can look in the child's direction without making eye contact. In this way, you can make sure you are not giving subtle gesture cues to the child right before the change is presented. Sing the song three times. The first time introduce intentional word mistakes in the order presented on the score sheet. The second time introduce intentional rhythm mistakes in the order on the score sheet, and then introduce a word mistake at the end of the verse as a control question. The third time, introduce melody changes in the order on the score sheet and then introduce again a word mistake at the end of the verse as a control. The control questions are included given that many times, children do not understand that rhythm and melody changes could be considered "mistakes". Sometimes a child can only understand a mistake as a change of the words they know. This is why, if child does not raise a hand for any of the rhythm or melody changes, you must do the control exercise. In this way we can control if a lack of response to these types of mistakes is due to lack of attention, or to not understanding the change as a mistake.

If child does not raise the hand, but shows an evident reaction to the mistake, you should mark other reaction, and under the column "which", write down the reaction. If the response of the child is delayed, also mark "OTHER REACTION" and in the "which" column write down: delayed response.

In the change of words, change a key word (not an article) located where the instruction states.

In the change of rhythm, don't make changes of tempo. Change the rhythm!

For the changes of melody, use notes that are out of the chord. Not necessarily out of the key, but at least out of the usual chord.

SCORE

TYPE OF MISTAKE	**RAISE HAND**		**OTHER REACTION**	**WHICH?**
CHANGE OF WORDS	YES	NO		
Change word at the end of the verse				
Change word in the middle of the verse				
Change a word at the beginning of the verse				
CHANGE OF RHYTHM				
At the beginning of the verse				
In the middle of the verse				
At the end of the verse				
CONTROL				

Change word at the end of the verse				
CHANGE OF MELODY				
At the beginning of the verse				
In the middle of the verse				
At the end of the verse				
CONTROL				
Change word at the end of the verse				

MOTIVATION RATING SCALE

MOTIVATION	
On a scale from 1 to 4, rate the child's motivation throughout the mistake identification item	
1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

ITEM 7. Beat span

Explain to the child that you are going to clap beats and he should listen and imitate. Explain that you will do more beats every time and that he must not begin until you have finished clapping. Place yourself in a manner that is close to the child. Clap and wait for the response. Difficulties: If there is no response, repeat the model and score only the second attempt. If the child begins clapping before you finish: A. Tick the impulsivity box to mark that the response is impulsive. A. If the imitation is correct, score 1. B. If the imitation is not correct, give the instruction again.

Emphasize that he must not begin clapping until the therapist is done. Repeat the stimulus, and score the second attempt. If the child is unable to imitate the model, stop the exercise after offering support to do the imitation. Do not keep presenting the following models.

SCORE

1 point if the child imitated correctly the model. 0 for not being able to imitate. I.E: If the child was able to imitate all 7 models, the total score will be 7. If the child was able to imitate until the 4th model, and for the 5th model it was necessary to repeat it more than once, offer support so the child can do it, but the total score will be 4. Remember possible difficult situations: If there is no response, repeat the model and score only the second attempt. If the child begins clapping before you finish: A. Tick the impulsivity box to mark that the response is impulsive. A. If the imitation is correct, score 1. B. If the imitation is not correct, give the instruction again. Emphasize that he must not begin clapping until therapist is done. Repeat the stimulus, and score the second attempt. Make sure you marked (x) that you had to allow a second attempt.

TARGET RESPONSE	**SCORE**	**REQUIRED 2nd ATTEMPT**	**IMPULSIVE RESPONSE**
1 beat			
2 beats			
3 beats			
4 beats			
5 beats			
6 beats			
7 beats			
TOTAL			

MOTIVATION RATING SCALE

MOTIVATION	
On a scale from 1 to 4, rate the child's motivation throughout the beat span	
1. Not motivated	2. Slighty motivated
3. Adequately Motivated	4. Highly motivated

GENERAL RATING SCALE FOR ITEMS 5, 6, 7 (Changing conditions)

Based upon your observation of the child on the previous 3 items, rate the child's overall performance, according to the following criteria.

SCORE	CRITERIA. The child…..
6	Performed correctly and independently
5	Performed independently with self-verification* and correction**
4	Performed independently with self-verification but without correction

<table>
<tr><td>3</td><td>Performed independently with mistakes</td><td colspan="3"></td></tr>
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TURN-TAKING AND GOODBYE IMPROVISATION. ITEMS 8 AND 9

In these items, the child will be asked to use instruments in interactions with the therapist. There will be moments of turn-taking and improvisation. You need to have ready the following group of instruments:

- 2 drums of different sizes
- Keyboard
- Guitar
- Shaker
- Xylophone or metalophone
- Triangle
- Rainstick
- 1 instrument from your country (please describe it on the score sheet)

For some of items, you will be asked to note the approximate duration of playing. Have a watch in hand (you can use an iPad, iPhone, cell phone, or regular stop watch)

PRELUDE

Present a group of instruments. Ask the child to explore them. Have in hand a watch. Use it to measure the total time of exploration. When the child begins to play an instrument, the time will begin to run. Stop the watch when the child stops playing. This prelude is a way to get the child comfortable using instruments, and to identify preferences. Keep in mind that if child plays for more than 4 minutes, you should stop the child from playing after maximum 6 minutes, so that you can continue with the assessment.

SCORE

PREFERRED INSTRUMENT	

TOTAL DURATION OF EXPLORATION	1 minute or less	between 2 and 4 minutes	more than 4 minutes
WAS THE CHILD MOTIVATED TO EXPLORE INSTRUMENTS ?	YES	NO	

ITEM 8. TURN-TAKING

Explain to the child that you are going to be taking turns playing the instruments. You always take the first turn. Explain that the child doesn't have to play necessarily the same as you did, nor use the same instruments. Play less beats on the first turns and more beats on the later turns.

SCORE

	CHILD WAIT FOR TURN?	**CHILD PLAY DURING TURN?**	
TURN 1			
TURN 2			
TURN 3			
TURN 4			
TURN 5			
CHILD'S MUSICAL MATERIALES WERE SIMILAR TO	ALWAYS	SOMETIMES	NEVER

THE THERAPISTS?			

MOTIVATION RATING SCALE

MOTIVATION	
On a scale from 1 to 4, rate the child's motivation throughout the TURN-TAKING	
1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

ITEM 9. Goodbye improvisation

Goodbye improvisation: Ask the child to use instruments, voice, and/or body percussion to make music together as a way to say goodbye.

SCORE

Child was able to participate in the music making?	YES	SOMETIMES	NO
Musical materials of the child were related to the therapist's? (complement, imitate,	ALWAYS	SOMETIMES	NEVER

propose, or respond)			

MOTIVATION RATING SCALE

MOTIVATION	
On a scale from 1 to 4, rate the child's motivation throughout the GOODBYE IMPROVISATION	
1. Not motivated	2. Slightly motivated
3. Adequately Motivated	4. Highly motivated

OVERALL PERFORMANCE RATING SCALE FOR ITEMS 8 AND 9

Based upon your observation of the child on ITEMS 8 AND 9, rate the child's overall performance, according to the following criteria.

SCORE	CRITERIA. The child…..
6	Performed correctly and independently
5	Performed independently with self-verification* and correction**

4	Performed independently with self-verification but without correction			
3	Performed independently with mistakes			
2	Child performed with support of therapist	TYPE OF SUPPORT PROVIDED (you can mark more than one)	verbal	gestural
			prompt	
1	Could not perform (Even with the support provided)			
**self-verification: when child notices he is making a mistake. It can be a facial expression and/or a verbal expression*				
***self-correction: when child not only is aware of a mistake, but is able to correct himself.*				

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