

자폐범주성장애 아동을 위한 음악치료 중재 문헌 내 사회적 의사소통 측정 도구 분석

유가을*

자폐범주성장애 아동은 사회적 의사소통 발달에 있어 넓은 범주의 개별적 변이성을 보이기 때문에 이에 대한 중재 개입 시 효과적인 전략이 매우 중요하며, 이를 정확하게 평가할 수 있는 사회적 의사소통 평가도구의 중요성이 지속적으로 강조되고 있다. 본 연구에서는 음악 중재 문헌 내에서 사용된 사회적 의사소통 측정 도구에 대해 고찰하고 이를 분석하였다. 전자 데이터베이스 및 음악치료 학술지 검색을 통해 자폐범주성장애 아동의 사회적 의사소통을 변인으로 한 중재 연구 중 1980년에서 2015년까지 출간된 통제된 디자인의 연구가 검색되었고, 최종 분석에는 21개의 연구가 포함되었다. 분석 결과, 측정 도구 유형으로는 행동 직접 관찰이 가장 많이 사용되었고, 측정 도구 유형과 그에 따른 목표 영역 간 조합에 있어 변이성이 크게 나타났다. 또한 선정된 연구 중 90.4%를 차지하는 연구에서 측정 도구 사용의 적절성 검증을 위한 평가자 간 신뢰도가 보고되고 있음이 나타났다. 이러한 결과는 음악치료 중재 문헌 내에서 객관적, 체계적 평가 시도가 증가함에도 불구하고, 동일 기능 수준에 접근하는 개별 연구 간 평가 방안 및 전략에 있어 일관성이 떨어지고, 이로 인한 임상근거 도출에 제한이 있음을 시사한다. 결론적으로 자폐범주성장애의 고유한 특성을 고려하여, 사회적 의사소통 평가 시 전반적 기능 수준 변화뿐만 아니라 특정한 행동 습득, 사회 인지 수준 등을 고려할 필요가 있음을 제언하였다.

핵심어 : 자폐범주성장애, 사회적 의사소통, 평가 척도, 음악 중재

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I . Introduction

Children with autism spectrum disorders (ASD) show impairments in their social communication development beginning in the early years of life (American Psychiatric Association [APA], 2013). Disturbances in social experience during early childhood limit accurate processing of social cues and information from others and the environment (Bedford et al., 2012; Swain, Eadie, Prior, & Reilly, 2015). Lack of adequate social information processing is documented to exacerbate the malfunctioning of neural networks that jointly mediate social perception, social cognition, motor control, and motivation (Dawson, 2008). In addition, these deficits interfere with concurrent and future cognitive, language, and emotional development (Bottema-Beutel, Yoder, Hochman, & Watson, 2014; Dawson et al., 2004; Toth, Munson, Meltzoff, & Dawson, 2006).

In order to promote early social experiences and facilitate proper development in children with ASD, extensive attempts have been made to develop effective interventions targeting the social communication skills of this population (Rao, Beidel, & Murray, 2008; Reichow & Volkmar, 2010; White, Keonig, & Schail, 2007). With the emphasis on the development of effective early intensive intervention for this population, the identification of evidence-based intervention among this variety of intervention has been of importance (Odom, Collet-Klingenberg, Rogers, & Hatton, 2010). Likewise, the availability of sensitive and valid measures of social communication skills in children with ASD is critical for identifying the appropriate approach to social needs of these children and for evaluating the outcomes of intervention efforts (Klin & Jones, 2015).

An important aspect to consider when measuring social communication skills of children with ASD is individual variability in behavioral features. As reflected in the DSM-V where Asperger's disorder and pervasive developmental disorder not otherwise specified were integrated into one diagnostic category (i. e., ASD), the broad range of social communication-specific behaviors observed in ASD are not always easy to distinguish from other disorders with similar psychosocial or behavioral issues (Davidson et al., 2015; McPartland, Reichow, & Volkmar, 2012). Considering the broad range of behavioral differences evident within the diagnosis of ASD and the degree of overlap between ASD symptoms and those of other relevant disorders, it is critical that measurements to identify and assess social communication skills be specific to this disorder (Anagnostou et al., 2015; Matson, 2007). In addition, for better understanding of children with ASD who show

heterogeneity in developmental pace and trajectory across individuals and dynamic mechanism underlying social deficits (Fitzpatrick, Diorio, Richardson, & Schmidt, 2013), factors, such as one's developmental level and severity of ASD symptoms, need to be considered (Lord et al., 2005; Matson, 2007).

With regard to assessing such diverse social communication skills of children with ASD, measurements used in the literature are categorized into three types, depending on the type of the target skills and behaviors (Gresham, Sugai, & Horner, 2001; Otero, Schatz, Merrill, & Bellini, 2015). These three types include (1) global measures of social development observed across multiple social environments (e. g., schools and the home), usually implemented via parent-rated or teacher-completed rating scales or interviews such as the Social Skills Rating System (Gresham & Elliott, 1990); (2) direct observation of behaviors directly targeted within intervention, usually administered by teachers or clinicians, as observed in research with single subject design; and (3) role-playing or scenario-based measures, which enable assessment of social cognition for this population such as Theory of Mind tests (Baron-Cohen, Leslie, & Frith, 1985). Each type of measurement can be effectively applied to different skills and environments (Otero et al., 2015). However, each type also has its own set of applications and limitations that require careful alignment with the nature of targeted skills.

Attempts to promote measurement selection by identifying specific combinations of the type of measurements and target social communication skills hasn't been straightforward in the ASD literature. A review of the measurements for children with ASD demonstrated that great variability existed in terms of which measurement was used to assess which specific behavior (Anagnostou et al., 2015; Bolte & Diehl, 2013; Magiati, Moss, Charman, & Howlin, 2011). The broad range of measurement tools used for diverse applications across studies indicates that there is limited agreement in terms of effective assessment and evaluation strategies (Bolte & Diehl, 2013). Research supports that multiple and dynamic assessments of social communication skills are important but consensus on that methodology is still needed.

In terms of measuring social communication skills in children with ASD, music has been reported as being an effective modality to better understand and predict potential functioning of children with ASD (Wigram & Gold, 2006). The use of music or musical stimuli has been found to contribute to an immediate increase in responsiveness to stimuli, the environment, or a social partner (Yoo, 2014). Music also enhances motivation toward engagement in reciprocal social or emotional interaction (Accordino, Comer, & Heller, 2007). Likewise, the use of music and music therapy interventions has led to increased favorable outcomes for children

with ASD. Such potential induced by positive responses to music by children with ASD indicates that the utilization of music and a musical environment may address limitations in traditional verbal assessments and enhance multifaceted understanding of potential skills and level of functioning in these individuals.

Since music elicits responses from children with ASD that are different from their responses to verbal-based conditions, there is a need to better understand the specific assessment and evaluation strategies associated with the music therapy literature. Despite the documented desirable outcomes of music therapy for improving social communication in children with ASD (Geretsegger, Elefant, Mössler, & Gold, 2014; Gold, Wigram, & Elefant, 2006; Whipple, 2004), how such interventions can be expanded to maximize their effectiveness has been of relatively little interest. Increased attempts to identify measurement tools in terms of its sensitivity and specificity to measure specific social communication skills within musical environments and conditions may enhance understanding of how music therapy intervention can be effectively applied to a specified domain of social communication skills, accordingly indicating intervention areas in a need for further development. A systematic analysis of the measurements used in the literature will present baseline data on, and clinical implications for measurement use. Such analysis will contribute to more effective decision-making in terms of measurement selection for clinical use and evidence-based practice. Therefore, this review aimed to summarize findings from the music therapy intervention literature for improving social communication skills of children with ASD, to analyze the measurements used in the studies, and to present implication for future studies.

II . Methods

An electronic search was conducted for English-written research published between 1980 and 2015 via electronic databases, including CINAHL, Cochrane Central Register of Controlled Trials (Clinical Trials; CENTRAL), PsycINFO and PubMed. Keywords for searches included combinations of the following descriptors: autism spectrum disorder, autism, autistic disorder, pervasive developmental disorders, Asperger, ASD and PDD for population-specific terms; social communication, communication, social skills, social behavior, social interaction, social development and interpersonal relations for outcome-specific terms; and music, music therapy, music intervention, and improvisation for intervention-specific

terms. Also, a manual search for relevant research was conducted with peer-reviewed journals associated with music therapy. After an initial search, a review of titles and abstracts excluded duplicate studies and irrelevant studies. Then, full texts were retrieved and relevant articles for further analysis were selected based on the following inclusion criteria.

1. Inclusion criteria

Criteria for participants included children with clinical diagnosis of ASD aged from birth to 21 at time of study. Individuals with comorbidity, such as other neurological or developmental disorders, were excluded. With regard to intervention, all intervention types that utilized music or music activity were included. Included studies needed to use outcome measures for social communication, including joint attention, initiation of and response to social interaction, communicative behaviors, or social behaviors. For more systematic analysis of measurement tools used to evidence changes in social communication skills after music intervention, only research with an experimental design, quasi-experimental design, or single subject design were included. Descriptive studies and case study designs without a control group were excluded.

2. Data analysis

Systematic analysis of social communication measurement in music therapy interventions was conducted in terms of the target social construct and type of measures. The definition of primary social construct or social communication skills was examined. Based on categories used in the field (Cordier et al., 2015; Otero et al., 2015), the type of measurement was categorized to direct observation of social behaviors within the intervention context (DO), structured or semi-structured interview (In), ratings by caregivers (RC), ratings by professionals (RP), or self-report (SR). Specific data collection methods within each type of measurement were also analyzed. The quality of each measurement was assessed in terms of whether the research reported reliability, validity, measurement error, and/or responsiveness.

III. Results

A total of 341 articles were identified after the initial electrical database and manual searches. Duplicates and irrelevant studies were excluded and 33 studies were retrieved to see if they met the criteria for inclusion. Studies that did not examine the effects of an intervention and lacked a control group or a controlled condition were excluded. Finally a total of 21 studies with 238 participants were selected based on the inclusion criteria.

1. Features of included studies

An overview of the 21 studies analyzed in this study is displayed in <Table 1>. Of these studies, 13 were conducted with single subject designs, which equaled 61.9% of the total studies. Four studies applied randomized controlled designs (RCT). In addition, within subjects comparison design and between subjects comparison design without randomization were used in three studies and one study, respectively. While earlier studies tended to apply single subject designs, all four of the RCT studies were conducted within the last five years (2011-2013). The ages of the participants in the included studies ranged from 3.2 to 15.8 years, and 47.6% of the studies targeted preschool children with a mean age of 3.2 to 5.9 years. With regard to the intervention provided to children with ASD, song-based interventions were the most frequently used, including musically-adapted social story and use of originally composed songs to meet the needs of the children (11 studies); followed by improvisation-based interventions, including improvisational music therapy and relational music therapy (five studies); listening-based interventions, including the use of background music (three studies); and movement-based interventions including movement to music (one study). One study was based on an intervention that applied both singing and improvisation.

<Table 1> Characteristics of Included Studies

Author (year)	Participants		Target social skill	Intervention	Results
	Study design	N			
Gunter et al. (1984)	SS	2	Aberrant vocalization	Music playing with headphones	Decreases in aberrant vocalization
Egerton (1994)	SS	11	Musical and nonmusical communicative behaviors	Improvisational music therapy	Significant increase in CRASS at the last session compared to the first session
Wimpory et al. (1995)	SS	1	Eye contact; social interaction; symbolic play	Use of familiar games and simple songs about a child's action	Increases in all target behaviors
Orr et al. (1998)	SS	1	Decreased head jerking and screaming	Rhythmic entrainment with provision of recorded music at 50-60 bpm	Decreased occurrence of head jerking and screaming during intervention phases
Brownell (2002)	SS	4	Decreased inappropriate vocalization; following directions	Musically adapted social stories	Decreased problem behaviors in the singing condition, but not with statistically significant difference from the reading condition except in one case
Paisiali (2004)	SS	3	Decreased aberrant vocalization and problem behaviors	Prescriptive songs following the guidelines of social stories	Decreasing trends in the occurrence of aberrant vocalization or problem behaviors but significant differences between phases only in one participant
Kern et al. (2006)	SS	4	Interaction behavior; play; engagement	Structured singing of theme songs through outdoor music center	No significant increase in social interaction; increased desirable peer interaction with individualized song interventions
Kern, Wakeford et al. (2007)	SS	1	Performance of multi-step self-care tasks	Use of song embedded in multi-step daily living routines	Compared to verbal presentation condition, singing intervention was more effective in increasing cleaning up and hand washing, not in toileting

Note. SS: Single subject design.

<Table 1> Characteristics of Included Studies (continued)

Author (year)	Study design	Participants		Target social skill	Intervention	Results
		N	Age (M, yrs)			
Kern, Wolery et al. (2007)	SS	2	3.3	Performance of multi-step greeting tasks	Singing during the morning routine	Increased independent performance of required behaviors during morning routine in both children
Kim et al. (2008)	Within-subject	10	4.3	Joint attention; eye contact; turn taking	Improvisational music therapy	Greater increases in joint attention and significantly increased eye contact and turn-taking duration in music therapy condition compared to the toy play condition
Katagiri (2009)	Within-subject	12	11.5	Recognition and facial expression of emotions	a. Background music associated with emotions b. Teaching songs composed to scenario about emotions	Significant increases in emotional understanding in all conditions; most improvement in the background music condition
Kim et al. (2009)	Within-subject	10	4.3	Joint engagement; emotional synchronicity; compliant behaviors	Improvisational music therapy	Significantly greater occurrence of all target behaviors in music therapy condition compared to the toy play condition
Finnigan et al. (2010)	SS	1	3.7	Social responsiveness; decreased social avoidance	Interactive singing and instrument playing with familiar melodies	Increases in all measures of social responsiveness and decreased social avoidance behaviors in the music condition
Lim (2010)	Between-subject	54 (Ex: 18; Ex 2: 18; Con: 18)	4.7	Speech production	Developmental speech and language training through music	Significantly increased speech production in both music and speech conditions; greater increases with low functioning children in music than in speech treatment condition

Note. Ex: experimental group; Con: control group.

<Table 1> Characteristics of Included Studies (continued)

Author (year)	Study design	Participants		Target social skill	Intervention	Results
		N	Age (M, yrs)			
Gattino et al. (2011)	RCT	24 (Ex: 12; Con: 12)	9.8	Verbal/nonverbal communication	Relational music therapy	No significant differences in autistic symptoms in general; significantly decreased symptoms only in the subgroup with autistic disorder
Lim et al. (2011)	SS	22	4.3	Speech production	Singing the target words/phrases	Higher scores on verbal production evaluation scales at posttest than speech training condition but did not reach statistical significance
Schwartzberg et al. (2013)	RCT	30 (Ex: 16; Con: 14)	15.8	Social reciprocity; social participation; and decreased socially inappropriate behaviors	Music-based social story	Increased comprehension and social skills; significant main effect only in the subcategory of social skills as within subject variables
Simpson et al. (2013)	SS	3	5.9	Receptive labeling	Interactive singing	Increased labelling task performance in all participants
LaGasse (2014)	RCT	17 (Ex: 9; Con: 8)	7.6	Eye gaze; joint attention; and initiation of and response to communication	Movement to music and instrumental playing	Significantly increased joint attention, gaze toward others, and social skills rating scores in the Ex; no significant group differences in communicative behaviors
Thompson et al. (2014)	RCT	23 (Ex: 12; Con: 11)	3.7 (Ex) 3.9 (Con)	Social engagement; speech and language skills; and parent-child relationship	Family-centered music therapy	Significantly improved social interaction; increased speech but not with statistical significance; and no significant increases in parent-child relationship
Vaiouli et al. (2015)	SS	3	5.6	Focus on faces; and joint attention behaviors	Improvisational music therapy	Increased joint attention behaviors and engagement in all participants

Note. RCT: randomized controlled trials; Ex: experimental group; Con: control group.

2. Target social communication areas in included studies

With regard to target social areas, dependent variables in the included studies were categorized into seven areas: social attention, social engagement, initiation of social interaction, communicative behaviors, self-control, self-care skills, and emotional reciprocity. Definition and examples of each target area are displayed in <Table 2>.

<Table 2> Definition and Examples of Target Social Communication Areas

Target area	Definition	Examples
Social attention	Focus and orientation of gaze and body toward others and socially relevant events	Eye contact, gaze shift, and joint attention
Social engagement	Participation in reciprocal activities and maintenance of social interaction	Engagement in play and acceptance of interaction initiated by adults or peers
Initiation of social interaction	Spontaneous attempts to vocalize or act for the purpose of interacting with others	Initiation of play and approaching peers
Communicative behaviors	Intentional use of speech to initiate interaction with others	Greeting and speech production
Self-Control of problem behaviors	Inhibition and control of inappropriate behaviors that interfere with social interaction	Decreased aberrant vocalization and challenging behaviors
Self-Care skills	Completion of a task to increase independent participation in daily activities	Performance of self-care behaviors such as hand-washing, and toileting
Emotional reciprocity	Identification and sharing of the emotion and emotional state	Emotional recognition, emotional expression, and emotional contagion

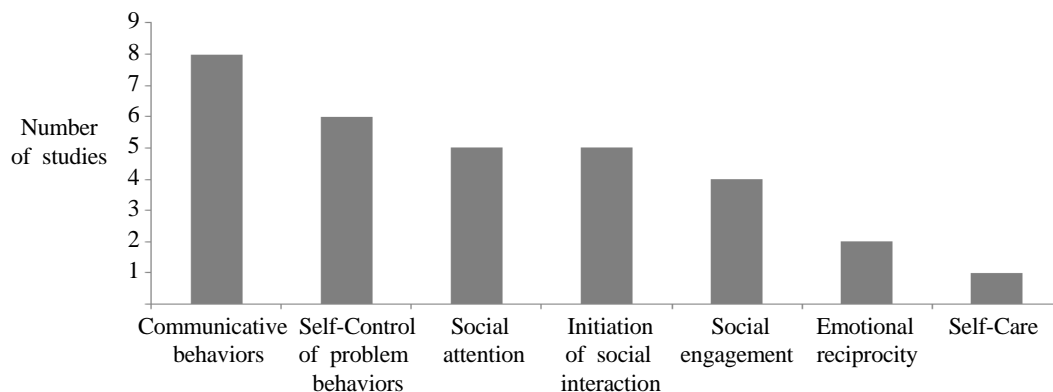
A single social communication area was targeted in 12 studies and multiple areas were targeted in 9 studies (see <Table 3>). For social communication skills targeted as a single outcome, communicative behaviors were included in five studies, followed by self-control of problem behaviors targeted in four studies. Self-care skills were targeted only independently. When multiple areas were targeted, the areas that were most commonly combined with another area included initiation of social interaction, followed by social attention and social engagement.

<Table 3> Target Social Communication Areas in Included Studies

Number of target areas	Target area	Author and published year of included studies	Number of the studies
Single	SA	Vaiouli et al. (2015)	1
	CB	Edgerton (1994); Lim (2010); Gattino et al. (2011); Lim et al. (2011); Simpson et al. (2013)	5
	SC-P	Gunter et al. (1984); Orr et al. (1998); Brownell (2002); Paisiali (2004);	4
	SC-S	Kern, Wakeford et al. (2007)	1
	ER	Katagiri (2009)	1
Multiple	SA+IS	Wimporoy et al. (1995); Finnigan et al. (2010); Kim et al. (2008)	3
	SA+IS+CB	LaGasse (2014)	1
	SE+IS	Kern et al. (2006)	1
	SE+CB	Thompson et al. (2014)	1
	SE+ER	Kim et al. (2009)	1
	SE+SC-P	Schwartzberg et al. (2013)	1
	CB+SC-P	Kern, Wolery et al. (2007)	1

Note. SA: social attention; CB: communicative behaviors; SC-P: self-control of problem behaviors; SC-S: self-care skills; ER: emotional reciprocity; SE: social engagement; IS: initiation of social interaction.

When reflecting each study could multiple areas of social communication, most of the studies included in the analysis targeted communicative behaviors (eight studies), followed by self-control of problem behaviors (six studies), social attention and initiation of social interaction (five studies, respectively). Social engagement was targeted in four studies and emotional reciprocity was the focus in two studies. The least frequently targeted area was self-care skills (see <Figure 1>).



<Figure 1> Frequency of studies that targeted each social communication area

3. Type of measurements for social communication skills in ASD

The types of social communication measurements for children with ASD used in the music therapy intervention literature are summarized in <Table 4>. With regard to type of measurement, a total of 15 studies (71.4%) applied direct observation as the method to measure changes in social communication skills after intervention. When targeted behaviors were directly observed to measure changes in social communication skills, the actual occurrence of the behaviors was recorded in 10 studies (e. g., through frequency recording or duration recording) and five studies measured the estimated occurrence of the target behaviors via interval recording or time sampling. In nine studies using behavioral coding, coders included independently trained coders.

A total of 10 global measures of social communication skills were used in six studies: Autism Social Skills Profile (ASSP), Autism Treatment Evaluation Checklist (ATEC), Childhood Autism Rating Scale adapted for Brazil (CARS-BR), Comprehension Checks (CC), Early Social Communication Scales (ESCS), MacArthur-Bates Communicative Development Inventories, Words and Gestures (MBCDI-WG), Parent-Child Relationship Inventory (PCRI), Pervasive Developmental Disorder Behavior Inventory (PDDBI), Social Responsiveness Scale (SRS), and Vineland Social-Emotional Early Childhood Scales (VSEECs). Among such measurements, six measures were based on ratings by or interviews with caregivers, and the other five measures were rated by professionals (one measurement was based on both caregiver- and professional-completed ratings). In one study, an investigator-invented measurement (Verbal Production Evaluation Scale) was used. A music therapy-based measurement tool (Music Therapy Diagnostic Assessment) was included in one study. Each of these measurements was used in a single study, except SRS, which was applied in two studies, indicating a great variability in the use of measurement tools in the music intervention literature.

<Table 4> Type of Measurements Used in Included Studies

Author(year)	Study design	Age of participants	Target social area	Measurement	Type of measures	Data collection method	Tester
Gunter et al. (1984)	SS	10-13	Self-Control	Behavioral coding	DO	Interval recording	Trained coders
Edgerton (1994)	SS	5-9	Communicative behaviors	CRASS	DO	Interval recording	Music therapy students
Wimporoy et al. (1995)	SS	3.3	Social attention; initiation of interaction	Behavioral coding	DO	Frequency and duration recording	Investigator; blinded coder
Orr et al. (1998)	SS	11.0	Self-Control (problem)	Behavioral coding	DO	Frequency recording	Investigator; classroom paraprofessional
Brownell (2002)	SS	6-9	Self-Control (problem)	Behavioral coding	DO	Frequency recording	Investigator; classroom teacher/instructional associate
Paisiali (2004)	SS	8.9	Self-Control (problem)	Behavioral coding	DO	Frequency recording	Caregivers; paraprofessional
Kern et al. (2006)	SS	1.8	Social engagement; communicative behaviors	Behavioral coding	DO	Frequency recording	Investigator; special educator; trained coder
Kern, Wakeford et al (2007)	SS	3.2	Self-Care	Behavioral coding	DO	Frequency recording	Investigator; educational specialist consultant
Kern, Wolery et al.. (2007)	SS	3.3	Self-Care; communicative behaviors	Behavioral coding	DO	Time sampling	Investigator; special educator; trained coder
Kim et al. (2008)	Within-subject	4.3	Social attention; initiation of interaction	¹ PDDBI ² ESCS ³ Behavioral coding	¹ RC ² RP ³ DO	¹ 3-point rating ² Frequency rating ³ Frequency and duration recording	¹ Caregivers ² Clinician ³ Investigator; trained coder

Note. CRASS: Communicative Responses/Acts Score Sheet; PDDBI: Pervasive Developmental Disorder Behavior Inventory; ESCS: Early Social Communication Scales; DO: direct observation; RC: rating by caregivers; RP: rating by professionals.

<Table 4> Type of Measurements Used in Included Studies (continued)

Author(year)	Study design	Age of participants	Target social area	Measurement	Type of measures	Data collection method	Tester
Katagiri (2009)	Within-subject	11.5	Emotional reciprocity	Emotion recognition test	RP	Event recording	Investigator; trained coders
Kim et al. (2009)	Within-subject	4.3	Emotional reciprocity; social engagement	Behavioral coding	DO	Frequency and duration recording	Investigator; trained coder
Finnigan et al. (2010)	SS	3.7	Social engagement; initiation of interaction	Behavioral coding	DO	Frequency recording	Investigator; behavior therapist
Lim (2010)	Between-subject	4.7	Communicative behaviors	VPES	RP	Yes/no rating	Speech/language pathologists
Gattino et al. (2011)	RCT	9.8	Communicative behaviors	CARS-BR	RC	4-point rating scale	Caregivers
Lim et al. (2011)	SS	4.3	Communicative behaviors	VPES	RP	Yes/no checklist	Speech/language pathologists
Schwartzberg et al. (2013)	RCT	15.8	Social engagement; self-control (problem)	ASSP	RP	4-point Likert	Investigator; trained coders
Simpson et al. (2013)	SS	5.9	Communicative behaviors	Behavioral coding	DO	Interval recording	Investigator; trained coders

Note. RCT: randomized controlled trials; VPES: Verbal Production Evaluation Scale; CARS-BR: Childhood Autism Rating Scale adapted for Brazil; ASSP: Autism Social Skills Profile.

<Table 4> Type of Measurements Used in Included Studies (continued)

Author (year)	Study design	Age of Participants	Target social area	Measurement	Type of measures	Data collection method	Tester
LaGasse (2014)	RCT	7.6	Social attention; initiation of interaction; communicative behaviors	¹ SRS ² ATEC ³ Behavioral coding	¹ RC ² RC; RP ³ DO	¹ 4-point Likert ² 3-point Likert ³ Event recording	¹ Caregivers ² Caregivers; investigator ³ Trained coders
Thompson et al. (2014)	RCT	3.7 (Ex) 3.9 (Con)	Social engagement; communicative behaviors	¹ VSEECs ² SRS ³ MABCDI-WG ⁴ PCRI ⁵ MTDA	¹ IN ² RC ³ RC ⁴ RC ⁵ RP	¹ 5-point rating ² 4-point rating ³ 3-point rating / Yes/no checklist ⁴ 4-point Likert ⁵ 4-point rating	¹ Caregivers ² Caregivers ³ Caregivers ⁴ Caregivers ⁵ Not specified
Vaiouli et al. (2015)	SS	5.6	Social attention	Behavioral coding	DO	Interval recording	Investigator; trained coders

Note. SRS: Social Responsiveness Scale; ATEC: Autism Treatment Evaluation Checklist; VSEECs: Vineland Social-Emotional Early Childhood Scales; MABCDI-WG: MacArthur-Bates Communicative Development Inventories, Words and Gestures; PCRI: Parent-Child Relationship Inventory; MTDA: Music Therapy Diagnostic Assessment; IN: interview.

With regard to the number of measurements selected, the use of a single type of measurement was observed in 17 studies (81%). In four studies, a combination of measurement tools was found in the form of ratings by caregivers, ratings by professionals, and direct observation (Kim et al., 2008); two types of caregiver-rated measures (Schwartzerg et al., 2013); and ratings by caregivers, ratings by professionals, and direct observation (LaGasse, 2014); and interview with caregivers, ratings by caregivers and direct observation (Thompson, McFerran, & Gold, 2014). This study also examined which type of measurement was used depending on the target social area (see <Table 5>). For all target areas, direct observation was the most frequently used means of measuring the intervention outcomes for social communication in children with ASD. For communicative behaviors, social attention, and social engagement, the use of caregiver- or parent-completed rating scales almost equaled the use of direct observation. With regard to self-care skills and emotional reciprocity, only direct observation was used.

<Table 5> Type of Measurement Depending on Targeted Social Communication Area

Target area	Type of measurement (number of studies)	Examples of measurement
SA	DO (4) RC (3) RP (1)	Behavioral coding PDDBI; SRS ESCS
SE	DO (3) RP (2) RC (1) In (1)	Behavioral coding ASSP; MTDA SRS VSEECs
IS	DO (2) RC (1)	Behavioral coding PDDBI
CB	DO (5) RC (5) RP (3)	Behavioral coding; CRASS ATEC; CARS-BR; MABCDI-WG; SRS ATEC; VPES
SC-P	DO (3) RP (1)	Behavioral coding ASSP
SC-S	DO (2)	Behavioral coding
ER	DO (2)	Behavioral coding

Note. SA: social attention; CB: communicative behaviors; SC-P: self-control of problem behaviors; SC-S: self-care skills; ER: emotional reciprocity; SE: social engagement. IS: initiation of social interaction; DO: direct observation; RC: ratings by caregivers; RP: ratings by professionals; In: interview. The measurement types are presented based on their frequency in the analyzed studies.

4. Quality assessment of measurements in included studies

The analysis of the quality of the measurements used in the 21 research studies are summarized in <Table 6>. Of the included studies, a total of 18 reported interrater reliability with the mean agreement of .88, indicating the considerable quality of the measurements. Two studies in which existing measurement tools were modified and administered, reported internal consistency with a mean rating of 0.71. None of the studies reported the validity of their measurements, which may be attributed to the fact that the most of the included studies used exiting measurement tools rather than newly developed tools. With regard to blinding of outcome assessment, only in seven studies (33.3%) were the evaluators blind to the assignment of the observed children or the order of sessions from which recorded behaviors were selected.

IV. Discussion

This study aimed to analyze the measurements used for documenting changes in social communication skills of children with ASD in the music therapy intervention literature. The controlled studies that targeted social communication skills in children with ASD were identified, and the measurements used in those studies were included in the analysis. A total of 21 studies that met the criteria were analyzed.

The identified studies primarily applied a single subject design and song-based intervention was frequently used in the literature. The frequent selection of a single subject design indicate that individual changes in behaviors/responses directly targeted in the intervention context have been emphasized in the music therapy literature, supporting a recent study that demonstrated that increased outcomes were observed when a specific behavior was directly targeted and when corresponding changes were measured in a context similar to that of the intervention (Yoder, Bottema-Beutel, Woynaroski, Chandrasekhar, & Sandbank, 2014).

The results also demonstrate that a single area of social communication skill was more frequently targeted compared to multiple areas. The most frequently targeted social communication skills include communicative behaviors, social attention, and self-control of problem behaviors. While the variables in relation to acquisition of a specific behavior (e. g., communicative behaviors or self-control behaviors) were targeted as single expected outcomes,

<Table 6> Quality of Measurements in the Included Studies

Study	Measurement	Components of quality assessment			
		Interrater reliability	Internal consistency	Validity	Blinding
Edgerton et al. (1994)	CRASS	.75 - 1.00	-	-	N
Gunter et al. (1984)	Behavioral coding	.86 - .91	-	-	N
Wimporly et al. (1995)	Behavioral coding	.92	-	-	N
Orr et al. (1998)	Behavioral coding	1.00	-	-	N
Brownell (2002)	Behavioral coding	.86 - .93	-	-	N
Paisiali (2004)	Behavioral coding	.92 - .99			N
Kern et al. (2006)	Behavioral coding	.98	-	-	N
Kern, Wakeford et al. (2007)	Behavioral coding	.96	-	-	N
Kern, Wolery et al. (2007)	Behavioral coding	.94	-	-	N
Kim et al. (2008)	PDDBI	.19(pre) / .67(post)	-	-	N.A.
	ESCS	.71 - .97	.60	-	N
	Behavioral coding	.90 - .98	-	-	Y
Katagiri (2009)	Behavioral coding	N	-	-	N
Kim et al. (2009)	Behavioral coding	.86 - .98	-	-	N
Finnigan et al. (2010)	Behavioral coding	.86, .87	-	-	Y
Lim (2010)	VPES	.999	-	-	Y
Gattino et al. (2011)	CARS-BR	.91	.82	-	Y
Lim et al. (2011)	VPES	N	-	-	Y
Schwartzberg et al. (2013)	ASSP	N.A	-	-	N.A.
	CC	N.A			N.A.
Simpson et al. (2013)	Behavioral coding	.75 - .85	-	-	N.A.
LaGasse (2014)	SRS	N.A	-	-	N.A
	ATEC	N.A	-	-	N.A
	Behavioral coding	.86 - .94	-	-	Y
Thompson et al. (2014)	VSEEC	N.A	-	-	N.A.
	SRS	N.A	-	-	N.A.
	MABCDI	N.A	-	-	N.A.
	PCRI	N.A	-	-	N.A.
	MTDA	.60	-	-	N
Vaiouli et al. (2015)	Behavioral coding	.91 - 1.00	-	-	Y

Note. Y: yes; N: no.

there was a tendency for other variables, such as social engagement, initiation of social interaction, and emotional reciprocity, to be targeted with other types of social communication skills. This reflects the complicated nature of these variables as they become the basis for more complex social communication behaviors, rather than functioning as endpoints in and of themselves.

Among the types of measurements that varied across the studies, direct observation of behaviors was used most frequently when measuring changes in social communication skills after music therapy intervention. Also, the use of the direct observation method was applied as a single measurement. While behavioral observation enables direct evaluation of a specific behavior and sensitive reflection on behavioral changes in short-term trials, it is limited when it comes to addressing inconsistencies with regard to an individual's developmental pace based on the acquisition of social skills and behaviors (Anagnostou et al., 2015; Bolte & Diehl, 2013). If a child fails to accurately show behaviors/responses in a controlled environment despite a child's intention or motivation to learn the target behaviors, social communication measurements might underestimate the level of his or her potential development across settings. These results indicate the needs to assess social communication skills at multiple levels for better understanding of a child with ASD.

With regard to caregiver- and professional-rated global measures of social communication skills, there was large variability across studies. Only one measure (i. e., SRS) was used in two studies. The combination of targeted social communication areas and specific measurements used for the skills also varied greatly among the included studies. Such inconsistency may decrease the internal validity and limit the interpretation of outcomes in terms of which subskills or subcomponents of social communication can be effectively targeted by the music therapy intervention. Further conclusive analysis of music intervention effects depending on outcome variables and the combination of target area-intervention type-outcome measures can be suggested in order to propose more robust music intervention effectiveness for future studies and clinical practice.

With regard to measurement quality, the majority of the included studies reported interrater reliability. These results indicate that attempts to increase the appropriateness and objectivity of the data collected have been sufficiently made. Meanwhile, internal consistency or validity of the measurements was reported only in a few studies. Blinding of outcome assessment were administered in only one third of the included studies. This may be attributed to the existing measurement tools that were primarily used, rather than modified or newly developed

measurements that require corroboration of appropriateness via validity testing. Also, research that is conducted in a clinical environment has limitations in controlling the blinding processes. However, in order to corroborate the evidenced effectiveness of music interventions for children with ASD, more controlled selection and administration of measurements need to be considered in future clinical research.

This study analyzed social communication measurement tools used in the music therapy interventions with children with ASD. However, the evaluation of these measurements was primarily based on reports of quality components of these measurements. Future studies should be conducted to examine the relationship among target goal areas, the type of measurement used and the differential effects evidenced. In addition, the search was limited to peer-reviewed journals published in English. Further research is needed to more cautiously rule out publication bias by including studies published in languages other than English and broader types of literature. Controlled measurement of different levels of social communication is also suggested for clinical use and future studies. For example, attempts to rely on both direct observation of behaviors in the intervention context and assessment of social functioning across settings, including more natural environment (e. g., home and school), will monitor changes in context-bound behaviors, and also predict generalizability to multiple settings.

In conclusion, this analysis of social communication measurement for children with ASD in the music literature ascertains that diverse approaches have been attempted to measure change in social communication. The results of this study will provide useful resources for intervention-wise and measurement-wise decision making. It will also give rise to the needs of multifaceted understanding of children with ASD and controlled efforts to expand outcome measures of music therapy intervention for this population.

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Analysis of Social Communication Measurement in the Music Therapy Intervention Literature for Children With Autism Spectrum Disorder

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With broad individual variability in social communication skills of children with autism spectrum disorders and increasing focus on interventions targeting social communication of this population, there is a need for systematic analysis of how social communication outcomes are measured. This study aimed to systematically analyze the measurement tools used in the music therapy interventions for improving social communication of children with ASD. Electronic databases and music therapy journals were searched for controlled studies published between 1980 and 2015. A total of 21 studies were included for the analysis. The results demonstrated that direct observation of behaviors was the most frequently used and the combination of targeted social communication areas and specific measurements used for a specific skill varied among the studies. In addition, 90.4% of studies reported interrater reliability. These results indicate that there has been a diversity in approaches to measure social communication skills despite increasing attempts for systematic measurements. In consideration of the nature of social communication development in children with ASD, multifaceted strategy to understand and assess the target skills in terms of specific behavior acquisition, social functioning in general, and social cognition was recommended.

Keywords : autism spectrum disorder, social communication, measurement, music intervention

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