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EFFICACY OF MUSIC-CENTERED IMPROVISATIONAL MUSIC THERAPY ON THE TREATMENT OF PRESCHOOL CHILDREN ON THE AUTISM SPECTRUM: A CONTROLLED STUDY

Eficácia da musicoterapia improvisacional musicocentrada no tratamento de crianças pré-escolares no espectro do autismo: um estudo controlado

Eficacia de la musicoterapia musicocentrada de improvisación en el tratamiento de niños preescolares en el espectro del autismo: un estudio controlado

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Abstract - Music is related as a treatment for people on the Autism Spectrum (ASD), although controlled studies with specific music therapy approaches are scanty. Aiming to investigate the effects of Music-centered Improvisational Music Therapy(MCIMT)on the treatment of preschool children with ASD, 45 autistic children aged 2 to 6 years old were assigned to groups under control (n=19) and intervention (n=26) conditions. Initial and Final assessments(T1 and T2) were performed through psychiatric and music therapy scales. The intervention group received individual weekly Music-centered Improvisational Music Therapy sessions. Both groups kept usual care during study. Intervention group participated in follow up evaluation (T3) two months after T2. Statistical analyses showed that both groups were paired on T1. Differences between T1 and T2 were significant for almost all scales on the intervention group while the control group showed significance only on one communication subscale. The intervention group showed moderate to large effect size, while the control group showed a small effect size. Most improvements were not maintained on T3. Correlations between initial data and treatment response rate are discussed. Results suggest the value of Music-centered Improvisational Music Therapy in promoting improvements on behaviors, communication, and socialization for pre-school children with ASD.
Keywords: autism spectrum; preschool children; music therapy; music-centered improvisational music therapy.

Resumo - A música é relacionada ao tratamento para pessoas com Transtorno do Espectro do Autismo (TEA), embora estudos controlados com abordagens específicas da Musicoterapia sejam escassos. Com o objetivo de investigar os efeitos da Musicoterapia Improvisacional Musicocentrada no tratamento de crianças pré-escolares com TEA, 45 crianças autistas, de 2 a 6 anos, foram alocadas nas condições Controle (n = 19) e Intervenção (n = 26). Elas foram submetidas à avaliação inicial e final (T1 e T2), por meio das escalas da Psiquiatria e

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Musicoterapia. O grupo intervenção recebeu sessões semanais individuais de Musicoterapia Improvisacional Musicocentrada. Ambos os grupos mantiveram os cuidados habituais durante o estudo. O grupo intervenção participou da avaliação de manutenção (T3) dois meses após o T2. As análises estatísticas mostraram que os grupos estavam pareados em T1. As diferenças entre T1 e T2 foram significativas para quase todas as escalas no grupo intervenção, enquanto o grupo controle mostrou significância apenas em uma subescala de comunicação. O grupo intervenção mostrou tamanho de efeito moderado a grande, enquanto o grupo controle mostrou um tamanho de efeito pequeno. A maioria das melhorias não foi mantida no T3. As correlações entre os dados iniciais e a taxa de resposta ao tratamento são discutidas. Os resultados sugerem o valor da Musicoterapia Improvisacional Musicocentrada na promoção de melhorias nos comportamentos, comunicação e socialização para crianças em idade pré-escolar com TEA.
Palavras-chave: espectro do autismo; crianças em idade pré-escolar; musicoterapia; musicoterapia improvisacional musicocentrada.

Resumen - La música está relacionada con el tratamiento de personas con trastorno del espectro autista (TEA), aunque son escasos los estudios controlados con enfoques específicos de musicoterapia. Con el fin de investigar los efectos de la Musicoterapia Improvisacional Músico Centrada en el tratamiento de niños en edad preescolar con TEA, se asignaron 45 niños autistas de 2 a 6 años de edad a las condiciones control (n = 19) e intervención (n = 26). Fueron sometidos a evaluación inicial y final (T1 y T2) mediante las escalas de Psiquiatría y Musicoterapia. El grupo de intervenção recibió sesiones individuales semanales de Musicoterapia Improvisacional Músico Centrada. Ambos grupos mantuvieron su tratamiento habitual durante todo el estudio. El grupo intervención participó en la evaluación de mantenimiento (T3) dos meses después de T2. Los análisis estadísticos mostraron que los grupos estaban emparejados en T1. Las diferencias entre T1 y T2 fueron significativas para casi todas las escalas en el grupo intervención, mientras que el grupo control mostró significancia solo en una subescala de comunicación. El grupo intervención mostró un tamaño de efecto de moderado a grande, mientras que el grupo control mostró un tamaño de efecto pequeño. La mayoría de las mejoras no se mantuvieron en T3. Se discuten las correlaciones entre los datos iniciales y la tasa de respuesta al tratamiento. Los resultados sugieren la importancia de la Musicoterapia Improvisacional Músico Centrada para promover mejoras en el comportamiento, la comunicación y la socialización de los niños en edad preescolar con TEA.
Palavras Claves: espectro del autismo; niños preescolares; musicoterapia; musicoterapia improvisacional músico centrada

1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that affects communication, socialization, and behavior since early childhood. The prevalence in the population is approximately 1:59, being more common in males (Baio et al, 2018). Since there is no biological identification marker for ASD, the diagnosis is made through clinical observation (Landa, 2008).

There are two pillars for ASD: (a) deficits in interaction and social communication and (b) restricted and repetitive patterns of behavior and interests. The first pillar manifests as limitations, for example, of non-verbal communicative behaviors, imitation, imaginative ability, socio-emotional reciprocity, and relationships development and maintenance. The second one includes the stereotyped use of body or objects, resistance to changes, fixation of interests and hyper or hypo sensitivity to sensory stimuli (APA, 2013).

The phenomenological and behavioral diversity of ASD, along with the discussions about its possible causes and the different treatment proposals motivate research in several fields of knowledge (Rossignol, 2009). Novel treatments have been implemented in order to improve ways to stimulate the abilities affected by ASD (Rossignol, 2009). Music therapy appears in this context as a possible and ascending form of treatment that contributes to health promotion of this population (Wigram & Gold, 2006; Rojas et al., 2018).

According to Molnar-Szakacs and Heaton (2012), people with ASD generally have a remarkable interest in music and may even have exceptional musical ability, therefore music could be a unique window into the world of ASD. In a previous study, the authors argued that musical activities are social activities that would provide interaction, thus enabling language and motor skills acquisition (Molnar-Szakcs et al, 2009). It is possible that the apparent success of music therapy in the treatment of ASD is due to the special interest that music incites in this population (Berger, 2003). In short, music therapy would help people with ASD through pleasurable and motivational activities that attract interest and attention, facilitating the achievement of the

therapeutic goals. There are experimental researches that confirm these hypotheses. They show positive developments in communication and / or social skills as well as reduction of stereotyped behaviors in children with ASD after music therapy treatment (Finnigan & Starr, 2010; Simpson & Keen, 2011; Lanovaz et al., 2012; Rojas et al., 2018, André et al., 2018).

Music therapy procedures and methods vary according to the approach, goals of therapy and needs of the individual or group. The musical experiences used are: listening, recreation, improvisation and composition, which can be applied together or separately (Bruscia, 2016).The most common music therapy approach in ASD research is Improvisational Music Therapy (IMT), which is also the closest to clinical reality (Wigram & Gold 2006; Gattino, 2012; Geretsegger et al., 2015). During clinical process, music improvisation motivates the use of the voice and the musical instruments, usually in a playful way, thus stimulating communication and interaction (Geretsegger et al, 2012). According to the authors, music improvisation allows the music therapist to adapt the music to the child's behaviors and mirror the child's mood.

In a randomized controlled study, Kim et al. (2009) compared IMT to toy play sessions and non-directive sessions to directive sessions. Ten pre-school children with ASD were treated for 12 weeks in each condition. Emotional, motivational and interpersonal responses were analyzed for their frequency and duration through randomized excerpts of session recordings. The results showed greater statistical significance in non-directive musical practices, especially regarding the increase of joy and emotional synchronicity. The study emphasizes the importance of socio-motivational aspects of music interaction, especially for providing engagement initiatives.

In a review about IMT, Gattino (2012) points out the improvement in non-verbal communication as the main effect of this approach. Sarapa and Katusic (2012) report that music creation through clinical improvisation can provide musical communication and thus brings improvements in other communication levels. Other relevant results in the literature are: improvements in joint attention and imitation, as well as decrease in undesirable behaviors such as crying and vocal stereotypes (Wigram & Gold, 2006; Kim et al., 2008; Geretsegger et al., 2015). It is important to emphasize that the goals of

IMT are directly related to communication and interaction, which are the most affected areas in ASD (Wigram & Gold, 2006).

When the music therapist applies IMT within a music-centered perspective it can be called Music-centered Improvisational Music Therapy (MCIMT). Music-centered Music Therapy is an indigenous music therapy theory grounded on music that understands music as the agent of therapy (Aigen, 2005). In Music-centered Music Therapy, clinical music improvisation is a very usual way to engage children with ASD in the music therapy process. The music therapy relationship can be seen as a triangle where the child, the music and the music therapist live together in the musical experience (Brandalise, 2001). This helps the music-centered music therapist to the listen to the child as a musical being and respond to him/her musically in a subtle and careful way. This also allows more quality in the shared music making and enhances achievement of goals through a meaningful experience (Brandalise, 2001; Nordoff & Robbins, 2007).

The main objective of this research is to investigate the effects of MCIMT in the treatment of children with ASD. MCIMT is communly used with this population but quantitative investigation of its effects was not found. Specific objectives of this research are: (a) to evaluate the progress of children before and after music therapy; (b) to compare intervention group to control group; (c) to evaluate the maintenance of the children' progress two months after intervention; (d) to correlate initial data with children response rate to intervention.

2. Methods

2.1 Participants

The participants were 45 children diagnosed with ASD, aged 02 to 06 years old. Exclusion criteria were: already received Music Therapy, profound hearing loss, hearing hypersensitivity and / or severe neuropsychiatric disease (for example, an inborn error of metabolism, epilepsy). Consent was obtained for the experimentation and the privacy rights of human subjects were preserved.[5]

Subjects were invited on the Psychiatry Service of the Clinical Hospital of *Universidade Federal de Minas Gerais* (UFMG), where they were previously given

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diagnosis confirmation for ASD. As the subjects were referred by the psychiatrists, they were randomly assigned to the intervention group or to a waiting list (control group). Only the intervention group received the MCIMT sessions. The children in the control group (waiting list) did not receive music therapy intervention for 16 weeks, and after this period were referred to music therapy. Both groups maintained usual care: psychiatric follow-up, medication treatment (if there was one), other therapeutic treatments and school attendance.

2.2 Assessment

Clinical ratings were done at baseline (T1) and after 16 weeks (T2) for both groups through an interview with parents (out-session evaluation) and at individual MCIMT session with the child (in-session evaluation). For the subjects on the Intervention group, ratings were replicated 2 months after under the same conditions, to evaluate the maintenance of treatment effects (T3).

During the interview, the following scales were used to evaluate the child's health and clinical condition: Childhood Autism Rating Scale (CARS) (Pereira et al, 2008), Autism Treatment Evaluation Checklist (ATEC) (ARI, 2007), Autism Behavior Checklist (ABC-1) (Marteleto & Pedromônico, 2005), Aberrant Behavior Checklist (ABC-2) (Aman & Singh, 1986), Children Global Assessment Scale (CGAS) (Shaffer, 1983) and Clinical Global Impression (CGI) (Guy, 200). The first three scales evaluate the symptoms of ASD and the others evaluate general behavior and performance. These are out-session measures and were answered by the parents in two meetings held with the purpose of interviewing the children's parents. Each meeting lasted one hour.

The in-session evaluation was made through observation of the filming of the Music Therapy sessions. The following Nordoff-Robbins Scales (NRS) were used: The Child-Therapist Relationship in Coactive Music Experience (NRS1) and Musical Communicativeness (NRS2) (Nordoff & Robbins, 2007).

The NRS1 was translated and validated for the Brazilian context by André (2021).Further evidence of the validity and reliability of this scale can be seen in the studies by André et al. (2018) and André, Gomes & Loureiro (2020a, 2021a, 2021b). Through this scale, the music therapist can assess two aspects: levels of participation

and quality of resistivity. These aspects are evaluated from 7 levels. In this context, the higher the level reached by the child, the more adequate is the relationship in the musical experience.

The NRS2 was translated and validated for the Brazilian context by André (2017). Other evidence of reliability and validity of this scale can also be found in research by André et al. (2018) and André, Gomes & Loureiro (2017, 2018, 2020b, 2021a, 2021b). This scale allows evaluating the child's musical communication in three aspects: vocalizations, use of musical instruments and body movements. Each aspect is subdivided into seven levels, where level 1 represents no musical communication and level 7 represents the best possible musical communication (Nordoff & Robbins, 2007; André, 2017).

These scales were filled by the music therapist and by undergraduate trainees who followed the evaluation sessions, and were replicated if there was no agreement among the answers. Each evaluation session lasted 30 minutes.

2.3 Music therapy intervention

During the 16 weeks between T1 and T2, the children on the intervention group received weekly, individual music therapy sessions of about 30 minutes long. All sessions were filmed for further analysis. Sessions were held in a room at the Psychiatry Service of the Clinical Hospital of UFMG assigned for the research. An Ethylene Vinyl Acetate mat and the following musical instruments were used: a guitar, a four-octave keyboard, two medium drums, two sticks, two maracas, six egg-shakers, a frog-shaped reco-reco, a soprano recorder, and the human voice.

The sessions were structured in the MCIMT approach, already explained, based on Brandalise (2001), El-Khouri (2006) and Nordoff and Robbins (2007). The major goals were to strengthen therapeutic bond and to develop expressiveness, creativity, and musicality; specific goals were set for each child, depending on individual needs (Nordoff & Robbins, 2007).

The clinical music improvisation sessions could be standardized in three stages of intervention (Table 1) (Freire, André & Kummer, 2015). The three stages of

intervention were conducted using the first five Levels of Musical Interaction by El-Khouri (2006): musical contact, mirroring, support, encouragement, and dialogue. The stages division also considered the process through detecting clinical music fragments, creating clinical themes and creating variations of clinical themes (Brandalise, 2001).

The Hello and Goodbye Songs were the same in the three stages, for all children (the music therapist adapted the song for each child's name). In the first stage, contact, ambiance, and exploration took place. The music therapist awaits the child's musical initiative (clinical music fragments), and intervenes musically, inviting the child to engage in a shared music experience. In the second stage, with the engagement in the coactive music making, the music therapist supports the child's musical expression and leads the improvisations to create a clinical theme and to motivate the child to maintain musical communication and retake the theme. In the third and last stage, therapist and child propose music variations, which may be incorporated into the clinical theme (Table 1).

Because of the heterogeneity of ASD cases and the child's receptivity to treatment, the numbers of sessions at each stage are not fixed – Table 1 presents an ideal average of sessions for each stage. The real number of sessions depend on each child since the music-centered music therapy process is singular for each individual.[6]

Session time	**Intervention**
0-5 minutes	**Hello Song and invitation for the child to enter the room / play instruments**

6For further details on this subject, we recommend reading Freire, André and Kummer (2015).

5-25 minutes	**Stage I (Sessions 01-04)**	**Stage II (Session 05-12)**	**Stage III (Sessions 12-16)**
	Beginning of therapeutic relationship; Space and instruments exploration; Child's initiatives (clinical music fragments).	**Engagement in the coactive musical experience; Creation of clinical theme; Motivation to retake theme and maintain musical communication.**	**Variations of clinical theme; Consolidation of variations and expansion of clinical theme; closing sessions.**
25-30 minutes	**Goodbye Song and tidying up the music room**		

Table 1: Structure of Clinical Intervention in Music-centered Improvisational Music Therapy (MCIMT) the happened during intervention

2.4 Data analysis

Statistical analyses were performed using Statistical Package for Social Sciences - SPSS (version 17.0 for Windows). Descriptive analyses were carried out to characterize the sample, and comparative analyses were performed to evaluate effects of intervention. The sample was characterized as non-normal distribution, so nonparametric methods were used. Categorical variables are presented in relation to their frequency (counting and percentage). Continuous variables are presented in relation to their means and standard deviations.

For comparative analyses, the effect size was calculated through Cohen's d, which gives the magnitude of the difference between conditions, considering an average effect above 0.5 and a large effect above 0.8 (Dancey et al, 2006). For correlation analyses, the improvement delta obtained through the difference between scores (Δ = initial score - final score) was considered as treatment response rate. It was adopted a bilateral p-value less than 0.05 as the level of statistical significance for all tests. If there were even lower values ($p \leq 0.01$ and $p \leq 0.001$), they were highlighted.

The comparison objectives and the respective methods were:

(a) To verify intergroup differences for baseline clinical and demographic data, and for the scales on T1 and T2 - Mann-Whitney tests for 2 independent samples;

(b) To verify intragroup difference between T1 and T2 - Wilcoxon Test for 2 related samples;

(c) To verify intragroup difference between T2 and T3 for Intervention group - Wilcoxon Test for 2 related samples;

(d) To verify if age, gender, number of therapies and parent data relate to treatment response rate - Spearman's correlation test.

3. Results

3.1 Initial demographic and clinical data

By the end of the research, 19 children were in the control group and 26 in the intervention group. Both groups were composed mostly by boys, as it is expected on ASD cases. The control group comprised of the average age of 3 to 4 years old, and the intervention group average was around 5 years old. This age difference is expected in waitlist control group survey design. By concerning demographic characteristics, the groups showed statistical difference only to children's age. Groups were also similar regarding their parents' demographic characteristics: age (average over 30 years), gender (majority women) and schooling (education average over 10 years) (Table 2).

	CONTROL GROUP (N=19)	**INTERVENTION GROUP (N=26)**	
Children data	***Mean (SD)***	***Mean (SD)***	***P value***
Age (months)	47.32 (11.71)	60.38 (9.343)	.001
	Freq (%)	*Freq (%)*	
Gender (Male)	15(78.9%)	23 (88.5%)	.390

Parents data (who answered the interview)	***Mean (SD)***	***Mean (SD)***	***P value***
Age (years)	34.47 (5.168)	33.77 (6.611)	.827
Schooling (years of study)	10.84 (3.834)	10.35 (3.111)	.499
	Freq (%)	*Freq (%)*	
Gender (Female)	19 (100%)	25 (96.2%)	.393

TABLE 2: Demographic data
Abbreviations: SD = standard deviation; Freq = frequency.

Also on baseline, children in both groups presented ASD diagnosis confirmation through ABC-1 (means above the cut score of 49 points) and CARS (mean=38, which corresponds to severe autism). Most subjects in both groups participated in two other therapies. There were no significant changes in drug treatment and in school attendance during the study period. There was no statistically significant difference in these usual care between the groups (p>0.05) (Table 3).

	CONTROL GROUP (N=19)	**INTERVENTION GROUP (N=26)**	
Children data	***Mean (SD)***	***Mean (SD)***	***P value***
Diagnostic confirmation (ABC-1)	80.00 (24.527)	81.12 (26.790)	.713
Confirmation and severity of ASD (CARS)	38.68 (7.020)	38.13 (6.097)	.982

Number of therapies during research	2.05 (0.911)	2.00 (1.166)	.674
	Freq (%)	*Freq (%)*	
Changed drug treatment during research	Yes: 7 (36.8%)	7 (26.9%)	.483
Started attending school during research	Yes: 3 (15.8%)	1 (3.8%)	.169

TABLE 3: Clinical data
Abbreviations: SD = standard deviation; Freq = frequency; ABC-1 = Autism Behavior Checklist; CARS = *Childhood Autism Rating Scale*

3.2 Comparative analyses

3.2.1 Intergroup analysis

On baseline, there was no statistical significance between control and intervention groups (p>0.05) in any scale, thus reaffirming the similarity between the groups at the beginning of research (Table 4).

On T2, all scales proportional to the child's impairment presented smaller results for the intervention group, and all scales proportional to the child's development presented higher results for the intervention group. Most of them had a significant p value (p<0.05) (Table 4).

	T1			**T2**		
	Control Group (n=19)	**Intervention Group (n=26)**		**Control Group (n=19)**	**Intervention Group (n=26)**	
Variables	**Mean (SD)**	**Means (SD)**	**P value**	**Mean (SD)**	**Means (SD)**	**P value**
Childhood Autism Rating Scale	38.68 (7,020)	38.13 (6,097)	.982	38.53 (7.171)	32.60 (5.221)	.006**
Autism Treatment Evaluation Checklist:						
1.Speech/Language/	19.32 (.,118)	19.19 (5.099)	.604	18.00 (7.579)	14.73 (6.334)	.107

Communication						
2. Sociability	20.47 (8.167)	18.88 (7.706)	.505	20.79 (4.962)	12.62 (5.933)	<.001***
3. Sensory and cognitive awareness	17.79 (8.243)	14.88 (6.993)	.268	16.53 (6.875)	10.46 (5.623)	.003**
4. Physical/health behavior	24.21 (1.,297)	26.92 (10.594)	.364	29.37 (11.534)	18.31 (9.854)	.005**
Total	81.79 (29.386)	79.88 (25.574)	.899	84.68 (26.266)	55.92 (21.631)	.001***
Autism Behavior Checklist:						
1. Sensory stimuli sensorial	13.84 (6.492)	13.88 (5.813)	.945	14.32 (5.687)	9.00 (5.621)	.078
2. Relating	20.84 (8.241)	19.00 (9.432)	.363	20.42 (6.113)	11.92 (6.343)	<.001***
3. Body and object use	17.05 (8.784)	17.31 (8.735)	.982	16.89 (7.688)	12.27 (8.013)	.073
4. Language	13.74 (4.965)	15.62 (4.674)	.166	13.74 (5.342)	11.15 (4.017)	.125
5. Social self-help	14.53 (3.963)	15.15 (4.929)	.399	14.74 (3.541)	11.65 (5.215)	.053
Total	80.00 (24.527)	81.12 (26.790)	.713	80.00 (18.409)	56.00 (21.674)	.001***
Aberrant Behavior Checklist:						
1. Irritability, Agitation, Crying	15.68 (7.789)	14.65 (8.280)	.637	17.00 (6.807)	10.65 (6.164)	.003**
2. Lethargy/Social Withdrawal	21.74 (8.742)	20.81 (8.949)	.917	22.16 (9.209)	12.00 (6.086)	<.001***
3. Stereotypic Behavior	6.95 (5.307)	7.12 (5.109)	.773	6.84 (4.298)	4.46 (3.603)	.088
4. Hyperactivity, Noncompliance	18.26 (9.267)	18.65 (9.351)	.899	18.74 (7.490)	12.92 (6.829)	.015*
5. Inappropriate Speech	3.05 (3.504)	3.19 (3.359)	.759	3.58 (3.878)	2.31 (2.665)	.432
ChildrenGlobalAssessment Scale	31.26 (14.425)	35.00 (9.317)	.633	32.84 (12.760)	39.12 (8.548)	.097
Clinical Global Impression						
Severity	5.11 (1.100)	4.85 (1.084)	.444	5.05 (1.079)	4.12 (1.033)	.011**
Clinical improvement	-	-	-	3.58 (.838)	2.69 (.736)	.001***
Nordoff-Robbins Scales:						
1. Child-Therapist Relationship	2.368 (0.8794)	2.577 (0.7168)	.434	2.553 (1.1042)	4.231 (0.9190)	<.001***
2. Musical Communicativeness	2.368 (1.0116)	2.327 (0.6625)	.800	2.421 (1.1698)	3.865 (1.2046)	.001***

TABLE 4: Comparison between research groups on T1 and T2
Abbreviations: SD = standard deviation. *p≤0.05; **p≤0.01; ***p≤0.001

3.2.2 Intragroup analysis

For children in the intervention group, the difference between T1 and T2 was statistically significant in all scales and subscales, with p≤0.01. Only the last two ABC-2 subdomains (hyperactivity and inappropriate speech) had an effect size smaller than 0.5. For all other scales, the effect size was greater than 0.5 (mean effect) or greater than 0.8 (large effect). In-session scales (NRS1 and NRS2) showed significant difference with p≤0.001 and effect size d>1.0 (Table 5).

For children in the control group, p-value showed a p<0.05 significance only in two ATEC subdomains (1-speech / language / communication and 4-physical / health behavior), but with an effect size less than 0.5. In the first ATEC domain (speech / language / communication), the difference results in a positive delta (means the children improvement), but this difference, the p-value and effect size were even higher in the intervention group (p<0.001 and d=780), which demonstrates a positive effect of the music therapy intervention. In the fourth ATEC domain (physical / health behavior), the difference results in a negative delta (meaning that the children in the control group worsened). There was no statistical significance for the control group in any other measurement (Table 5).

	CONTROL GROUP (N=19)				**INTERVENTION GROUP (N=26)**			
	T1	**T2**			**T1**	**T2**		
Variables	**Mean (SD)**	**Mean (SD)**	**P value**	**Effect *(d)***	**Mean (SD)**	**Mean (SD)**	**P value**	**Effect *(d)***
Childhood Autism Rating Scale	38.68 (7.020)	38.53 (7.171)	.635	.021	38.13 (6.097)	32.60 (5.221)	<.001***	.977
Autism Treatment Evaluation Checklist:								

1.Speech/Language/ Communication	19.32 (7.118)	18.00 (7.579)	.032*	.180	19.19 (5.099)	14.73 (6.334)	<.001***	.780
2. Sociability	20.47 (8.167)	20.9 (4.962)	.968	.049	18.88 (7.706)	12.62 (5.933)	<.001***	.918
3. Sensory and cognitive awareness	17.79 (8.243)	16.53 (6.875)	.195	.167	14.88 (6.993)	10.46 (5.623)	<.001***	.701
4. Physical/health behavior	24.21 (11.297)	29.37 (11.534)	.009**	.452	26.92 (10,.94)	18.31 (9.854)	<.001***	.842
Total	81.79 (29.386)	84.68 (26.266)	.337	.104	79.88 (25.574)	55.92 (21.631)	<.001***	1.015
Autism Behavior Checklist:								
1. Sensory stimuli sensorial	13.84 (6.492)	14.32 (5.687)	.614	.079	13.88 (5.813)	9.00 (5.621)	<.001***	.854
2. Relating	20.84 (8.241)	20.42 (6.113)	.506	.059	19.00 (9.432)	11.92 (6.343)	<.001***	.898
3. Body and object use	17.05 (8.784)	16.89 (7.688)	.758	.019	17.31 (8.735)	12.27 (8.013)	<.001***	.602
4. Language	13.74 (4.965)	13.74 (5.342)	.959	.000	15.62 (4.674)	11.15 (4.017)	<.001***	1.029
5. Social self-help	14.53 (3.963)	14.74 (3.541)	.812	.056	15.15 (4.929)	11.65 (5.215)	<.001***	.690
Total	80.00 (24.527)	80.00 (18.409)	.687	.000	81.12 (26.790)	56.00 (21.674)	<.001***	1.037
Aberrant Behavior Checklist:								
1. Irritability, Agitation, Crying	15.68 (7.789)	17.00 (6.807)	.199	.181	14.65 (8.280)	10.65 (6.164)	.003**	.554
2. Lethargy/Social Withdrawal	21.74 (8.742)	22.16 (9.209)	.793	.047	20.81 (8.949)	12.00 (6.086)	<.001***	1.172
3. Stereotypic Behavior	6.95 (5.307)	6.84 (4.298)	.733	.023	7.12 (5.109)	4.46 (3.603)	.002**	.611
4. Hyperactivity, Noncompliance	18.26 (9.267)	18.74 (7.490)	.444	.057	18.65 (9.351)	12.92 (6.829)	<.001***	.708

5. Inappropriate Speech	3.05 (3.504)	3.58 (3.878)	.309	.144	3.19 (3.359)	2.31 (2.665)	.015*	.292
Children Global Assessment Scale	31.26 (14.425)	32.84 (12.760)	.674	.116	35.00 (9.317)	39.12 (8.548)	<.001***	.461
Clinical Global Impression								
Severity	5.11 (1.100)	5.05 (1.079)	.564	.055	4.85 (1.084)	4.12 (1.033)	<.001***	.690
Nordoff-Robbins Scales:								
1. Child-Therapist Relationship	2.368 (0.8794)	2.553 (1.1042)	.457	.187	2.577 (0.7168)	4.231 (0.9190)	<.001***	2.022
2. Musical Communicativeness	2.368 (1.0116)	2.421 (1.1698)	.903	.049	2.327 (0.6625)	3.865 (1.2046)	<.001***	1.455

TABLE 5: Comparison between T1 and T2 on research groups
Abbreviation: SD = standard deviation. *p≤0.05; **p≤0.01; ***p≤0.001

When comparing T2 with T3 in the intervention group (follow up), it was observed that the children maintained the gains or worsened in the domains of the variables evaluated. Nine of these worsenings were statistically significant, generally relate to social domain: sociability (ATEC-2);relating(Autism Behavior Checklist-2); social self-help (Autism Behavior Checklist-5); total-Autism Behavior Checklist; lethargy/social withdrawal (Aberrant Behavior Checklist-2); hyperactivity, noncompliance(Aberrant Behavior Checklist-4); Clinical improvement (CGI); Child-Therapist Relationship (NRS1); and Musical Communicativeness(NRS2) (Table 6). Furthermore, only one scale had an effect size greater than 0.8 (CGI-clinical improvement), and all the others had a small effect size (d <0.5) (Table 6).

	T2	**T3**		
Variables	**Mean (SD)**	**Mean (SD)**	**P value**	**Effect *(d)***
Childhood Autism Rating Scale	32.60 (5.221)	32.20 (8.360)	.540	.059

Autism Treatment Evaluation Checklist:				
1.Speech/Language/Communication	14.73 (6.334)	14.76 (6.180)	.840	.005
2. Sociability	12.62 (5.933)	14.64 (6.027)	.034*	.338
3. Sensory and cognitive awareness	10.46 (5.623)	10.44 (6.001)	.764	.003
4. Physical/health behavior	18.31 (9.854)	19.60 (10.050)	.896	.130
Total	55.92 (21.631)	59.60 (22.008)	.293	.169
Autism Behavior Checklist:				
1. Sensory stimuli sensorial	9.00 (5.621)	10.84 (6.408)	.079	.306
2. Relating	11.92 (6.343)	14.88 (6.845)	<.001***	.449
3. Body and object use	12.27 (8.013)	13.36 (7.724)	.304	.139
4. Language	11.15 (4.017)	11.60 (3.651)	.793	.117
5. Social self-help	11.65 (5.215)	13.36 (4.202)	.048*	.363
Total	56.00 (21.674)	64.04 (22.065)	<.001***	.368
Aberrant Behavior Checklist:				
1. Irritability, Agitation, Crying	10.65 (6.164)	11.92 (6.474)	.112	.201
2. Lethargy/Social Withdrawal	12.00 (6.086)	13.72 (7.109)	.028*	.261
3. Stereotypic Behavior	4.46 (3.603)	5.16 (3.693)	.220	.192
4. Hyperactivity, Noncompliance	12.92 (6.829)	15.32 (6.594)	.019*	.358
5. Inappropriate Speech	2.31 (2.665)	2.92 (2.482)	.080	.237
Children Global Assessment Scale	39.12 (8.548)	38.68 (9.711)	.588	.048
Clinical Global Impression				
Severity	4.12 (1.033)	4.12 (1.130)	1.000	.000
Clinical improvement	2.69 (0.736)	3.80 (0.577)	<.001***	1.691
Nordoff-Robbins Scales:				

1. Child-Therapist Relationship	4.231 (0.9190)	3.771 (0.9666)	.003**	.488
2. Musical Communicativeness	3.865 (1.2046)	3.354 (1.1931)	.002**	.426

TABLE 6 – Comparison between T2 and T3 of the Intervention group
Abbreviation: SD = standard deviation. *p≤0.05; **p≤0.01; ***p≤0.001

3.3 Correlation analysis - treatment response rate

The correlation between demographic data and treatment response rates shows that the age of the child was significantly associated with improvement delta of language (ATEC1, ρ=-0.479), physical health and behaviors (ATEC4, ρ=-0.391) and musical communicativeness (NRS2, ρ=0.475). The relationships were negative for ATEC scores and positive for NRS2, showing that the younger the child, the better was their response to treatment (Table 7).

Statistically significant relationships were found between the severity of ASD and delta of improvement in six of the out-session evaluations: children with a more severe initial condition had better results when evaluated in relation to CARS scores (ρ=0.516), to scales that measure sociability (ATEC2, ρ=0.482; ABC-2, ρ=0.402), to physical health (ATEC4, ρ=0.391), to irritability (ABC-1, ρ=0.469) and to global assessment (CGAS, ρ=-0.472) (Table 7).

The number of therapies the child attended during research, their parents' age and the years of parental study were not correlated significantly to any treatment response rate (Table 7).

		Demographic data				
		Children's age	**ASD severity**	**Number of therapies**	**Parents' age**	**Parents' years of study**
S ***Childhood Autism***	Correlation Coefficient	-.260	**.516****	.051	.148	-.092

p	***Rating Scale***	Sig. (2-tailed)	.199	**.007**	.803	.469	.655
e	**Autism Treatment Evaluation Checklist (ATEC)** 1. Speech/Language/ Communication	Correlation Coefficient	-.479*	-.250	-.029	-.119	-.145
a		Sig. (2-tailed)	.038	.217	.889	.564	.481
r m a n ' s r h o	**ATEC** 2. Sociability	Correlation Coefficient	-.102	**.482***	.201	.087	-.185
		Sig. (2-tailed)	.619	**.013**	.326	.672	.366
	ATEC 3. Sensory and cognitive awareness	Correlation Coefficient	.050	.086	.183	-.079	-.252
		Sig. (2-tailed)	.807	.677	.370	.702	.215
	ATEC 4. Physical / health behavior	Correlation Coefficient	**-.391***	**.391***	-.035	-.104	.011
		Sig. (2-tailed)	**.048**	**.048**	.865	.612	.959
	ATEC Total	Correlation Coefficient	-.205	.304	.007	-.063	-.165
		Sig. (2-tailed)	.314	.131	.973	.759	.419
	Aberrant Behavior Checklist (ABC) 1. Irritability, Agitation, Crying	Correlation Coefficient	.197	**.469***	.181	-.176	-.004
		Sig. (2-tailed)	.335	**.016**	.376	.390	.983
	ABC 2. Lethargy / Social Withdrawal	Correlation Coefficient	.083	**.402***	.200	.154	-.297
		Sig. (2-tailed)	.687	**.042**	.328	.452	.141
	ABC 3. Stereotypic Behavior	Correlation Coefficient	-.076	.103	.130	.167	.111
		Sig. (2-tailed)	.713	.618	.526	.413	.588
	ABC 4. Hyperactivity Noncompliance	Correlation Coefficient	-.126	.308	.243	.132	.020
		Sig. (2-tailed)	.538	.126	.231	.520	.921
	ABC 5. Inappropriate Speech	Correlation Coefficient	.109	.312	-.011	-.222	.017
		Sig. (2-tailed)	.597	.121	.956	.275	.935
	Children Global	Correlation Coefficient	-.039	**-.472***	.101	.105	-.040

Assessment Scale	Sig. (2-tailed)	.850	**.015**	.622	.611	.847
Nordoff-Robbins Scale 1. Child-Therapist Relationship	Correlation Coefficient	-.041	.074	-.082	.065	.141
	Sig. (2-tailed)	.842	.721	.689	.751	.491
Nordoff-Robbins Scale 2. Musical Communicativeness	Correlation Coefficient	**.475***	-.074	-.034	-.181	.262
	Sig. (2-tailed)	**.040**	.720	.868	.375	.196

Table 7: Treatment response rate and demographic data correlation
Abbreviation: Sig = significance.

4. Discussion

Results have shown a significant difference in practically all intervention group scores, both in intergroup and intragroup analyses. In intragroup analysis, all the scales and subscales presented statistical significance, with medium to large effect size. This means that children in the intervention group improved after musictherapy sessions. In contrast, children in the control group showed statistically significant improvement only in one subscale[7] for intragroup analysis, and no large effect size. At some scales[8], the control group presented worsening.

Intergroup analysis shows that the groups were similar to each other on T1 and different on T2. The results indicate improvement in the intervention group. The only significant difference between both groups was age, which was higher in the interventiongroup, as it is expected in waitlist control group survey design.Previous studies, such as Landa (2008), show that younger autistic children tend to have higher treatment response rates. Therefore, the age difference would not have been decisive for the evolution difference between the groups. On the contrary, the intervention group (with older age) presented improvements, whereas the control group, which had the improvement predictive characteristic (younger age), did not improve.

External variables to the study, such as parents' age, parental education, other treatments that the child participated and school attendance were paired in both groups on baseline, with no statistical difference. There were also no relations between these

7 Speech / language / communication (ATEC-1).
8Autism Treatment Evaluation Checklist, Autism Behavior Checklist, Aberrant Behavior and Children Global Assessment Scale (CGAS).

variables and children improvement at the end of intervention (rate of improvement). Therefore, they were not determinant variables to results.

These results allow inferring that the improvements of the intervention group were provided by musictherapy intervention. The results corroborate other researches that also show the positive effects of IMT, with statistical significance, in the treatment of children with ASD (Farmer, 2003; Boso et al., 2006; al., 2009; Rojas et al., 2018, André et al., 2018). The studies are heterogeneous, mainly regarding to the methodsused, which cause difficulties to more robust comparisons.

In contrast to these results, Gattino et al. (2011) and Beleninik et al. (2017) did not find significant differences for the effects of IMT respectively with the CARS instrument or the social affect domain of Autism Diagnostic Observation Schedule (ADOS). Gattino (2011) describes a randomized clinical trial with 24 boys from the Pervasive Developmental Disorders Program (city of Porto Alegre, Brazil) designed to compare individuals treated with music therapy (n = 12) and standard care (routine clinical activities, including medical examinations and consultations, n = 12). This author reports that the results were evaluated by two blind evaluators, before and after the interventions, using the verbal, non-verbal and social communication scores of the Brazilian version of the Childhood Autism Rating Scale (CARS-BR). In that study, CARS-BR scores at T1 and T2 did not show a statistically significant difference in the three measured outcomes. However, the study found a statistically significant positive difference in the nonverbal communication subgroup analysis among patients with autistic disorder, p = 0.008 and standard mean difference of 2.22 (95% CI 1.90 to 2.53).

Beleninik et al. (2017) describe a music therapy study conducted in 9 countries with children aged 4 to 7 years with ASD. The authors report that the primary outcome was symptom severity over 5 months, based on the Autism Diagnosis Observation Schedule (ADOS), social affect domain (range, 0-27; higher scores indicate greater severity; minimal clinically important difference, 1). Pre-specified secondary outcomes included parental-rated social responsiveness. All results were also evaluated at 2 and 12 months. Over 5 months, participants assigned to music therapy received an average of 19 music therapy, 3 parent counseling, and 36 other therapy sessions, compared with 3 parent counseling and 45 other therapy sessions for those assigned to enhanced

standard care. From baseline to 5 months, mean ADOS social affect scores estimated by linear mixed-effects models decreased from 14.08 to 13.23 in the music therapy group and from 13.49 to 12.58 in the standard care group (mean difference, 0.06 [95% CI, -0.70 to 0.81]; P = 0.88), with no significant difference in improvement. Of the 20 exploratory secondary outcomes, 17 showed no significant difference, demonstrating that 'for that group, among children with autism spectrum disorder, music therapy compared to enhanced standard care did not result in any significant difference in symptom severity based on the ADOS domain of social affect over 5 months.

This difference between results of this current study compared to the studies performed by Gattino et al. (2011) and Beleninik et al. (2017) may occur because the researches used specific domains of the scales, while the present study uses the total score. Furthermore, those researches used diagnostic scales, while the present study also used treatment evaluation scales such as ATEC, including an in-session evaluation (NRS). Another probable reason is the use of external evaluators to research by Gattino et al (2011). In the present study, CARS was filled by parents during the interview with the music therapist, which is a research bias and may have influenced results.

It is important to highlight results that show improvement in musical communicativeness and speech. Researches show the multifocal nature of musical stimuli and indicate how music can increase connections between speech areas of the cerebrum in people with ASD (Wan & Schlaug, 2010; Fabricius, 2012; Ouimet et al, 2012; Hutka et al, 2013). Reviews on IMT discuss the importance of musical communicability for ASD and show relations between musical development and the development of non-verbal and verbal communications (Sarapa & Katusic, 2012; Gattino, 2012).

The results of treatment improvement rates correlation to children's age or ASD severity are significant only in eight of the 21 analyzed variables[9], by having weak or moderate correlations. These results are scarce but point to a higher response rate in younger children with more severe symptoms of ASD.

9See Table 7 – Significant correlations to children's age: (a) Physical / health behavior (ATEC-4), and (b) Musical Communicativeness (NRS2). Significant correlations to ASD severity: (a) Autism diagnosis (CARS); (b) Sociability (ATEC-2; (c) Physical / health behavior (ATEC-4); (d) Irritability, Agitation, Crying (ABC-1); (e) Lethargy / Social Withdrawal (ABC-2); and (f) children global assessment (CGAS).

Children in the intervention group did not maintain their improvement two months after the end of treatment. Results show worsening in almost all the scales (with statistical significance in nine of them[10]), comparing T3 with T2. We emphasize the in-session scales (NRS) which show a significant reduction of gains. However, the follow up scores were still higher than baseline. The reversal intervention effects show the importance of not interrupting treatment and indicates ways to understand the effects of music therapy on brain activity. Previous studies suggest the need for continuous treatment of people with ASD to improve acquisition and generalization of desired skills (Berger, 2003).

From previous research inIMT, only Mers (2007) investigated follow up results three weeks after the end of treatment and found that the gains were maintained. Disagreement between researches may have occurred due to the difference in follow up duration, number of subjects or assessment tools.

One of the major research challenges is sample size, which is still small compared to the current incidence of ASD in the population. However, it is a large number compared to most investigations in non-pharmacological therapeutic interventions. Despite low sampling, great significance and effect size were found in statistical analyses.

Researchers suggested that future experimental studies shall be done with cross-over trials designs and double-blind evaluations. Thus, the reproducibility of the experiment is increased and the probability of biased results is decreased. It will also be important for further studies to investigate the predictors of the improvement effects found in the present study.

The evaluations and clinical intervention structure used in this study contribute to the development of a research protocol in Music-centered Improvisational Music Therapy. Studies such as this one may contribute to interdisciplinary areas of scientific research as well as to the clinical field in favor of an effective practice of music therapy to improve the lives of people with ASD.

10See Table 6 – Significant worsening in follow up: (a) Sociability (ATEC-2); (b) Relating (Autism Behavior Checklist-2); (c)Social self-help (Autism Behavior Checklist -5); (d) Autism Behavior Checklist -Total; (e) Lethargy/Social Withdrawal (Aberrant Behavior Checklist-2); (f) Hyperactivity, Noncompliance (Aberrant Behavior Checklist-4); (g) Clinical improvement (CGI); (h)Child-Therapist Relationship (NRS1); and (i) Musical Communicativeness (NRS2).

5. Final Considerations

The effects of MCIMT were positive for the childrenthat received Music Therapy treatment. Improvements regarding children's health (improvement of communication, socialization, and behaviors in general) as well as therapeutic aspects (development of the child's musical communicativeness and the child-therapist relationship)were found. Nevertheless, the effects may be reversible. Age and severity of ASD may be predictors of improvement but they are not conclusive yet. MCIMT may be effective in treating children with ASD.

The present study corroborates research trends in music therapy for autism and stresses the importance of specifying the music therapy intervention approach used as treatment. The value of music and its role as therapy is evidenced and brings important contributions mainly to the recognition of MCIMT as an effective form of treatment for children with ASD.

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